National
HE STEM
Programme

PROMOTING SOCIAL ENGAGEMENT

Improving STEM student transition,
retention and success in higher education.

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Foreword

I am delighted to introduce to you this suite of transition and retention guides which have been produced under the National HE STEM Programme.

While increasing the supply of students to STEM Higher Education is important, ensuring that they experience a smooth transition to university and that as many as possible complete their studies successfully is of equal importance. There is a wealth of initiatives in this area that have reported on effective practice to help achieve this. The purpose of the guides is to collect and present effective practice models specifically from STEM departments. An important feature of this suite is the student perspective, which the authors have emphasised.

The issues related to induction, transition and retention are multi-faceted and therefore may have been addressed in slightly different ways in the different guides to take account of the specific context.

The suite consists of eight guides:
- Using data: an evidence-based approach to improving transition, induction and retention
- Happy landings – an introductory guide for students considering studying a STEM subject in Higher education
- STEMming the doubts – enhanced transition and induction to HE programmes
- Critical moments in the first year at university – towards a framework for effective transition
- Promoting social engagement: Improving STEM student transition, retention and success in higher education
- Improving retention: the curriculum development perspective
- Setting up a Maths Support Centre
- Optimising the part-time experience

My thanks go to the authors of the guides for distilling their knowledge and expertise and to the Steering Group for their valuable guidance. The group consisted of Professor Liz Thomas, Director for Widening Participation Research Centre (Edge Hill University), Hal Igarashi, Project Director Employer Engagement (Royal Academy of Engineering), Henriette Harnisch, Director of Academies and Trusts (University of Wolverhampton), Fiona Lamb, Associate Director (Engineering Education Centre), Ed Stevens, Regional Officer for Widening Participation and Outreach (South West) and Sadaf Alvi, Regional Officer for Higher Level Skills (Midlands and East HE STEM Anglia regional spoke).

Our collective hope is that the wealth of case studies and the student perspective presented will stimulate colleagues to consider improvements to the transition processes where they find it appropriate for their institution.

Professor Kamel Hawwash
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Introduction

This guide focuses on 'social engagement' – that is, the interactions between students and their peers and between staff and students – and the very important contribution this makes to the student experience, and thereby to retention and success.

The National Audit Office (NAO) report (2007) shows that students undertaking computer science, engineering and maths programmes are more likely than those in other disciplines to withdraw during their first year of higher education. The NAO found that the average continuation rate from stage 1 to stage 2 is about 91%. The continuation rate for students studying maths, computer science and engineering is about 88%; other STEM subjects, such as physical sciences have higher rates at around 93%.

A great deal of research in the UK, US and Australia explores the reasons why students withdraw from HE, and the interventions and approaches that might improve matters. The challenge, however, is to convert this knowledge into practice.

The What works? Student retention and success programme, funded by the Paul Hamlyn Foundation and the Higher Education Funding Council for England, was designed to bridge this gap by identifying effective approaches. This programme identifies the importance of students' sense of belonging in HE, which is most effectively nurtured through mainstream activities in which all students participate. This puts academic programmes and high quality, student-centred learning and teaching at the heart of retention and success. (Thomas 2012). It is therefore crucial that the lessons from international research in general, and the What works? programme in particular, are translated into effective practice.

Defining retention and success
The Higher Education Funding Council for England (HEFCE) uses two measures of retention:

'The first is the 'completion rate' – the proportion of starters in a year who continue their studies until they obtain their qualification, with no more than one consecutive year out of higher education. …A more immediate measure of retention is the proportion of an institution's intake which is enrolled in higher education in the year following their first entry to higher education. This is the 'continuation rate'.' (NAO, 2007).

It is the latter measure of retention – progression from stage 1 to stage 2 – which is most commonly used to evaluate the impact of specific interventions. This is because, here, effects and outcomes can be more readily gauged.

There is, however, more to 'student success' than just simply retention. Drop out is obviously a problem to be tackled, but this narrow view may give rise to ad hoc solutions that are not sufficiently far-reaching and sustainable.

We suggest that more effective, longer-lasting approaches can only be developed if the idea of student success is brought to the fore. This notion more easily encompasses issues of learning and teaching, leading to more deeply embedded positive practices. Once embedded, such practices become 'mainstream'. They are not short term interventions nor 'quick fix' measures, but part of a changed institutional culture.

The What works? programme found that mainstream approaches contribute to improving retention and maximise the success of all students. This is particularly true for activities undertaken in the academic sphere, as opposed to those from 'outside' – such as might be introduced by, for example, student services. Research indicates that those students who are most likely to withdraw are often the least likely to voluntarily come forward and access interventions that support them. In short, those in need of help often feel unable to ask for it.

This guide is designed to help staff in STEM disciplines to recognise the value of social engagement in enhancing student transition, retention and success. It provides three proven practical examples – all of which can be transposed to different institutional contexts. We selected the case studies from engineering, maths and computer science, as these appear to be the disciplines with the greatest challenges in relation to retention and success.

Key principles informing this guide
- Engagement with peers and staff enhance student belonging, and improve student transition, retention and success.
- Early engagement – pre- and post-entry – is particularly important and has long lasting impacts.
- The academic sphere is a key site for social engagement, especially for students who live at home and/or have other commitments such as family and employment responsibilities, or who struggle to make friends in more informal settings (eg, international students).

Adjusting to higher education

Making the transition into HE is challenging for all students, and those who fail to adjust to the expectations of study and life in HE are more likely to withdraw. Many researchers have identified a gap between students' expectations of HE and their experiences in it, research has found that students with more complex expectations of HE tend to adjust better than those with simpler ones. Thus, the likelihood is that those with little or no knowledge of HE are most likely to struggle to adapt to the experience.

Many students who leave HE early experience what Quinn et al (2005) term 'academic culture shock': most assume that HE would be more or less the same as learning in school or college. In particular, students are unprepared for becoming more autonomous learners with greater responsibility for organising and structuring their learning time. In addition, students feel challenged by the lecture teaching format, the size of classes and the (perceived) limited opportunities to interact with staff. Students do not always know what is expected of them in relation to assignments and exams, and are unsure about how to structure their academic writing. Furthermore, students tend to presume that they will receive same level of academic support they enjoyed in school or college.

In addition to misconceived expectations of academic work, students are also worried about making friends and fitting in socially. Survey research (Andrews and Clark 2011) found that a significant majority of students were worried about making friends (just under 75%), while most (70%) were confident they had the ability to succeed in their chosen area of study. Unsurprisingly, then, research finds that friendships influence students' decisions to stay on course when encountering both academic and personal difficulties.

But peer relations are not the only important variable in retention, with positive consequences for both academic performance and social support. Yorke and Longden (2008) identify how the academic experience itself can be socially isolating (eg, large lectures) which can also contribute to early withdrawal. The findings of the What works? programme bolsters this evidence by showing that social interaction in the academic sphere – with both staff and peers – contributes to a sense of belonging, improving both retention and success.

Importance of social engagement

The What works? programme found that students are more likely to remain in higher education, and to succeed, when they have a strong sense of belonging. This is most effectively nurtured at the departmental or programme level, and is achieved through:

- Supportive peer relations.
- Interaction with staff.
- Knowledge, expectations and confidence to be successful learners.
- An HE experience which is relevant to interests and future goals.

This guide focuses on the first two: developing supportive peer relations and interaction with staff.

Peer relations

The importance of social integration is undeniable (Tinto 1993). Evidence from the What works? Programme suggests that friendship groups have a positive influence on the student experience and on students' sense of belonging. Students with more friends and better social integration are less likely to think about leaving HE. Conversely, those who find it harder to make friends have a more negative student experience, and students who think about leaving feel less like they fit into – and belong within – their academic programmes. In summary, friendships and peer relations can make the following contributions to retention and success:

- Promote academic integration and belonging.
- Develop students' confidence as learners.
- Improve motivation to study and succeed.
- Offer a source of academic help and enable students to cope with their study.
- Share tacit knowledge, such as module choice and how to prepare for assessments.
- Provide emotional support.
- Offer practical support.
- Allow students to compare themselves to others and gain reassurance.

In general, students do not fully recognise the value of friends and social integration to their retention and success. For example, in one institutional survey (Foster et al 2012), students gave a low importance rating to the factor 'My fellow students are supportive'. Only 68% of all students thought that factor was important, placing it 13th of 17 Student Experience Factors. However, 70% felt that they had experienced the positive benefits of supportive peers. Nevertheless, students who had thought about leaving were more likely to cite lack of social opportunities as a factor that led them to consider leaving.

When students are thinking about leaving they often contact family and friends. Data from one survey (McCary et al 2011) shows the following groups are consulted:

- Family – 49%
- Friends – 44%
- Other academic staff – 30%
- Central support services – 23%
- Department administrator / secretary – 19%

Students make friends through:

- Course.
- Co-curricular activities.
- Accommodation.
- Clubs and societies.

The following groups of students have been identified as finding it harder to make friends:

- Students with family commitments.
- Those living at home and commuting to participate in HE.
- Mature students.
- Nursing students.
- Part-timers.
- International students.

Interaction with staff

Research demonstrates the importance not just of engagement with peers, but with academic staff too. According to Foster et al (2012), students who are thinking about leaving feel more distant from their teaching staff than their peers. In a small sample at one HEI over 75% of students said they had 'poor', 'very poor' or 'no relationship at all' with academic staff (Harding and Thompson 2011).

Although staff/student ratios are making it increasingly difficult to create supportive, academic environments, students do value being treated as individuals. So, do staff members know students' names? Are they interested in their progress, and not simply any problems they may present to them? It is all a matter of approachability – and the extent to which a member of staff is able (and available) to listen to students. Students seek relationships that are not overly formal, more mentor-like.

In short, students find it harder to relate to staff who do not treat them with respect, and who do not (or cannot) respond to emails, or else do so only very slowly. They also value those members of staff who are openly enthusiastic and obviously interested in their teaching work.

Developing social engagement in the academic sphere
Where and how does social engagement take place? One survey found that more students made friends through their course (87%), than via accommodation (74%) or participation in clubs and societies (36%) (Foster et al 2012). Also, there is a growing consensus that efforts to promote retention and success should concentrate on the classroom which is crucial to facilitating social interaction with staff and peers, and builds links that extend into wider social spheres.

One project (Boyle et al 2011) with a particular focus on undergraduates living at home (and commuting to university) found that they placed an emphasis on the importance of the *academic experience* of university over the *social experience*. They were, consequently, less likely to engage in activities aimed at developing social bonds (unless such activities were a requirement of their course).

Local students are often less engaged socially than peers living on campus. Both full-time mature and part-time students intimated that the social sphere is often not a driving force behind either their decision to study or in their daily interactions with other students. Participants regularly said that they 'didn't come to university to make friends', that they 'don't need new friends', and that they 'already have an active social life'.

Staff can play an important role in encouraging positive peer relationships and creating a cohort identity and/or sense of belonging. When social elements are integrated into the academic programme, students from varied backgrounds – and especially those with ongoing caring and/or work responsibilities, and living away from the institution – find it much easier to attend, and thus build the all-important social relations.

Staff can nurture cohort identity in a number of ways:
- Ice breakers and team building activities in class.
- Assessed and non-assessed group work in class and outside formal teaching time.
- Field trips, residential activities and course-related events.
- Pre-entry and induction activities.
- A space within the academic milieu where students spend time together.
- Staff organised social activities.
- Peer mentoring.

For those students who participate in them, field trips in particular provide good opportunities to develop friendships with both peers and staff. On their return to university, students subsequently feel far more comfortable approaching academic staff. There are however a range of other ways in which peer and student-staff relations can be developed.

Effective ways to increase social engagement

The following case studies offer real-world examples of effective approaches to facilitating social engagement, and provide evidence of the impact these have had on student transition, retention and success.

Activity weekend induction: Software engineering: University of Aberystwyth. (Panel one)
Here is an example of an opt-out induction activity for all first year students beginning software engineering courses. The staff and students all participate in a trip away from the university and take part in adventurous team building activities. This fosters social integration between students and with staff. Motivation has improved, class participation is much higher and retention rates are among the highest in the UK.

Team working in Engineering: Chemical Engineering and Advanced Materials (CEAM) and Mechanical and Systems Engineering (MSE), Newcastle University. (Panel two)
This case study examines the introduction of student engineering teams in two engineering schools. CEAM provides an example of an approach to create student groups at the very beginning the first semester. MSE has introduced group assignments into the first year. Both approaches develop teams that have academic and social benefits for students, enhance belonging to their respective schools and improve progression from stage 1 to stage 2.

Maths Arcade: Mathematics, University of Greenwich. (Panel three)
This focuses on the establishment of a co-curricular activity: maths games and support. The aim was to increase support for struggling maths students and provide an opportunity to stretch the more able mathematicians, whilst creating an environment where staff and students could interact more informally and thus enable the latter to get to know each other more easily. Student feedback about the Maths Arcade is very positive, and the pass rate in two 1st year courses has increased from just over 70% in 2009/10 to nearly 90% in 2010/11.

Panel one

Activity weekend induction, Software engineering courses:
Department of Computer Science, University of Wales, Aberystwyth.

The department runs two activity weekends – one in the first year and one in the second. The former aims primarily at team building and social integration, via challenges requiring awareness of group dynamics. This promotes links between students, and between students and staff, whilst simultaneously developing course-relevant problem-solving skills. The second weekend continues to focus on team building but is more explicitly concerned with raising students' awareness of employability issues.

All first year students – over 150 usually – participate in these weekends and attendance is 'compulsory', (ie, strongly encouraged). It is not merely a case of 'the more, the merrier' but 'the more, the more effective' – because often those most in need of such intervention are least inclined to take part without a strong requirement to do so.

Regarding cost, students currently contribute £25 (and monies can be obtained from the student hardship fund if necessary), which amounts to about 20% of the total. The remainder comes from the department.

One of the programme's 'unique selling-points' is that all staff are also encouraged to participate – including research assistants, PhD students and professors alike. This results in the fast erosion of unnecessary and potentially counterproductive boundaries between staff and students, and the boosting of morale in the context of the course. As one lecturer commented:

'… I have seen a considerable improvement in the attitudes of my tutor group. Before the weekend, few students volunteered ideas and readily participated in activities… However, in my most recent tutorial – after the weekend – I saw a marked improvement. Everyone participated and contributed towards the activities – everyone had made new friends. I was particularly pleased to see the quieter students participating without effort, and the louder more confident students taking into account their ideas and seeking their thoughts rather than (perhaps unintentionally) being dismissive – the dynamics of the year have changed markedly.'

After a weekend of interaction, lecturers are perceived as 'more human' – and if students encounter difficulties later in their course (be these academic, personal or other), they know that the department is not a mere bureaucracy but a place run by people who are approachable and who will listen and respond.

Not surprisingly, given that the programme has been running for 18 years, it has evolved in various ways – one of which includes its locations. The weekends have, however, always had an outdoor orientation. Indeed, in the cold Autumn of 2010, participants spent the two nights 'under canvas' – no mean feat.

Nor are the activities themselves particularly easy. In fact, some are impossible – albeit by design. The aim, according to main organiser Richard Shipton, is to test participants' abilities to tackle unsolvable problems, and to thus place individuals in a context where they are obliged to think and act in close cooperation with others in order to ensure that each and every angle of an issue has been fully explored. This encourages a team-player mentality to develop, as one student states:

'I enjoyed the weekend thoroughly. For me, it served most as a good opportunity to learn how I work in a team – an opportunity I don't often get – and a chance to try and improve my team-playing skills. I felt I learned a lot about myself.'

These sentiments were echoed by another attendee stressed the benefits of the weekend's focus on group tasks:

'Personally (I'll admit) team work has never been my favourite way of working. The weekend helped me to improve my skills considerably, and has reassured me that working in a team isn't so bad after all. I also know a lot more faces around the department than I did before, which is great.'

More fundamentally, these two days of shared activity see new friendships made, a point emphasised by a third student: '…it helped me make some great new friends that I am now in contact with regularly.'

The role of friendship in keeping students on course should not be underestimated. Undergraduates usually find themselves in unfamiliar cities, within an institution that can appear bureaucratic, impersonal, and worryingly large and complex compared to their previous educational establishment. Couple these factors to the fact that most students embark on courses of HE at an age when they are vulnerable to emotional instability and depression, and the potential for alienation and isolation increases dramatically. So, forging supportive friendships can be invaluable.

The programme

Given the two night / two day duration of the programme it is obviously necessary to make maximum use of the time available. On arrival, participants form groups and meet with facilitators for 'ice-breaking' exercises – then move swiftly on to more taxing activities. Despite the often-hostile October weather, a sense of fun soon develops. In recent years so-called 'high impact' exercises have received far less emphasis. Where previously participants may have found themselves on trapezes, or, groping their way cautiously up high rope ladders, their reserves of physical energy now tend to be spread a little more evenly over the the weekend.

Part of the reason for the success of the weekend stems from the way in which organisers update and improve the programme. For instance, recent years have seen the addition of an activity based on the popular TV series Dragons' Den, in which participants develop a mobile phone application.

Impact of activity weekends

Students and staff enjoy these activity weekends and find them beneficial. They get to know one another, which has positive benefits in the classroom and beyond.

In addition, students develop team working skills that help them to undertake collaborative study and prepare them for progression into the labour market.

At the institutional level Aberystwyth performs above the average for Wales in terms of continuation rates., The University has also received a number of other accolades (from www.aber.ac.uk/en/ undergrad/accolades):

- Aberystwyth University is, for the fourth year running, the best university in the country for student satisfaction according to *The Times Good University Guide 2011*;
- The 2011 results of the National Student Survey (NSS) awarded the University a score of 4.3 out of 5 for student satisfaction, and for the seventh year running, top in Wales. A total of 252,000 students voted that overall satisfaction at Aberystwyth University remains at a very high 92% – 10% higher than both the Welsh and the UK average.
- For the third year running, the University offers the best all-round student experience in Wales according to *The Times Higher Education's Student Experience Survey* 2011.

Strategic fit

The induction activity weekends chime with the holistic institutional approach adopted at Aberystwyth:

In the strong belief that student integration, engagement and the promotion of a culture of belonging fosters commitment and achievement, Aberystwyth University has implemented a large number of cross-cutting schemes aimed at enhancing student satisfaction and success and thereby improving retention. This approach fosters strong peer relations, helps develop the student as an individual, values him/her within the institution, and helps each student to obtain the confidence and ability to access the learning, skills and support needed to succeed in HE and beyond. (Croft, 2011).

More specifically, during Welcome Week, a number of University-wide initiatives are organised, and additional interventions in halls of residence and in academic department are organised. By cutting across academic, professional and social strands, these encourage collaborative staff/ student teamwork.

Link to conceptual model and findings from the What works? programme

This programme is an excellent example of integrating the social into the academic sphere. The activity weekend provides opportunities for students to get to know each other, as well as staff, in an informal setting. In turn, staff develop a better understanding of their students, which informs their teaching.

Tips and reflections

When asked for tips to those who wanting to start a similar induction programme, the organiser stressed in particular the need for a committed, enthusiastic supporter. Academics are plate spinners – lecturing, publishing, administrating, etc. They do not always give student retention the attention it requires.

A guiding spirit is therefore important to: rally compelling arguments on for example cost; convince the occasional, reluctant fresher; and dream up evermore engaging activities.

Secondly, but not unrelated to this, colleagues must be brought aboard. The department as a whole needs to understand why the programme is important and how it achieves the results it does. It is not always a given that staff will surrender a weekend to the cause – but , once they have, they are very likely to do so again.

The need for early planning is the third key point to note. This means running through activities with participating staff during the summer. The more familiar the organisers are with the tasks and objectives, the more smoothly the weekend will run. Smooth running will be particularly appreciated by all participants should they encounter inclement weather.

The fourth point is that of timing. Run a weekend too early and it will conflict with the activities throughout freshers' week and beyond; too late and new undergraduates may already be struggling with unfamiliar surroundings, lack of friendship groups and new course material. Experience suggests that weeks four or five are optimum.

Related publications
Croft, D. (2011) Aberystwyth University – Retention matters: an holistic approach, in Thomas, L. and Jamieson-Ball, C. (eds) *Engaging students to improve student retention and success in higher education in Wales*. York: Higher Education Academy

Ratcliffe, M., Woodbury, J. and Thomas, L. (2002) *Improving Motivation and Performance Through Personal Development in Large Introductory Software Engineering Courses*, Proceedings of the 15th Conference on Software Engineering Education and Training (CSEET.02).

Ratcliffe, M. and Thomas, L. (2003) *Enhancing the employability of student software engineers*. The Institution of Electrical Engineers.

Panel two

Team working in Engineering, Chemical Engineering and Advanced Materials (CEAM) and Mechanical & Systems Engineering (MSE), Newcastle University.

Two schools at Newcastle University have used student teams to improve student engagement, belonging and progression from Stage 1 to Stage 2.

The School of Chemical Engineering and Advanced Materials (CEAM) at Newcastle University has traditionally held a welcome reception for all new students in the first week of the first semester. In 2009/10, as a response to increasing numbers of stage 1 students (in excess of 100), the focus of this event was changed to deliberately stimulate student interaction with peers and academic staff. All were presented with a T shirt, a marker pen and – most importantly – a clear set of instructions. Each person was required to draw representations of their interests onto their shirt and to then find others with similar interests and form groups. Participants were given explicit directions regarding the intended mix of gender and ethnicity for each group. The underlying notion is that – because groups are self-selecting on the basis of shared interests – they will enjoy working together in the coming months when tackling a group design project. Note that, once the course is under way, these 't-shirt' groups are complemented by further group-based work where teams are created solely by staff.

The School of Mechanical and Systems Engineering implemented students in teams to undertake relevant tasks throughout year one, aiming to enhance both peer-to-peer support and peer-to-peer learning, and improve progression rates. In 2009/10 107 level one students were split into teams of five on the first day of semester one. Each team consisted of students with a range of previous academic attainment. No team consisted only of academic high achievers and none whose members had relatively low entry grades. In addition, ex-foundation year and overseas students were distributed throughout the teams, although women were always placed with another female student. In preparation for working as Engineering Teams, all students took part in a team building exercise during Induction Week aimed at encouraging participation and communication. A tutor was allocated to each team with the expectation of meeting up with them approximately every fortnight. The teams were encouraged to sit together during lectures and to work together on any exercises given by the lecturer. Formal project work, assigned within two Stage 1 modules, was to be completed as a team, with students encouraged to act independently in scheduling meetings and allocating work between team members.

Impact

The two engineering schools undertook evaluation of their team working as part of the What works? Student retention and success programme. Evidence from surveys, focus groups and institutional data suggest an impact on:

- Friendship and belonging.
- Academic engagement and learning.
- Progression from Stage 1 to Stage 2.

Friendship and belonging

MSE students commented that being divided into teams had the effect of decreasing their sense of disorientation and potential loneliness:

'In the first hour… you were sat in the introductory lecture thinking 'I don't know anyone', 'how am I going to make friends?' and they said 'we are going to put you in these teams' and instantly there was… straight away there was like 10 or 11 other people you knew straight away' (MSE student).

An online survey of the Stage 1 CEAM cohort found that students formed close social bonds with peers and a strong sense of 'belonging' to the School. When asked if they had formed close bonds with their peers, students' responses were entirely positive: all students either 'agreed' or 'strongly agreed'. When asked about this sense of 'belonging', 29 of 36 students said they 'always' or 'mostly' felt they belonged in the School. This was also reflected in the focus group:

'…it kind of makes… you don't just feel like one individual person on a course, it is kind of like you are in a conglomerate of people kind of thing… I think it does definitely make you feel part of the group or part of something within the year group rather than just one lone person.' (CEAM student)

Almost all CEAM students said their friendship groups had influenced their sense of belonging, and 23 of 36 students said that either Semester 1 or Semester 2 project groups had been an influence on their sense of belonging. Although it is not possible to establish definitively from this survey which factors were of most significance in facilitating these close bonds, it seems that School-facilitated integration activities had a significant impact. When asked about the strength and duration of these bonds – how many people were they still socialising with later in the year – 28% of respondents said 'all of them' and 58% 'most of them'.

Academic engagement and learning

Both MSE and CEAM students reported that having friends on the course provided academic support, the opportunity to share knowledge and skills, and solving problems together in modules where it was not actually required.

'In certain modules as well… if somebody has a problem… for example if I have a problem I will ask somebody else and vice versa…like theoretical stuff… calculations, a maths problem or something…we usually help each other out or if we have a bit of course work and we get stuck on it… a certain aspect of it… we go and ask as well. It is not always… well it is rarely we ask lecturers… most of the time we ask each other to be honest… and obviously when we get tutorials then we get an opportunity to ask the lecturer as well'. (MSE student)

Similarly 32% of CEAM students reported that they 'spend time with friends (not team mates) working together on academic projects' and a further 44% responded that friends had been a source of help and support when they did not understand academic work.

Team working is challenging, but with individuals and groups have developed strategies to overcome frustrations, sometimes alone, or sometimes with the support of the academic member of staff. Dealing with such challenges is arguably a valuable skill for future employment and life more generally. Furthermore, in the two years that engineering teams have been running in MSE positive student feedback has increased.

The survey and focus group data from both schools suggest that students largely enjoy working in teams. They also make friends, gain academic support and feel more integrated into the institution. And, whilst some experience frustrations, students' overall evaluation of teams is very positive. The experience from the two schools suggests that the central issue is not how groups are created. Rather, it is simply that they are:

'… I think if you are part of the kind of group then if, if you are going to drop out then… or if you are struggling academically then you have got people there to support you as well'.

Progression

Analysis of institutional data revealed that in 2009/10 CEAM saw 93% of level one students remain on the same Programme in the following year. In 2010/11 that rose to 95%. In addition, the number of students who left in the first two months of their degree programme decreased significantly, and in 2010/11 no students at all withdrew during the first two months. Overall, there was an improvement in retention and progression despite a significant increase in cohort size. (See Table 1).

In 2009/10 94% of MSE students remained on the same Programme the following year. In 2010/11 an increased number (115 of the 127 who had registered) remained, and although this is a slightly lower percentage, it is of a greatly increased student intake. The number of students progressing to the subsequent year for these two years was the highest for the six years for which data were available. (See Table 2).

Table 1: CEAM students remaining on the same Programme after two months and the following year (2004/5 to 2010/11)

Academic Year	Number of students registered	Number and Percentage of students leaving in first two months	Number of students remaining on the same Programme next year	Percentage of students remaining on the same Programme next year
2004/05	31	3 (9.7%)	23	74.1%
2005/06	46	4 (8.7%)	39	84.8%
2006/07	45	3 (6.7%)	40	88.8%
2007/08	56	3 (5.4%)	47	88.9%
2008/09	52	1 (1.9%)	46	94.0%
2009/10 (intervention year)	73	2 (2.7%)	68	93.1%
2010/11 (Intervention year)	103	0 (0.0%)	100	95.1%

Table 2: MSE students remaining on the same Programme next year (2005/06 to 20010/11)

Academic Year	Number of students registered	Percentage of students remaining on the same Programme next year	Number of students remaining on the same Programme next year
2005/06	93	85%	79
2006/07	75	84%	63
2007/08	91	89%	81
2008/09	114	84%	96
2009/10 (intervention year)	107	94%	100
2010/11 (Intervention year)	127	90%	115

Strategic fit

Newcastle University has a good rate of retention overall. However, retention and progression in engineering disciplines, although higher than the national average, compare poorly with the institutional average. This motivated the two Schools discussed here to see if using groups could further improve retention and progression. The year-on-year improvements are very encouraging, especially in the context of increasing student numbers.

Link to findings from the What works? programme

Both interventions centre on developing groups in the academic sphere at the very beginning of the first year of study, and then undertaking collaborative work in engineering teams. These interventions enable students to 'feel like they belong' within their School essentially by enabling them to get to know peers. This has additional benefits (particularly the peer support with academic learning), such as a contribution to the improvement of academic performance, increased student satisfaction and reduced rates of withdrawal.

Reflection and challenges

The T-shirt exercise is easy to implement and provides a vehicle to form groups at the very beginning of the first semester. However, the benefits of early group formation appear to be similar, irrespective of how the teams are formed. Team working can be challenging for students, and they need understand how to address these difficulties in constructive ways. This process is enhanced by staff involvement. The effectiveness of team working more generally depends in part on high levels of commitment by members of staff. This would therefore need to be stressed in other settings for comparable outcomes to be achieved.


Tips for others

- Students require opportunities for interaction with fellow students from the moment of their arrival. Activities to promote social integration and team working are most effective when they are introduced early, from day one or before the student's arrival at university.
- Making opportunities for interaction within a structured environment – where students are obliged to relate to each other – means they are supported to move out of their social 'comfort zone,' helping them get to know peers.
- It is helpful if the change is initiated and/or supported by a senior member of the course team – ideally with input from colleagues across the engineering programme. Most important of all, the new approaches should be led by someone who is enthusiastic and interested in students.
- Those student groups which represent minorities (for example women in engineering), require specific consideration and additional facilitation in gaining full integration.
- Social and academic integration reinforce each other and are most effective when attention is paid to both these aspects.

Further information and resources
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Publications
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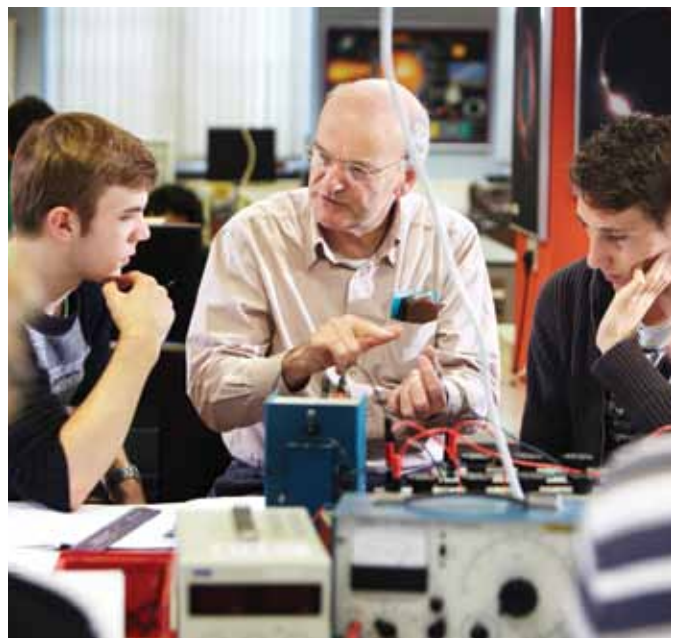
Panel three

Maths Arcade: improving the engagement of students in their learning, Mathematics Department, School of Computing and Mathematical Sciences, University of Greenwich.

Staff in the Department of Mathematics faced the challenge of how to keep first year students with a large ability spread engaged in learning. In September 2010 the Department set up the Maths Arcade to increase support for struggling maths students and provide an opportunity to stretch the more able mathematicians, whilst creating an environment where staff and students could interact more informally and students get to know each other more easily. The objectives were to:

- Provide a weekly drop-in session with staff available to provide tutorial support.
- Offer a wide variety of strategy games and puzzles for students to play with each other and staff.
- Set a weekly puzzle to stretch the most confident, and to run this as a termly competition.

The weekly one-hour drop-in session was attended by at least three members of staff. It provided an informal environment where students could get help with tutorial questions and play, or watch others play, some of the many mathematical strategy games and puzzles available. The games chosen required strategic thinking but did not take long to play. Chess and Go were available but not encouraged as much as other, less well-known games such as Quarto and Qorridor. There is a weekly mathematical puzzle or problem competition. Different levels of difficulty are set to encourage participation and challenge solvers. A £10 book token prize is offered each term for the student who has correctly solved the most puzzles. Typically, only one or two students submitted official solutions, but many others were seen to be working on the problems without choosing to enter the competition. Despite lack of entries, it has certainly met the objectives of providing something for the most able students to work on.

Many students found the set-up preferable to arranging an appointment with a lecturer in their office as there was not stigma attached to attending. Some students liked to play games before getting work out in order to ask for advice. The fact that several staff were on hand meant that students could benefit from different approaches and different ways of explaining mathematical topics.

The sessions have been well attended by a wide variety of students from diverse backgrounds, requesting both specific support, and engaging in games and activities with staff and their peers. Some students came regularly every week, others just now and again when help was needed. Three staff attend the Maths Arcade each week and three others come when they can. This has been just enough for the average of 30 students that attend, but more staff would be beneficial, as students particularly appreciated staff joining in with the games. The core staff organised a training workshop to show staff and PhD tutors the advantages of attending, and enabling them to try out some of the games.

Staff who attend regularly find that they can help or get to know far more students than during their 'office hours'. To support better staff engagement, this year they are being encouraged to make the Maths Arcade one of their office hours. Staff feel that the initiative has been helpful in getting a wider than usual number of students engaged and embedded early on in their programmes, and has increased first year attainment.

Impact of providing opportunities for social engagement

First year students were asked for feedback on a maths event that they had attended as part of their personal development programme. A number of events had been organised by the Maths Society including a comedy night and a couple of academic speakers. Despite these other options, over 70% of students chose to write about the Maths Arcade:

'The people who were once strangers to me when I first started [attending the Maths Arcade] are now some of my closest friends.' (Young, male, BME, first year, with English as a second language and dyslexic).

'The problems presented to me in the Maths Arcade helped me to learn to think out the box, which has helped me a lot in my personal study' (Young, male, Asian first year from a low participation neighbourhood).

'Various activities provided by Maths Arcade have had a positive effect on my social skills and my approach to tackling problems'. (Young, female, BME, first year, with English as a second language).

The Maths Arcade seems to have influenced pass rates which rose from just over 70% in 2009/10 to nearly 90% a year later. Whilst staff are aware that there are other factors involved, the Maths Arcade is thought to have been a major contributory factor. In terms of retention and progression the drop-out rate has fallen by almost three-quarters.

In summary, the Maths Arcade initiator, Noel-Ann Bradshaw commented:

'The benefits to the students were more varied than I had imagined. The weekly puzzle and board games stretched the most able but also provided new students who did not initially know each other with an occasion to socialise and mingle with their peers in an unthreatening situation. Maths students are often socially shy and this gave them an opportunity to form friendships in a safe environment. In particular students liked the opportunity to spend time and play these games with staff outside the classroom environment and beat them!

… Many students also made use of the tutorial help that was offered at the same time. They appreciated the fact that a number of staff were on hand to answer student queries and to set them in the right direction. Those who made use of this were often the students that would not have visited something branded as a 'help session' because they do not like to acknowledge, even to themselves, that they are having difficulties with the material. Staff benefitted from being able to get to know a number of students in a relaxed and informal setting.' (Bradshaw 2011, p27).

Strategic fit of the Maths Arcade

The Maths Arcade has made a positive contribution to improving the transition of students into the University. The staff member who led the development of the Maths Arcade gave a presentation at the University Teaching and Learning conference in July 2011. This resulted in similar initiatives being developed to in two other areas of the University – the Business School and the School of Engineering. Recently The National HE STEM Programme Mathematics Curriculum Innovation Fund funded a project to roll out the Maths Arcade in other universities: Sheffield Hallam, Keele, Leicester and Salford, with similar ventures based on Greenwich's initial idea taking place in Nottingham and Bath.

**Link to conceptual model and findings
from the What works? programme**

The Maths Arcade is not embedded into the academic curriculum, but offered alongside it. It emphasises academic engagement in a social context, driven by the active engagement of members of staff. This is clearly valued by students as it enables them to develop their capacity to engage and expands their social networks. It also develops their problem-solving skills and capacity to ask for support, while providing opportunities to stretch and challenge the most able students.

Reflection and challenges

The strengths of this project are:

- An informal opportunity for staff to get to know students and use this to inform teaching.
- Students get to know each other and make new friends which they value.
- Interaction with between students, and between staff and students promotes a sense of identity and belonging to the Department of Maths.
- The activities help to improve students' problem solving skills.
- The initiative provides a way of stretching and developing further the more able students, and a non-threatening way of supporting weaker students.

Limitations or challenges currently being faced at the University of Greenwich are:

- Constraints created by timetabling and the availability of a suitable room. It would be ideal to have a designated space available whenever needed to fit in with students' and staff timetables.
- Greater staff buy-in and engagement would be useful to help ensure that all staff promote the service to students and attend some sessions each term.
- Staff relationships with students can depend on just one person.

Tips for others

- Make sure you are clear about what you want to achieve and why you are implementing a Maths Arcade.
- Engage other staff in the project that the initiative is not wholly dependent on you for its success. For example, involve them in the planning and delivery of sessions.
- Engage students in developing the initiative. Start by asking them if it is something they would use and encourage them to spread the word. Consider employing a postgraduate student to promote and co-ordinate the service and provide cover if staff are unavailable.
- Talk to staff in other institutions and/or departments who are doing something similar.
- Monitor attendance and collect feedback on what students find beneficial, and what changes they would suggest.
- Examine institutional data, such as attendance at lectures, retention and achievement rates that might be used as supporting evidence about the value of the initiative.
- Promote the work of the Maths Arcade, student and staff feedback and any changes in student attendance, retention and success to others in the university.
- If you have an useful idea, go for it!

Further information and resources
Email: Noel-Ann Bradshaw, Principal lecturer and initiator of the Maths Arcade: n.bradshaw@greenwich.ac.uk

Publications
How to set up a maths arcade: **www.hestem-sw.org.uk/ project?id=9&pp=108**

Bradshaw, N. (2011) The University of Greenwich Maths Arcade, MSOR Connections Vol 11 No 3 Autumn Term 2011, p26–9. **http://mathstore.ac.uk/headocs/Connections_11_3_Bradshaw.pdf**, accessed 8th December 2011.

Key messages and principles for promoting social engagement

Key messages

- Students benefit both academically and personally from social engagement with peers and staff, especially when experiencing difficulties.
- Students do not always recognise the value of social engagement, and may find it difficult and/or frustrating at times.
- Some find it particularly difficult to engage with staff and/or peers and need to be facilitated to do so; all students benefit from this.
- Students need structured opportunities for engagement as early as possible, ideally beginning pre-entry and extending into the first stage and beyond.
- Efforts to increase social engagement are particularly effective in the academic sphere, as some students do not prioritise or are unable to engage in other aspects of university life.
- Efforts are more effective when interventions have an overt academic purpose.

Key principles

- Mainstream: Interventions to improve social engagement should be embedded into mainstream academic provision where possible. This helps to ensure that all students participate, and thus benefit. It improves retention of those considering withdrawal – but will also contribute to maximising the success of all students. Where interventions are not mainstreamed, they should be aligned with the academic programme – for example, by being delivered at times when students are likely to already be on campus without having to hang around.
- Proactive and developmental: Activities should proactively seek to engage students and develop their capacity to do so. This involves a structured approach to social engagement, such as setting up teams or organising an activity away from the university. It also requires staff intervention to ensure all students engage initially, and are supported to work through challenges that they encounter.

An 'opt-out' rather than opt-in approach is useful. Particular attention should be paid to students who opt-out, and additional support provided if necessary. If students have to opt in it is important to make transparent how they should engage and what the benefits are likely to be.

- Relevant: Social activities need to be informative, useful and relevant to students' current academic interests and future aspirations; the potential benefits of engaging should be explicit. This is why engagement in the academic sphere and with an overt academic purpose is particularly effective.
- Well timed and appropriate media: Early social engagement is essential for retention and success. Information may be better delivered via an alternative media, as students' learning styles and needs will differ from each other and over time. It may be that the organisation of teaching and learning needs to be revised.
- Collaborative: Activities should encourage collaboration and engagement with fellow students and members of staff from across the department.
- Monitored: The extent and quality of student's social engagement should be monitored and, where there is evidence of low levels of engagement, follow-up action taken.

Reflective questions

Here, finally, are some reflective questions to help STEM departments to critically review their approach to nurturing a sense of belonging, and to enhancing student engagement, retention and success.

- To what extent do the department, programme and module actively nurture a culture of belonging through social engagement?
- To what extent do all staff feel responsible for – and participate in – promoting student belonging through social engagement? Are staff encouraged through recognition, support and development, and reward structures to give sufficient attention to retention and success?
- To what extent is social engagement integrated into pre-entry, transition and induction activities and into learning, teaching and assessment, especially in the first year?
- To what extent are collaborative learning and teaching used to promote social engagement? Could this be increased in any ways?
- To what extent do the department, programme and modules develop the capacity – understanding, skills and opportunities – for all students to engage with peers and staff through their academic studies?
- Does monitoring identify students who are not social engaged with peers and staff? What follow up action is undertaken?
- Do all students feel they belong in the department, programme and module that they are studying? How could this be improved through greater social integration?

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