

MATHEMATICS, STATISTICS AND OPERATIONAL RESEARCH

Principles of inclusive curriculum design

Anticipatory
Flexible
Accountable
Collaborative
Transparent
Equitable

Generic considerations

- cost and financial considerations;
- embedding student and staff well-being;
- promoting student engagement;
- use of technology to enhance learning;
- responding to different approaches to learning;
- avoiding stereotypes and celebrating diversity;
- making reasonable adjustments.

Introduction

It is the responsibility of the every member of staff within HE to respond to the requirements of equality legislation. The basic principle that can and should be universally responded to is that **it is attitudes, barriers and other forms of discrimination within the system rather than individual characteristics or deficits that are the cause of disadvantage**. Employing an inclusive approach is underpinned by the adoption of other principles of inclusive curriculum design, summarised in the adjacent text box and discussed in the introduction section of this guide available at www.heacademy.ac.uk/assets/documents/inclusion/disability/ICD_introduction.pdf

May and Bridger assert, in respect of developing an inclusive culture, “making a shift of such magnitude requires cultural and systemic change at both policy and practice levels” (2010: 2). In essence this change is represented by a shift in focus from responding to the ‘needs’ of individuals or specific groups of students to an approach that anticipates and plans for the *entitlements* of the evolving student population. Thus the onus is on institutions and subject communities to change and adapt their policies and practice rather than expect this of individual or specific groups of students.

There are many generic considerations of inclusive curriculum design, summarised in the adjacent text box, which are discussed in the introduction section. The focus of this section is on subject-specific considerations for those in those subjects aligned to mathematics, statistics and operational research. Here examples of innovation and effective practice are provided to demonstrate that effective practice for one group can and should be effective practice for all. The examples, resources and ideas included in this and other subject guides have come from the sector. They were obtained directly in response to a general request made to the sector during 2010, from a review of the HEA Subject Centres or from recommendations made by colleagues teaching in the specific subject.

Where there are examples in other subject guides that may be particularly relevant or worth reviewing for further adaptation these are flagged. However, notably inspiration and ideas for curriculum design can come from many sources, therefore reading strategies employed and ideas in other subject areas can be a useful source of new ideas.

Inclusive curriculum design: subject-specific considerations

Supporting a diverse student body

Like many other STEM subjects Mathematics, Statistics and Operational Research (MSOR) have tended to recruit larger numbers of male students; for example, HESA data report that 38% of Mathematics students are female (cited in Easson, 2010: 22). Consideration should be given to ensuring the curriculum anticipates all students, particularly if they have different prior experience, expectations and aspirations from their peers. An inclusive approach to curriculum design is to work collaboratively with existing students, particularly those in a minority, to anticipate the needs of different students and support the development of transparent information or materials that ensure the entitlement needs of all students are met.

In response to a survey of female students on male-dominated programmes that reported the isolation some female students experienced and highlighted their desire to be more fully integrated into communities of practice, the Faculty of Engineering, Computing and Creative Industries at Edinburgh Napier University facilitated a support forum to be run by students for students. The *SSF4F: Student Support Forum for Females* highlighted their desire to improve their employability by developing better links with employers and gaining a greater awareness of potential career options. The forum:

- hosted a series of events to help women students develop links with other female students and develop professional networks;
- created a website to share resources and created a database of 'Friends of SSF4F' who are willing to make contributions such as offering placements or being guest speakers (Cairncross *et al.*, 2008).

The [more maths grads](#) project was funded by HEFCE to “develop, trial and evaluate means of increasing the number of students who have not traditionally been well represented in higher education” (more maths grads, undated).

www.moremathsgrads.org.uk/home.cfm

Questions to consider when enhancing the skills elements of a programme

- Is it desirable to have a separate skills module, or to integrate skills development into other activities in the course, or some combination of these?
- How can skills such as writing, presenting, and working with others be developed through mathematical activities, for example through modelling or project work, or indeed through mathematical modules?
- Could a learning log have a role to play in encouraging a reflective approach?
- If skills are to be assessed, what part should that assessment play in the overall pattern of assessment?

(Challis *et al.*, 2009b: 41)

Queen Mary, University of London worked in partnership with local schools and colleges who serve student groups targeted by widening participation activities (such as students living with a parent or guardian during their studies and students from minority ethnic communities, particularly the Bangladeshi community) to improve recruitment from these students while also raising the prior attainments of entrants (Easson, 2010).

The **more maths grads** HE curriculum theme highlights the central role friends play in supporting the learning of many Mathematics students (Challis *et al.*, 2009a). They suggest a number of strategies that will support students to make friends and develop networks:

- an attractive induction programme;
- tutor groups and group projects;
- accessible and convivial places for informal groups to meet up and work.

Focusing on students finding it difficult to make friends either because of cultural differences (such as not wishing to socialise in a bar) or because of other commitments, the team stress the importance of a monitoring system to identify isolated students and tailored responses such as personal tutoring or peer mentoring.

Anticipating the prior experience of all students

Mathematics, Statistics and Operational Research programmes and modules should anticipate all students' prior experience, expectations and aspirations to assist students in their transition into higher education. Some students' educational experience may not have given them access to skills and knowledge that traditionally have been viewed as prerequisites for studying Mathematics and related subjects in higher education. Existing provision should be reviewed to ensure it has anticipated what may be required for those students entering from non-traditional or minority (in relation to the rest of the cohort) routes. The nature of these differences will vary between programmes and institutions depending on recruitment patterns, for example some programmes will have a greater diversity of entry routes than others.

Collecting and tracking data from diagnostic tests is one way for programmes to map changes in a student's knowledge and skills at entry and during the programme over time. These data can then inform curriculum design so that changes can be made in response to the prior learning and education experience of entrants. Another inclusive approach would engage prospective, current and alumni MSOR students with a

diversity of prior experience at the curriculum design stage so that their previous education experience is anticipated within the Mathematics, Statistics and Operational Research curricula.

Addressing mathematical barriers to both admission and progress

Recognising that the Engineering curriculum had prioritised the prior experience of students entering from A-level courses the University of Sheffield utilised *Higher Futures* funding to address mathematical barriers to admission and progress of their Business and Technology Education Council (BTEC) students.

A survey of students on local BTEC courses highlighted their knowledge and confidence about core areas of mathematics. A key finding was that BTEC students had access to significantly less guided learning hours during their course compared with A-level students, which meant many BTEC students were less prepared for the Engineering programme's mathematics component (Hobson and Rossitor, 2009). All students are encouraged to use the University's Maths and Statistics Help Centre, which provides:

- diagnostic tests to allow students to better understand their strengths, areas requiring development and progress over time;
- drop-ins for targeted support;
- study skills guidance and signposting to a wide range of support to augment classroom learning.

This approach is inclusive because it encourages all students to make use of universal and targeted support that can enhance their learning. This Higher Futures funded project also highlighted the specific skills and experiences students entering from vocational qualifications may bring, such as work experience or study of a broader range of subjects, thereby enriching the cohort's diversity.

The University of Sheffield is considering developing additional targeted teaching input and working in collaboration with further education colleges to enhance mathematics skills and raise student aspirations prior to entry.

Collaboration with mathematics colleagues in schools and the FE sector provides opportunities to support the transition of all students into higher education and, as the following example illustrates, access to effective mathematics practice that can be adapted for use in the HE sector to ensure the entitlement of all MSOR students to an accessible curriculum.

See the Engineering and Economics subject guides for more examples of inclusive curriculum design tackling mathematical

barriers and English, Engineering, and Languages, Linguistics and Area studies subject guides for supporting transition and work with secondary schools.

Enhancing employability skills for all students

Responding to the requirements of current and future employers of MSOR graduates is an important element of enhancing their employability. However, debates remain within the subject grouping about the best way of embedding generic skills development so that all students have the opportunity to acquire and refine them (Challis *et al.*, 2009b).

One inclusive approach adopted at Coventry University embeds generic skill acquisition in compulsory modules for all students on mathematically related programmes:

- Professional and Academic Skills: PASS (Year 1);
- Graduate and Enterprise Skills: GRADES (Year 2).

These are run in conjunction with optional modules (Add+vantage), which enable students to add skills for employability (Tyrrell, 2008). A key element of these modules was to provide an opportunity to get to know the students individually and to build relationships between staff and students.