Is Peer Assisted Learning of benefit to undergraduate chemists?

COMMUNICATION

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Peer Assisted Learning has been a relatively common feature in US universities for several decades, and has been adopted more recently in Britain to help reduce student 'drop-out', and also to encourage a more student centred learning approach. Peer Assisted Study Sessions ('PASS') started in the University of Manchester Chemistry Department in 1995 and in 1997 a similar scheme was started in the Chemistry Department at UMIST. In both schemes the sessions are led by third and fourth year students (PASS Leaders) who volunteer and are given training in the support of group learning. During the first year of operation both at Manchester and UMIST the voluntary participation by first year undergraduates was very low, but now 50% of the first year cohort can be described as regular participants at the University of Manchester. Careful collection of data has indicated that those first year students who regularly participate in PASS achieve higher chemistry exam results than non-participants. There are also other hidden benefits to all the scheme stakeholders.

Introduction

Peer assisted learning is a well established feature of education at many North American universities. Often called Supplemental Instruction (S.I.), it was first introduced in 1973 at the University of Missouri-Kansas City, by Dr. Deanna Martin in the School of Health Sciences[1,2]. S.I. has since been adopted by over 350 different departments in universities across the USA, and the model has spread to include over 100 institutions in 12 other countries[3]. S.I. is one of the few post-secondary programmes to be designated as an 'Exemplary Educational Programme' by the US Department of Education who have validated the claims that S.I. improves the grades of participating students and improves student retention. The emphasis of S.I. is to help all students on 'high risk' courses, not to selectively target 'high risk' students. Two essential features of S.I. are that it is voluntary, and that it is not seen as remedial in nature so that able students participate to the benefit of all. In 1990 Kingston University, in conjunction with four other universities, adapted and developed the American S.I. model for use in Britain[4-7]. The British model emphasises the partnership with academic staff and most British S.I. schemes are introduced and co-ordinated by an enthusiastic academic in a particular university department whereas in the US, S.I. is usually administered centrally by an Educational Development Unit. In 1994, HEFCE provided funding to a consortium of academics from a number of English universities (the 'SI Network') for the production of training resources[8].

During the early 1990s the combined drop-out and failure rate in the Department of Chemistry at the University of Manchester was approximately 20% of its total first year intake. This clearly indicated that first year chemistry was a 'high risk' course. Part of the departmental response to this situation was the initiation, in 1995, of a peer tutoring scheme based upon the British model of SI. The scheme was given the title PASS (Peer Assisted Study Sessions)[9] in order to encourage the first year students to expect that participation would help their chances of progressing into the second year of study. In 1997 a similar scheme was started in the Chemistry Department at UMIST. The broad aims were to develop a framework which would:

- provide effective support for the first year programme and encourage the active participation of the majority of first year students;
- benefit PASS leaders;
- not demand excessive staff time.

This communication will describe the organisation of the PASS schemes and give preliminary, but extremely encouraging results, which indicate that PASS has a number of direct and indirect benefits to the undergraduate teaching of chemistry.

Methods

It was envisaged that third and fourth year students (PASS Leaders) would be recruited and, after appropriate training, would encourage first year students to work at problem solving in small groups. The scheme would be voluntary both for the unpaid PASS Leaders and for the first year student participants, and would run on a weekly basis during term time until Easter. Each PASS session would be based around a tutorial worksheet but more general advice on note taking, revision and exam techniques would also be provided by the PASS Leaders.

Student leader recruitment

Recruitment of PASS leaders from upper year cohorts is started at around Easter time. This involves a short talk given by the academic in charge of the scheme (the PASS co-ordinator) which emphasises the benefits of the scheme to the PASS leaders (CV enhancement, revision of fundamental chemistry, increased confidence etc.). The PASS co-ordinator also writes to all of the students on industrial placements inviting them

to be PASS leaders on their return to the department. So far, at Manchester and UMIST there have been no problems recruiting a sufficient number of PASS Leaders to run the scheme. Nor has their been so much demand that a selection process to choose PASS leaders has been necessary. Should this be the case in the future, then we believe that it is more important to select PASS leaders with enthusiasm and reliability rather than with high academic ability. Senior year students returning from a year in industry consistently prove to be enthusiastic and effective leaders and could be given priority in any selection process. PASS leaders that struggled with the first year course but ultimately passed have also proved to be successful and empathetic role models.

Student leader training

The PASS Leaders all attend a compulsory training day (usually the first Saturday of the academic year) with an external trainer. Since the introduction of the schemes at Manchester and UMIST the trainer has been Ms. Jenni Wallace, a long standing and enthusiastic member of the SI Network who was involved in adapting the American model for British higher education. The importance of effective student leader training cannot be overemphasised in order to set the right 'tone' for the whole scheme, and to provide effective training in study strategies, group handling skills and the facilitation of learning. It is emphasised that the leaders' role is not that of a teacher, but instead it is to initiate group discussion and encourage the active participation of the first year students. This initial training day is not chemistry specific and indeed the PASS Leaders mix with students from the other University Departments within which PASS schemes are operating (e.g. Mathematics, Middle Eastern Studies and Philosophy). A second subject-specific training session takes place one afternoon during the second week of the academic year, during which the PASS co-ordinator explains in detail the organisation of the Chemistry PASS scheme.

The sessions

The hour long PASS sessions are timetabled on a weekly basis to fall between two formal teaching sessions. The sessions are held in a teaching laboratory which provides a convenient space for each group to work together without being distracted by other groups. Two PASS leaders are assigned to each group, which usually consists of 5 – 8 members. At Manchester University, each session is based around a tutorial worksheet which alternates between organic, inorganic and physical chemistry. These tutorial worksheets are an important component of the first year course and are compulsory for all students, whether PASS participants or not. A few days after the PASS session all first year students are required to submit the answers to the worksheet for marking by their academic tutor prior to attending a formal tutorial which also focuses on the content of the tutorial sheet. Should incomplete or incorrect answers be produced as a result of the PASS session then these can be corrected by the tutor. In addition, the marks obtained from the worksheet answers do not contribute towards the students' final grades. At UMIST the sessions are based on problems and learning objectives given in the first year course handbooks. At both universities PASS Leaders also provide the first year students with more general advice on note taking, revision and exam techniques. It is important to emphasise that the PASS sessions are designed to supplement the existing first year course not to replace any aspect of it. More general advice and information can also be disseminated by the PASS Leaders; for example the advantages and disadvantages of taking a year out in industry or taking certain second year course options. Sometimes the sessions may take on a more informal 'social' aspect, especially early on in the semester, where they can take the form of a question and answer session about aspects of student life of relevance to the group. The first year groups are not the same as for the formal tutorials to encourage greater mixing amongst the first years.

Academic staff involvement

Staff involvement is restricted to the PASS co-ordinator who is responsible for organising recruitment, the venue, stationary, training, sorting the students into manageable groups, ensuring that the problem worksheets are distributed to the PASS leaders in time, *etc*. Negotiating a suitable timetable slot where both the leaders and first years have a formally 'free' session can sometimes be problematic. The co-ordinators also collect registers from the sessions which are confidential to the co-ordinator and allow the tracking of attendance to aid end-of-year statistical evaluations of the scheme. Initially this administrative aspect involves a significant commitment of the co-ordinator's time, however, once up and running, the PASS Leaders effectively run the scheme. Financially, the cost to the Department is minimal.

Results

Table 1 shows the number of PASS Leaders and of first-year participants at both Manchester and UMIST for each year the scheme has operated.

The averaging of the figures over both semesters obscures the observation that participation tends to decrease in the second semester. For example, at Manchester in 1997-98, an average of 68 students attended each of the nine sessions in the first semester, and this dropped to an average of 30 students for each of the five sessions in the second semester.

We have anlaysed the examination results of the students at Manchester during the 1997-98 session to assess whether any effect of participation in PASS can be detected. This year was chosen because, at the time of writing, it was the most recent (and largest) sample on which data were available. Based on attendance over the 14 sessions, students were classified as full participants (6 or more sessions), occasional participants (1 – 5 session) or non participant. Over the year as a whole, 17 students (12% of the cohort) failed to obtain the pass mark of 40% (averaged over all 3 papers) and were required to resit; none of these were regular participants in PASS. In contrast, in the year before the PASS scheme was introduced, there were 36 students (27% of the cohort) with

Table 1: Number involved in the PASS scheme

Year	*Manchester*		*UMIST*	
	Leaders	Participants*	Leaders	Participants*
1995-96	22	18	-	-
1996-97	24	41	-	-
1997-98	28	55	11	14
1998-99	24	58	12	14

* Average number of first year attending each session.
The total cohort at Manchester is about 140 and at UMIST 110.

Table 2: A comparison of examination results between PASS participants and non-participants at Manchester for the 1997-98 academic year.

	[a]No. of students	Mean No. of attendances	[b]Mean Exam results	[c]Mean A-level points
Non-participants	27	0	47.3	13.8
Occasional Participant (attended 1-5 sessions)	34	2.7	51.9	11.8
Full participant (attended 6-14 sessions)	65	9.6	60.7	13.7
all students	126	5.7	55.5	13.2

[a]Figures do not include those students who were absent for one or more exam (18); [b]based on the average of the final examination marks for the three chemistry courses covered by the PASS scheme (i.e. organic, inorganic and physical);
[c]Mean points calculated from each student's chemistry and best other science or Maths A-level results).

an average mark below 40%. This is strong evidence that the introduction of the PASS scheme is associated with improved performance.

Table 2 shows the average examination mark for full, occasional and non-participants. The average mark increases with increased participation. This supports the conclusion that participation in PASS is beneficial.

We considered the possibility that the difference between the three groups was due to a greater participation in PASS by more able students. As a measure of ability we calculated the mean A-level point-score based on the chemistry grade and the best grade achieved in any other science or maths A-level. We chose this because many of our students take, in addition to chemistry, only one other A-level in maths or science; we considered it inappropriate to include results from non-science subjects in our measure of ability in chemistry.

Table 2 shows that there is no difference in the mean A-level points score between full participants and non-participants, and so there is no reason to suppose that the strongest students are attracted to the scheme. The mean A-level point score of the occasional participants is slightly lower than that of the non-participants, yet their examination mark is a few percentage points higher. The most optimistic interpretation of this is that students can benefit from even a small commitment of time to the scheme.

We are aware of the dangers of evaluating new learning opportunities from a quantitative analysis of exam results[10]. We have therefore sought other evidence for the effectiveness of the PASS scheme. General questionnaires completed by first year students frequently refer favourably to the PASS scheme. PASS leaders provide a uniformly positive response through their specific questionnaire. Thus the scheme is clearly valued by both sets of students.

In addition we have held informal discussions with students and staff in the expectation that this is the most effective way to learn from them how the scheme could be further improved. These discussions also reveal a high degree of satisfaction with the scheme.

Discussion

Since the scheme is completely voluntary, we could not expect a high participation rate during the first years. The fact that over 50% of the first-year students at Manchester (including some of the most able ones) are now participating suggests that they believe that the scheme is worthwhile. This, in conjunction with their examination performance, provides good evidence that we have achieved the first of our key objectives. The PASS scheme has a number of other benefits for the first years. For example, students have a forum in which to discuss problems which they would feel uncomfortable talking to a personal tutor about; they realise that others are struggling with difficult aspects of the course (and that their PASS Leaders struggled and ultimately passed the course); they

meet more fellow students (especially during the all important first few weeks of the academic year). PASS also helps to break down the barriers that exist between years and to reduce the feelings of bewilderment which often accompanies the first year student experience in a large department. One important aspect of the scheme at Manchester is that the PASS Leaders take an active role in registration week by running a help desk, organising Department and Library tours, and helping with social functions. At UMIST several of the PASS Leaders also help with UCAS open days for potential undergraduates.

There are also clear benefits to the PASS Leaders. On their own admission they revise and gain a better understanding of the fundamental concepts of chemistry; they discover and develop skills in communication and group work which industry requests; they feel valued by the department and gain a sense of involvement in its affairs. The prime motivation for most final year students to become a PASS Leader is to improve their CV and to be able to answer those awkward questions on application forms. However, once involved in PASS they become increasingly enthusiastic and view the scheme as their own. Academic teaching staff are impressed by the degree of enthusiasm and commitment shown by the PASS Leaders and benefit from informal feedback on courses.

We believe that the PASS scheme has improved first year learning within the Chemistry Departments of Manchester and UMIST, and that schemes like PASS could be a useful addition to most undergraduate chemistry courses. Our experience suggests that a successful scheme requires a number of elements. The most important is the availability of an enthusiastic academic co-ordinator backed by a supportive academic staff. It is also essential to ensure that there is a vacant slot in the timetable which is common to the first and the final year students at a time when there is a suitable room available. We have found that there are advantages in timetabling the PASS sessions in a 'lecture trap' between two compulsory teaching sessions; this has minimal impact on the students' flexibility to manage their time.

Initial participation is likely to be disappointing, and so perseverance is required to maintain the scheme until it is accepted and embedded in the curriculum. This means that all faculty staff need to promote the scheme and actively encourage student participation. With perseverance, the scheme eventually becomes self-perpetuating with first year students becoming keen to be PASS leaders.

The PASS scheme has many benefits, but it should not be seen as a 'cure-all' for all problems; it is just one facet of student-centred learning which is beginning to play an important role in higher education. Dearing[11] suggests that universities should be "considering how students can become active participants in the learning process" and PASS provides an excellent environment for this process. There is strong statistical and anecdotal evidence that peer support schemes are beneficial to all who participate – to the first years who gain support for the all important transitional year into university life, for the leaders who gain and develop many personal skills, and the staff and institution who gain by a reduced failure rate and by having more motivated and better prepared students.

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