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Students learning engineering skills together in cross-year-group integrated tutorials

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ABSTRACT

Through tutorials, students can develop their engineering and professional skills outside taught modules. We introduced a new integrated tutorial system in which students were taught in mixed year groups. Questionnaires and focus groups were used to investigate whether students preferred integrated tutorials or tutorials in their year groups. There was a clear preference for integrated tutorials, with students feeling that they provided improved pastoral and academic support and were more stimulating. They particularly appreciated the opportunity to mix with students from other years in a learning community. A minority of students felt that mixing the year groups meant that less material was relevant to individual students than in single-year group tutorials. Overall, integrated tutorials were felt to offer a more supportive learning experience than traditional year-group tutorials.

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INTRODUCTION

Tutorials provide an essential opportunity for students to consolidate knowledge gained in taught modules (sometimes referred to as courses or units) and to generalise their learning by discussing real-world engineering problems. Tutorials take many forms depending on the institution, the discipline and individual academics' preferences. Here, we define a tutorial as a regular opportunity for students to meet with staff for guidance on academic and personal matters that are broader than those discussed in individual modules. Our institution accepts that personal tutorials differ across disciplines; therefore, our tutorials focus on discussing employability skills, relevant resources and upcoming events.

Tutorials fill numerous overlapping roles including providing academic support, pastoral support, a learning community, peer learning, a social support network and so on [1]. Much of this could be provided by a tutorial system which is not discipline-specific. Indeed, the benefits of a learning community and social support network could even be enhanced by cross-disciplinary tutorials. However, discipline-specific tutorials can offer relevant advice which is consistent throughout an entire degree programme including the selection of optional components, specific advice on internships and careers, and the opportunity to develop professional engineering skills [2,3], as well as allowing open-ended student-led discussions about current engineering practices [4].

We recognise the broad range of activities which are referred to as "tutorials" and here take the opportunity to define our tutorial system. Our system is based on discipline-specific pastoral tutorials. Purely academic tutorials are given by subject-experts as part of taught modules. This ensures that all students on a module (who might come from different degree programmes in different departments) benefit from the same academic support. Here, we consider pastoral tutorials which are given in groups of about 10 students with a discipline-specific academic staff member. Where possible, the same staff member acts as tutor throughout the students' degree programme. We aim to have about 10 one hour tutorials per year, while encouraging students to arrange additional one-to-one meetings with their tutor where necessary. The topics covered are flexible but typically include professional engineering skills, preparation for employment, and revision and examination techniques.

In this paper, we compare two different tutorial systems, both following the general principles detailed above.

1 TUTORIALS AND LEARNING COMMUNITIES

1.1 The role of tutorials in an engineering programme

Tutorials provide an additional learning platform for students which complements more formal sessions, providing a further type of learning which goes beyond the formal lectures, project/problem based learning, and practical group work which take place elsewhere in an engineering programme. Students may be encouraged to discuss cross-cutting engineering themes which apply across subjects and which might be currently topical. They are informal and unassessed opportunities for students to engage in relevant topics [4] and they help to consolidate professional engineering skills such as teamwork, communication skills and an appreciation of broader contexts of engineering [5].

1.2 Learning communities for support and professional development

An important function provided by tutorials is the opportunity for students to develop a learning community [1,6,7]. This recognises that learners work together in a social group, gaining both social and academic support from each other whilst learning together. There is convincing evidence that "moderate to large academic benefits can be attributed to peer tutoring" [8]. Furthermore, newcomers to a group may gain particular benefit from working with established members of the group [9].

1.3 Integrated tutorials

In our previous tutorial system in a new 3-4 year biomedical engineering undergraduate programme, students were divided into tutorial groups, each of which consisted only of students from a single academic year. This brings undoubted advantages as the learning and interventions which students require tend to change year-by-year. All tutorials can therefore be focussed and are equally relevant to all students.

However, this system provided students with limited opportunities to *meet* with students from other year groups and almost no opportunities to *learn* with students from other years. Indeed, it was postulated that final year students underestimate their learning and maturity because they find it hard to compare their current level of knowledge to that which they had when they entered the programme. We decided to tackle this problem with a solution inspired by a local secondary school which has successfully introduced a "vertical", mixed-age tutorial system which "encourages students from all ages and groups to mix and socialise well" [10].

In our new, "integrated tutorial" system, two to three students from each year group make up a tutorial group of about 10 students. The tutor acts more as a facilitator than an expert and can encourage conversation between the students. A few single-year-group tutorials remain where we need to address topics which are specific to a single year group. We assessed the impact of the integrated tutorial system using a combination of questionnaires and focus groups in a new collaboration between tutors on the biomedical engineering programme and the Institution's Teaching and Learning Centre.

2 METHODOLOGY

2.1 Questionnaires

A questionnaire (*Fig 1*) was prepared, based on a 5-point Likert-type scale, designed to offer a quantitative comparison of students' opinions of the new integrated tutorial system to their opinions of individual year tutorials. It included 12 questions designed specifically to assess tutorials (shown in Fig 1) and 10 more general questions aimed at assessing students' opinions of the overall degree programme (not shown). Some questions were intended to be similar e.g. "how valuable are tutorials?" and "what is your overall view of tutorials?" in an attempt to provide some internal consistency check. The order of the five points on the Likert-type scale was randomised so that some questions were ranked good-bad and others bad-good. All were corrected so that 1 was bad and 5 was good before analysis. The questionnaires were anonymous, but students were asked to state their year group.

There is considerable controversy in the literature over the analysis of Likert-type data, depending on whether the categories are assumed to be equally spaced

intervals, and if so whether the data can be assumed to be Normally distributed or not [11]. Here, we follow the lead of the UK's National Student Survey, where positive answers (e.g. "agree" and "strongly agree") are added together and expressed as a percentage "satisfaction" score.

Tutorials:

		1	2	3	4	5	
How many did you attend?	None						All
How useful were they academically?	Very useful						Not useful
How useful were they for personal development?	Not useful						Very useful
How relevant were they to taught material?	Highly relevant						Not relevant
How did they prepare you for scenarios, minors, etc?	Not at all						Fully
How useful were they for internships, careers advice, etc	Very useful						Not useful
How stimulating were tutorials?	Very						Not at all
Do you have sufficient academic support?	Yes						No
Do you have sufficient pastoral support?	No						Yes
Was your tutor available outside tutorials?	Yes						Hardly at all
How valuable are tutorials?	Not at all						Extremely
What is your overall view of tutorials	Very useful						Pointless

Fig 1. The Likert-type questionnaire which students were asked to fill in to assess their opinions of tutorials.

2.2 Student focus groups

Qualitative data provided cross-year focus groups to gain a deeper understanding of students' experiences of the new tutorial system. Five students took part in discussions in the focus groups, which expanded on the questionnaire responses in order to yield more information. One limitation of this study is the small number of students taking part in the study due to scheduling conflicts. While the number is small, our findings provide an initial cross section of feedback to be studied further.

3 RESULTS

3.1 Questionnaires

22 students completed the questionnaire for the single-year tutorials and 28 for the integrated tutorials (in the latter, 14 were from year 1, 8 from year 2 and 6 from year 3). The satisfaction scores (percentage of scores of 4 or 5) are given in Fig 2. Similar questions (e.g. Q11 and Q12), and another set of questions which on the same sheet but which were not intended to test for differences between the tutorial systems, had an average absolute difference between the systems of 7%, so this was taken to be a measure of the uncertainty and any differences between the years of greater than 14% was deemed worthy of further examination. These are highlighted in bold in Fig 2.

Two questions (Q1 and Q10) were rated more positively under the old single-year tutorial system, and the remainder were more positively rated under the new system. All of the changes >14% corresponded to improvements of the new system over the

old one, with the average difference over all questions being 12%. Attendance was similar across both systems.

	Tutorials	Single-year tutorials	Integrated Tutorials
1	How many did you attend?	91	86
2	How useful were they academically?	**18**	**46**
3	How useful were they for personal development?	55	57
4	How relevant were they to taught material?	23	27
5	How did they prepare you for scenarios, minors, etc?	55	46
6	How useful were they for internships, careers advice, etc	**36**	**75**
7	How stimulating were tutorials?	**41**	**57**
8	Do you have sufficient academic support?	**62**	**86**
9	Do you have sufficient pastoral support?	**50**	**82**
10	Was your tutor available outside tutorials?	91	82
11	How valuable are tutorials?	45	54
12	What is your overall view of tutorials	52	61

Fig 2: Percentage satisfaction scores for two tutorial systems, with notable differences highlighted in bold

3.2 Student focus groups

When students were asked what is beneficial about the integrated tutorial system, their responses could be placed in two categories: academic and personal. Academically, students appreciated learning about modules and getting advice from students in other year groups. They saw other students as an unbiased source of information about modules and assignments. Personally, they saw the integrated tutorial as an opportunity to meet other students in the programme; it encouraged conversations between year groups and provided informal pastoral support. They particularly appreciated meeting like-minded students working in the same field.

Students suggested academic improvements that will be taken in to consideration (*e.g.* “more opportunities to talk to students from other year groups”), as well as practical issues around timetabling and very specific suggestions such as more assistance with writing job and internship applications. They particularly appreciated sessions that described practical engineering opportunities such as options for internships.

Overall, they felt that the integrated tutorial system led to more discussion among students, but a minority, particularly third-year students, felt that a reduced proportion of the time spent in tutorials is relevant to them, as much of the content might be relevant to students in other year groups.

4 DISCUSSION

On the whole, students preferred the new integrated tutorial system to the original single-year tutorials. However, their reasons were not those that we anticipated when we introduced it. The original aim was to provide students coming to the end of their degree with a comparison so that they could see how much they had learnt. This did not appear to be seen as relevant by either the questionnaire responses or the focus groups. Indeed, the main advantage was seen to accrue to new students who appreciated the opportunity to engage with and learn from more experienced students.

The results of the questionnaire showed that students did prefer the new system and felt it offered improved pastoral and academic support. They also felt that integrated tutorial conversations offered better advice on careers and internships. One of the strongest responses from the focus groups agreed with the response to Q7, namely that the tutorials were more stimulating because students engaged in conversation with each other. It is clear that students see the supportive, affective aspect of tutorials as very important – academic and pastoral support gained the highest satisfaction rating of all the questions. This aspect of community has been described in the literature [1,4,7] but its importance is perhaps under-recognised by practitioners.

There were substantial practical difficulties with the integrated system, mainly due to the challenging requirement to timetable sessions when students from all year groups can attend. It is also necessary to give more thought to planning and co-ordinating each session to ensure relevance to all students and so that all students receive a similar experience.

Advantages to staff of the new system include the transfer of expertise from tutor to student. The tutor's role has moved from being the source of information to a facilitator, encouraging students to discuss and solve problems themselves. This reduces the programme-specific experience needed for staff to get involved in tutoring and allows a wider range of staff to get involved.

One interesting suggestion which came from discussion with students is to allow them more influence over what topics are covered in tutorials. We will continue to develop our tutorial programme and encourage students to take an active role in planning tutorials as well as engaging in them.

5 SUMMARY

We have reconfigured the tutorial support system in an undergraduate engineering degree programme so that each tutorial group includes students from all years. Results demonstrated that overall students preferred the new tutorial system, though newer students were more in favour than students coming to the end of their programme.

We propose to continue to develop the integrated tutorial system, taking account of students concerns and suggestions as we do so.

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