UNIVERSITY OF Southampton

ENGINEERING THINKING: AN ANALYSIS ON THE DEVELOPMENT OF CRITICAL THINKING SKILLS WITHIN FOUNDATION YEAR

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Overview:

- Research Questions
- Background of the Study
- Research Setting & Participants
- Preliminary Findings
- Potential Contributions
- References

Research Questions:

Aims:

1. To investigate the awareness and understanding of criticality issues among students joining the EFY, taking account of their previous L1, cultural backgrounds and previous learning experiences.
2. To investigate the relationship between the theory, practice and the development of critical thinking skills within engineering foundation year programme

Key Questions:

1. What are students' perceptions and understanding of Critical Thinking skills?
2. What are faculty's perceptions of students' Critical Thinking skills?
3. Is there a relationship between students' English Language proficiency and their ability to use Critical Thinking skills?

Background of the study:

- significant change in the growing role of content/factual knowledge – curriculum reform
- content/factual knowledge is not forgotten - tendency to become dated in many discipline, i.e. engineering
- therefore, the learning process now needs to focus more on transferable and enduring academic skills…

critical thinking skills ⟹ sustainable learning ⟹ global citizen (global market)

Image: Google image

(Huntzinger, et al, 2007; Wals, 2002; Salmi,2001;Terenzini,1993)

Research Setting & Participants:

Setting: 2 UK universities

(i) University X, south coast England, county: Hampshire

(ii) University Y, north east England, county: Sunderland

- provides a good representative case study - cultural diversity - highest number of being UK, European and Asian students; China, Taiwan, Japan and Middle-East

Participants: EFY students and Module Instructors

- a sample from the population of both UK and overseas students in the EFY (2014-15)
- students took part in the research for the duration of a year - beginning of Semester 2 until the end of EFY progressing to Semester 2 of 1st year UG programme
- to capture a cross-sectional picture of the development of criticality among the three major groups of students; European, International and UK/USA.

Preliminary Findings:

4 types of data were collected:

(i) On-line survey (EFY students) – 3 stages

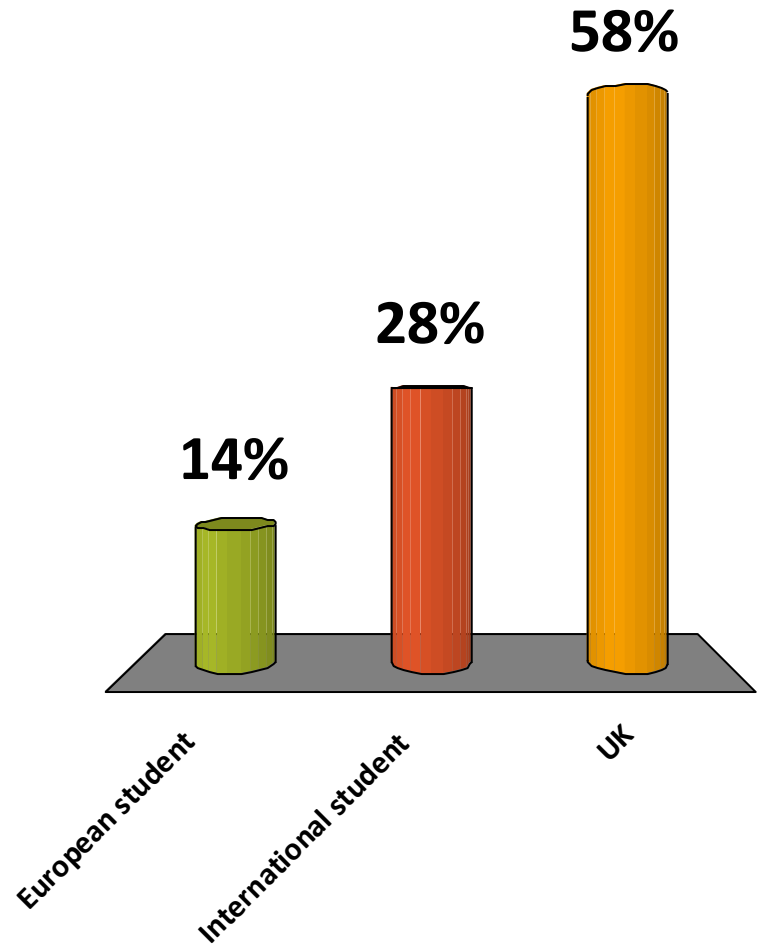
(ii) Semi-structured interviews – EFY students (3 stages); module instructors (once)

(iii) Zappers

(iv) Documents (programme profiles)

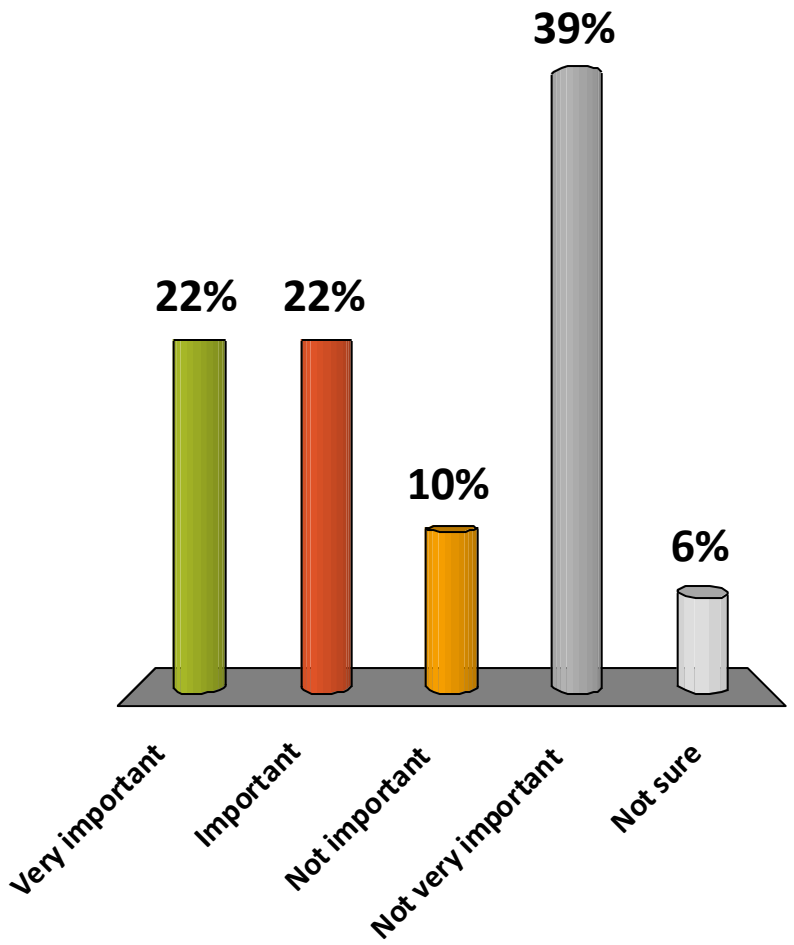
Findings: end of EFY 2014-15 (zappers data) - University X

A. European student
B. International student
C. UK



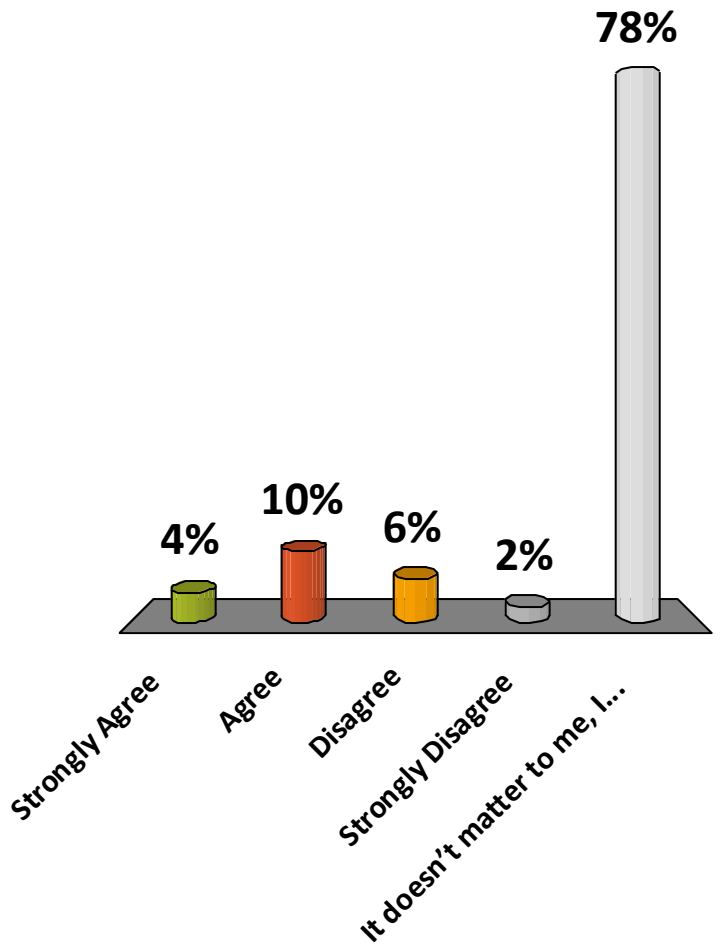
How important are critical skills for EFY?

A. Very important
B. Important
C. Not important
D. Not very important
E. Not sure



Do you agree you have enough in-class practise in the critical thinking skills in the EFY?

A. Strongly Agree
B. Agree
C. Disagree
D. Strongly Disagree
E. It doesn't matter to me, I just want to pass my exam!



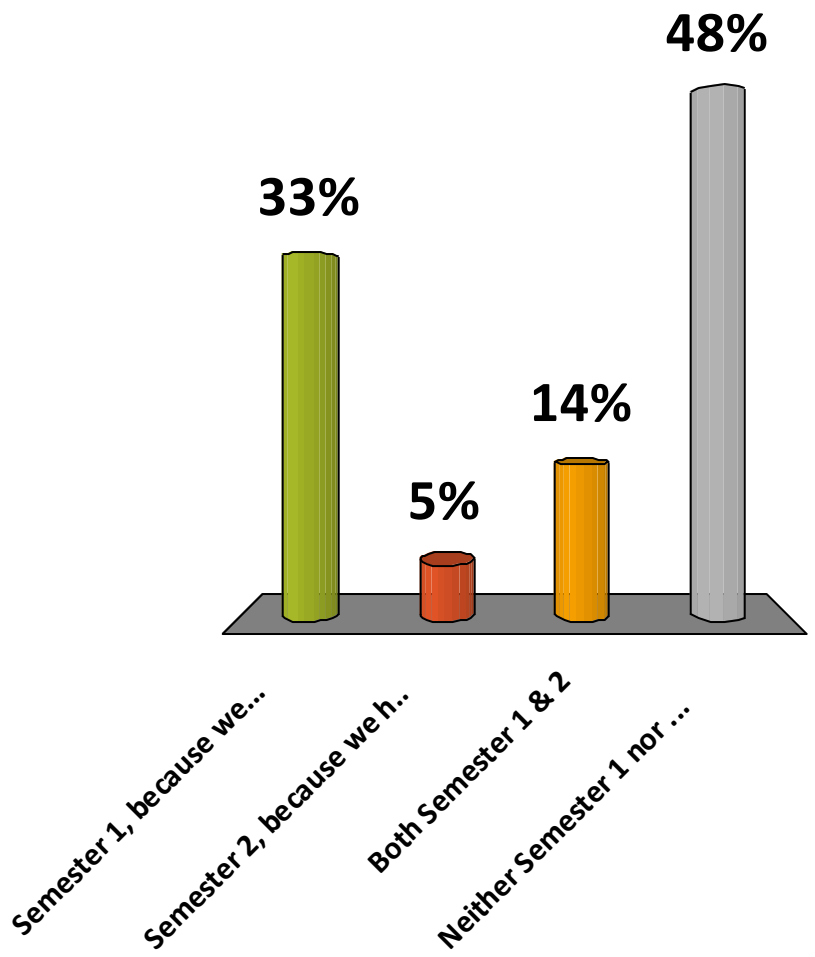
Which semester in EFY provided more opportunity to practise your critical skills?

A. Semester 1, because we had more time to explore and learn new skills

B. Semester 2, because we had more knowledge on content to challenge our thinking skills

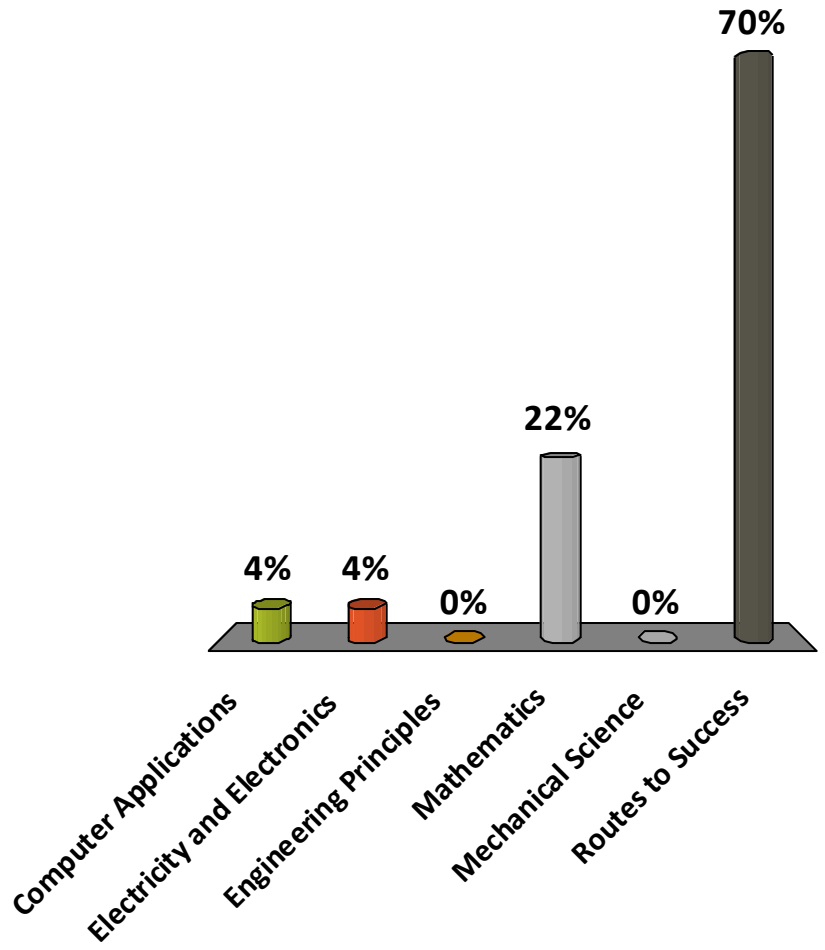
C. Both Semester 1 & 2

D. Neither Semester 1 nor Semester 2



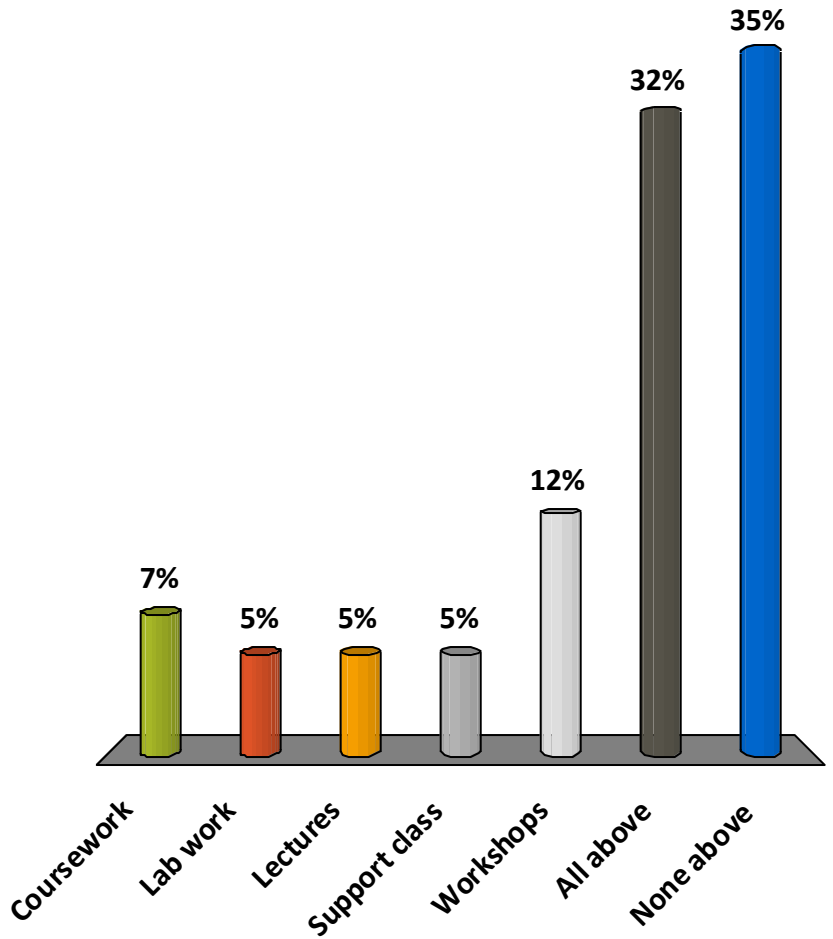
Which course in the EFY provided the most opportunity to practise your critical skills?

A. Computer Applications
B. Electricity and Electronics
C. Engineering Principles
D. Mathematics
E. Mechanical Science
F. Routes to Success



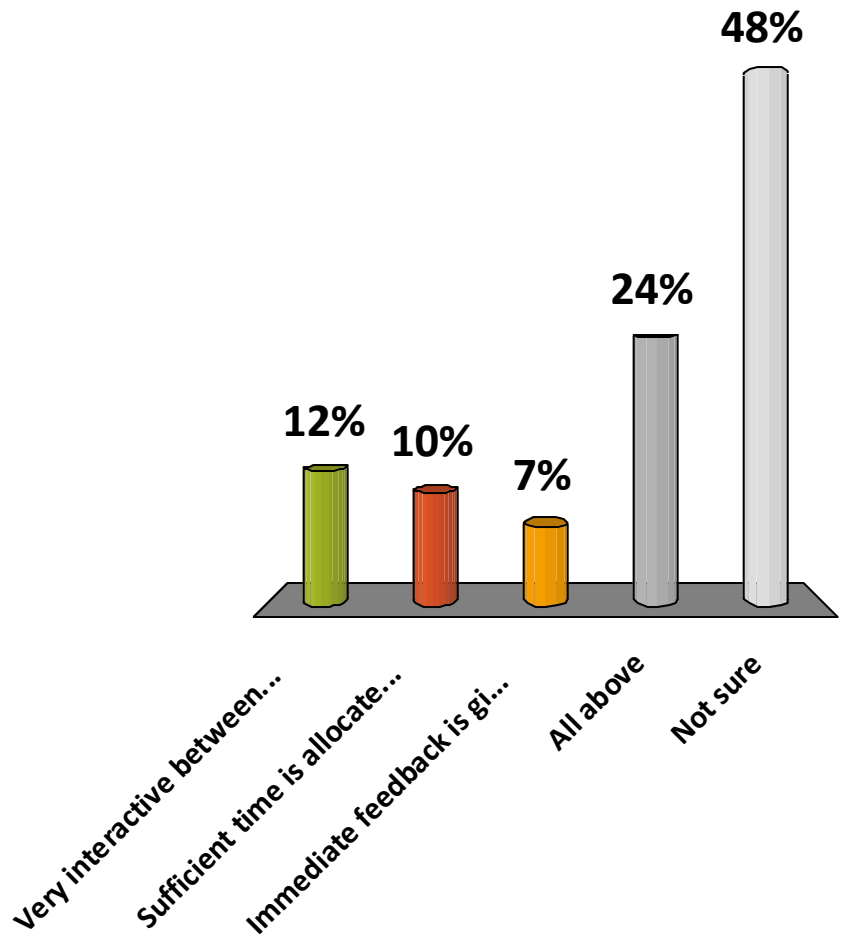
Which teaching and learning sessions should provide more practise on critical skills ?

A. Coursework
B. Lab work
C. Lectures
D. Support class
E. Workshops
F. All above
G. None above



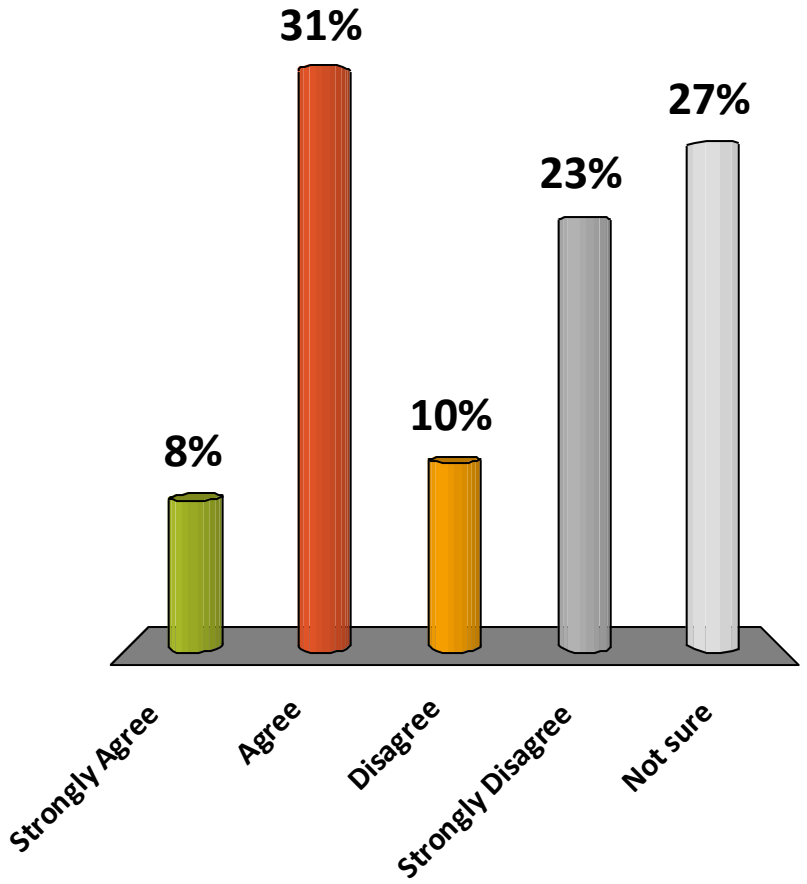
How do think some courses in the EFY could provide more opportunity for in-class practise on critical skills?

A. Very interactive between tutor and students
B. Sufficient time is allocated for Q & A sessions
C. Immediate feedback is given to raised questions
D. All above
E. Not sure



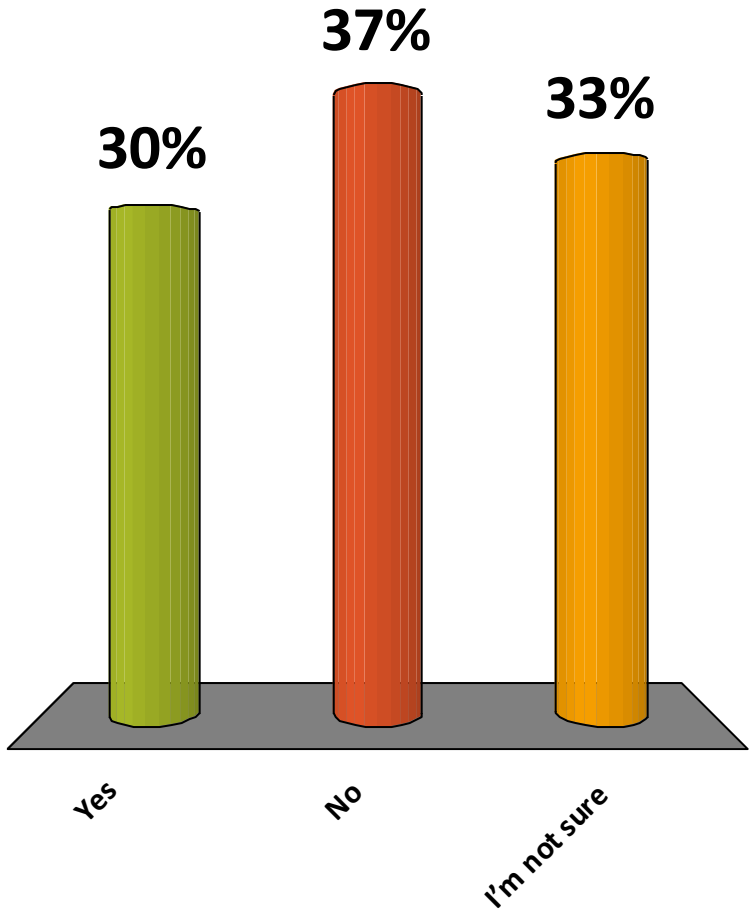
Do you agree you must have good command of English to learn critical skills?

A. Strongly Agree
B. Agree
C. Disagree
D. Strongly Disagree
E. Not sure



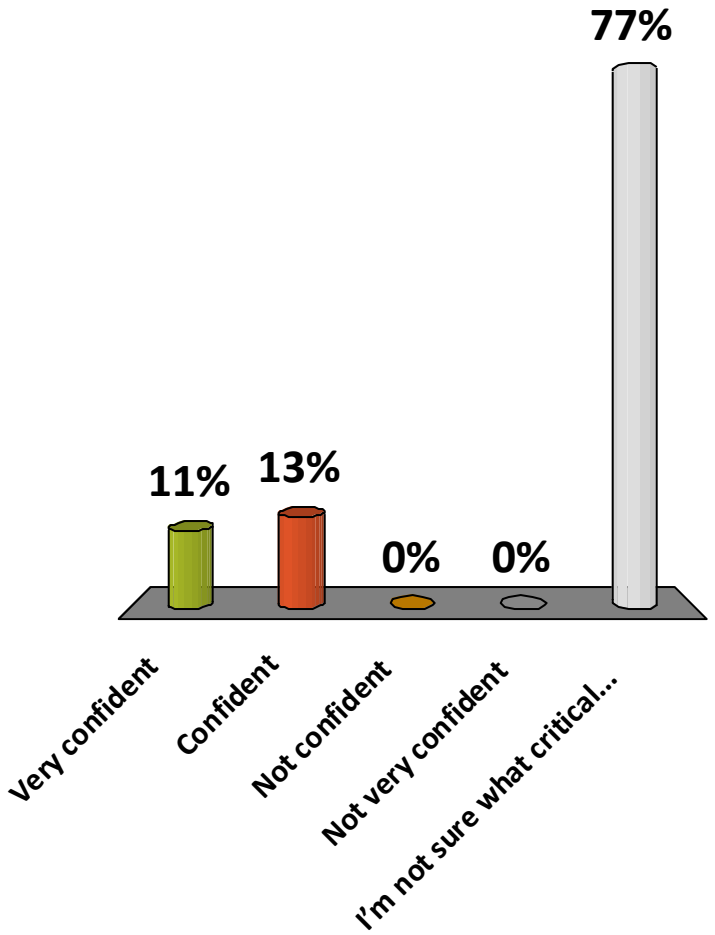
Do you think culture plays an important role in critical thinking skills?

A. Yes
B. No
C. I'm not sure



How confident are you now with Critical Thinking skills?

A. Very confident
B. Confident
C. Not confident
D. Not very confident
E. I'm not sure what critical thinking skills are!



Preliminary findings cont … (interview data – Stage 1) - EFY student experience

I enjoy it very much, definitely. It offers me many things, I benefitted in many ways, I think I benefitted very much in whole of foundation year, everything. Although I'm not sure I'm going to pass it or how I'm going to do, but, I'm sure I'm in a much better level than I first started, I mean when I first began in many ways. Not only in the field of knowledge, like Physics and Maths I know, of course I know Physics and Maths much more better than I knew, but also the way I think, the way I manage my life, and I thoroughly happy of how I'm progressing. I am happy with the way FY is organised too, although I believe, there're many complains from others. There must be some truth in them, but, I also compare the FY here with the type of education back in Greece, that's why I cannot complain, compared to what I had, and now how well things are organised

(from Greece, male, 21 yrs old))

Preliminary findings cont … (interview data – Stage 1) - EFY student experience

Well, at this moment foundation year, I think sometimes it's easy, sometimes it's difficult, because of my hearing difficulties and some issues. So, I can find myself alone in the education…because everyone, everyone learn everything in the classroom. I don't have such a opportunity because I can't hear in the classroom, you feel alone…every, every, most people came here, and they can understand the subjects at the lectures that moment…I have to struggle much more than them. I have to study at home at my own phase…like I told you, I can't understand the subjects in the classroom at the time, so, or sometimes problem will build up. So, I couldn't, I can't even sleep for many days, so that make me tired, distracted, so, the next day I can't focus on study…so, it make me withdraw from study…I see myself as a perfect formula for failure…I wish the university have a video […] lecture video…it would be really enjoying. I can see my teacher trying to teach everyone something very funny, I couldn't understand. I feel myself unefficient […] if I have the video I may feel I was in the class like other people…

(from Cyprus, male, 27 yrs old with hearing disabilities)

Preliminary findings cont … (interview data – Stage 1) - EFY student experience

I think it's a very different experience, like something that I've ever been through, and it's somehow difficult to go from, like to do this extreme change in routine and go extreme change in life, basically. Even though, I come from Dubai, which is like Europe, mini Europe, basically, but, it's very difficult to adjust to different certain ways of life and stuffs…it's a big change, it's a very big change, basically…big changes to, like, sometimes for example homesickness, and being tough and independent and all that. It's like good thing, the points for it. But, the bad point, I don't think like it's 100% true, but, sometimes the person who's moved from his homeland, somehow looses his identity as in a, his nationality and culture, because, he starts to blend into the other culture that he came from, which is somehow bad, I think. Because, a person, should, he shouldn't like do a 180 degrees change…the learning experience is somehow similar to the previous experiences because I was studying in an international school…but the only big huge difference is that in my school the coursework was bigger part than here…like the coursework 40% and final exam 60%…here the exam is 95%…coursework is separate module…a bit confusing

(from UAE, male, 18 yrs old)

Preliminary findings cont … (student interview data – Stage 1 & 3) - conceptualising critical thinking skills

Sem 2 EFY 2015

I think it comes [on?] problem solving, be able to visualise problem and be able to see what you're actually been given, and work out central solutions…read a bit of text and be able to extract the information out of it, and understand what it is, work out what you got to work out

(from the UK, male, 31 yrs old)

Sem 2 UG 2016

Hard to actually define what they are, its skills for that problem solving, to [be?] able to communicate work for other people. Almost like a life skills in a way, that's lots of applications… they're sort of problem solving skills, that can be applied to science, engineering or any problem that you have. So, I think, it's sort of a being able to find solution to problems, find solution to any problems use the same skills you would for engineering

Preliminary findings cont … (student interview data – Stage 1 & 3) - conceptualising critical thinking skills

Sem 2 EFY 2015

I would say, you get a wide, I mean a good idea, of the problem you're facing, and then, I would say you break it down into parts, and then you look each part individually, and go into more depth. That way, for me, that's critical thinking because, you're going into more depth. Allowing you to understand the problem a bit more, therefore, coming up with efficient solution for it, to me that's critical thinking

(from Bahrain, male, 19yrs old)

Sem 2 UG 2016

I would say like the ability to look at question or any dilemma in front of you, understand what, first of all, what's happening, then, what's it's asking you do, and then, obviously, the main part is how you will go about achieving what the, achieving the solution for the problem…I would say that's my definition of critical thinking skills

Preliminary findings cont …
- conceptualising critical thinking skills (module instructor)

Engineering module

critical thinking…my goodness…it's tough isn't it? Because, you got to be careful, you're not just thinking about deep knowledge, I'm not even sure really the, we're always right, write right questions to bring out to encourage the use of critical skills, I'm not sure whether, if we're as bad as the students in some ways. We just ask for a something, a difficult concept, that they could've learnt without critical skills…not sure we're expert enough to bring out…but, how do I define it? I'm almost to frightened to go there…it's all about asking a question…solving a problem, it's again asking a set of questions isn't it? … reflection, creativity, what are these things?…they need to be a creative problem solvers… critical and creativity complement each other

(from the UK, male, 9 yrs experience in EFY)

English language support

It's based on scientific methods…being able to think outside the box, being able to approach problem solving with varieties of, either strategies or perspectives with which to trying to solve a problem…to think outside the box…or, the ability to, for example to be able to apply the scientific methods in a flexible way, so, the ability to adapt your ideas, or assumptions, question your assumptions, question theories, but, also apply methods logically is part of critical thinking…those are the sorts of critical skills I expect them to learn…

(from the UK, female, 1 year experience)

Potential Contributions:

- Further evidence to support empirical research on the key issue
- Curricular and pedagogical revision in response to engineering students in EFY programme and ESAP course
- Design functional checklist for CTs for ESAP course (established literature + measured observations + expert consultation for model building)

Categories of Critical Thinking Skills for

CATEGORIES OF CRITICAL THINKING SKILLS FOR CRITICAL READING for Academic Texts or Research articles	Dewey (1910)	Ennis (2011)	Bowell & Kemp (2002)	Facione (2011).	Browne & Keeley (2013)	Cottrell (2005)	Paul, Nieweahner & Elder (2006)	Tsui (2002) Scriven et al (2006)	Thomson, (2009)
1.0 ANALYSIS OF COMPLETE ACT OF THOUGHT (ACAT)									
1.1 Identify author's position • evaluate scientific/engineering authorities • identify and clarify relevant points of view • identify viewpoints which has been ignored or distorted due to vested interests • evaluate technical arguments • identify contributing arguments (claims) - not influenced by tradition (custom), instruction, imitation, depend upon authority, appeal to one's advantage, fall in with a strong passion • identify writer's attitude(individual reasons) • recognise contradiction in theories, statements or thoughts • identify overall arguments (main idea) • identify conclusion and the reason that allegedly support it ***Conclusion Indicators**, i.e. beliefs, suggests, outcome, consequently, points to the conclusion that, the truth of the matter is …, in short…, as a result, it can be concluded … therefore, so, thus, must, should, should not, cannot, that, hence…*	X	X	X	X	X	X	X	X	X
1.2 Identify how parts relate to one another and to an overall structure or purpose • identify if alternative ways of looking at the situation been avoided in order to maintain a particular view • identify if the conclusions clearly stated • distinguish between relevant and irrelevant reason leading to conclusion • reconstruct of argument for clear	X	X	X	X		X	X	X	X

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