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Increasing interest for engineering higher education: the role of STEM initiatives in the UK

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Science, Technology, Engineering, Mathematics (STEM) landscape in the UK

- A national curriculum for the last 20 years
- A culture of ‘league tables’
- Devolution in Scotland and Wales
- Rapid expansion in the number of university students – but constant number of engineering students (circa 20,000 – 12,000 of which are UK students)
- Professionalisation of the role of ‘teacher’
- A national ‘STEM Programme’ for the last 5 years

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Student flows towards Higher Education

- 0.5m students in each yearly cohort
- STEM is compulsory to age 16
- 48% of 16 year olds reach the Government attainment benchmark (5 GCSEs including maths and English
- 56% pass the maths qualification at age 16
- 58% pass the general science qualification at age 16
- 12% of 16 year olds take physics as a distinct subject – 94% pass rate

36% of students continue academic studies after age 16. Only 10% of students progress in STEM subjects beyond the age of 16.

2% of 16-19 year old students are studying classroom-based engineering.

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Supply and demand issues

SUPPLY

- Government is investing in more STEM undergraduates.
- The system for training non-graduates after the age of 19 is complex, changing quickly and under great pressure.

DEMAND

- There is mixed evidence on the need for more engineering graduates.
- There seems consensus on the need for *more better* engineering undergraduates.
- There is good evidence for the need for more engineering technicians.

AMBITION

- The ambition of UK industry to become higher-skilled is in doubt.

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Engineering businesses now seek engineers with abilities and attributes in two broad areas - technical understanding and enabling skills.

The first of these comprises: a sound knowledge of disciplinary fundamentals; a strong grasp of mathematics; creativity and innovation; together with the ability to apply theory in practice.

The second is the set of abilities that enable engineers to work effectively in a business environment: communication skills; teamworking skills; and business awareness of the implications of engineering decisions and investments.

Educating Engineers for the 21st Century, RAEng, June 2007

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Initiatives to stimulate supply of STEM students

- The Government STEM Programme
- Widenging university participation generally
- Widening participation in STEM subjects at university
- 14-19 diplomas

Are these working?

- Number of students studying academic STEM courses post 16 rising
- Number of students studying vocational STEM courses post 16 falling
- Shortage of STEM specialist teachers persists – but interest in teaching rising
- Number of teachers in vocational subjects falling rapidly
- Number of university students now constant 43% of cohort
- % from lower-socio economic groups still not rising
- No change in engineering undergraduate numbers since 2002. Computer science down 19%. Chemistry down 4%. Physics up 4%. Maths up 9%. Medicine up 37%.
- 14-19 Diploma in engineering – so far so good after first year.

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Focus on two initiatives

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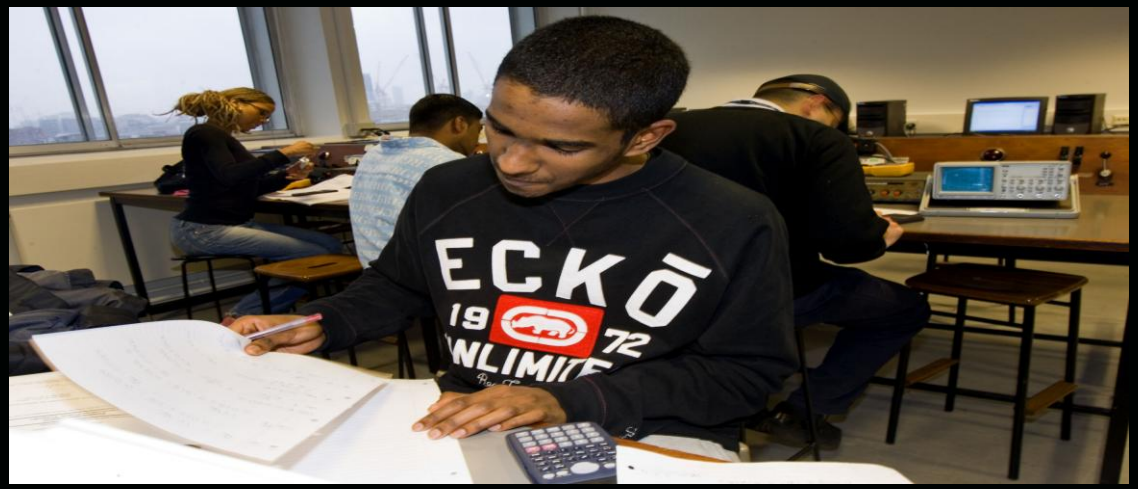

14-19 Diploma in Engineering

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Improving the student learning experience

- Compulsory training for new university teachers
- Compulsory quilifications in education for Further Education teachers
- Compulsory CPD for Further Education teachers
- Government-funded CPD for school teachers

In engineering degree courses

- CDIO
- Problem-based learning
- Team-based learning
- Technology transfer from industry
- A focus on self-efficacy

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Engineering self-efficacy is probably what employers want when they seek technical understanding coupled with enabling skills

Self-efficacy – definition, Albert Bandura

Perceived self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments

OR
a judgment of personal capability
(this is different to self-esteem being a judgment of self-worth)

OR
I know I can do this stuff

To build engineering self-efficacy we need practices that deliver authentic experience relevant to the student's domain of activity.

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What next in the UK?

- A probable change of UK Government
- STEM likely to remain a priority
- Widening participation may not remain a priority