

Introducing peer-supported learning approach to tutoring in engineering and technology courses

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Abstract An innovative, non-traditional tutoring programme based on collaborative and peer-support learning is described, and a reflection on two years of its implementation with specific subjects in electronic engineering and ICT-based courses at the University of Limerick is presented. The programme, known as Peer-Supported Learning Groups (PSLG), is an academic enrichment scheme, which has been developed by adapting the American SI model such that it meets the needs of students in Ireland and fits into the Irish third-level education system. The paper begins by giving a rationale for the introduction of the PSLG to the targeted subjects, followed by descriptions of the operational structure of the programme highlighting the difficulties encountered at the initial stages and the measures taken to alleviate these difficulties. Quantitative measures for evaluating the effect of the PSLG on students' performance, as well as analysis of feedback collected from the students and the leaders, are presented and discussed. The paper concludes by outlining issues for improving the current programme and associated further developments.

Keywords collaborative learning; peer tutoring; student-centred learning; study skills development

The first year of college has always presented challenges to both students and institutions. For students, it is one of life's critical transitions. In fact, the most critical period for first-time students, which is most likely to affect their dropout, is during the first two semesters in college. There are many academic and social differences between high school and college: academic environment; grading; knowledge acquisition; support; stress and responsibility.¹ Studies have shown that college students have less support from family, friends and teachers; higher stress due to more difficult academic work; increased responsibility for learning; and increased responsibility for making major life decisions. As a result, first-year college students often experience various problems that make them prone to withdraw. These problems include disorientation, mismatch from expectations, problems adjusting to self-learning and motivated study. For engineering and technology courses, the technical difficulty of the subjects adds to the above problems. Some students also find it difficult to integrate into their academic community or even make new friends. This results in lack of group work, communication and interaction between classmates on those difficult programmes, which otherwise would have helped all students. Effective models of retention stress the need for integrating students into the academic and social dimensions of the college community during the first weeks of their first year of college.²

University courses are the preparatory stage to a profession and should, therefore, encourage learning. This should be done with reference to the way in which pro-

professionals continue to learn; that is, through means which are self-directed, self-paced and resource-based. Marshall and Rowland³ noted that knowing how to learn makes it possible to continue learning after finishing formal education. Internationally, there are currently demands for the inclusion of professional and transferable skills training in undergraduate curricula. In Ireland, the recently commissioned quality assessment bodies of the HEA (Higher Education Authority) will soon require universities to demonstrate how outcomes regarding the acquisition and development of generic attributes, as well as study, technical and professional skills are being achieved. For engineering and technology-based courses in particular, the Institution of Engineers of Ireland (IEI) and other national accreditation bodies will also require the same. These changes are in response to increasing demands by employers that graduates must complement their technical work skills with an informed and sensitive awareness of the communities and cultures within which they may be employed.⁴ On the other hand, a new emphasis regarding the central focus of education is taking root in higher education throughout the world. Rather than the traditional teacher-centred model, the focus is continuously shifting to being learner-centred.⁵ After a long period of focusing energies and committing resources to improving teaching, many educators have turned their attention to improving the efficiency and effectiveness of the learning environment. The learning process must be expanded beyond the traditional classroom walls and additional partners must be added to the learning environment in addition to the classroom lecturer/tutor.

It was in this developing atmosphere of the need for improved learning outcomes, acquisition of effective study and professional skills, and for provision of academic and interpersonal support systems that the 'Peer-Supported Learning Groups (PSLG)' programme was introduced in the University of Limerick (UL) about two years ago, based on the Supplemental Instruction (SI) model used at many North American universities.⁶

Peer supported learning

Peer supported learning in the USA: the SI model

It has been widely recognised that the most effective learning environment is one where learning is an active process fully involving the learner, preferably in groups in a supportive and non-threatening environment that can be strengthened by a truly collaborative approach between students, and students and tutor.⁷ Many students taking challenging courses would cherish the opportunity to study with their colleagues. They would like to learn by interacting and helping each other in a confidential manner and with no fear of tutors' judgement. However, productive collaborative study group sessions are often difficult for students to organise and plan themselves.

Peer supported learning is a well-established feature of education at many North American universities. Often called Supplemental Instruction (SI), it was first introduced in 1973 at UMKC by Martin.⁶ Since then, the model has been adopted by a

large number of departments in universities across the USA, and spread to include over 100 institutions in 12 other countries.⁸ SI is a peer-tutoring scheme with a difference. Rather than tutoring, which implies teaching, SI is concerned with facilitation, with the emphasis upon learning. Second year university students volunteer to be trained to facilitate learning groups of first year students on historically difficult courses, often involving concepts that students entering higher education find hard to grasp initially and resulting in higher than usual failure and drop out rates. The emphasis of SI is to help all students on 'high risk' courses, not to selectively target 'high risk' students.

The core SI model in the USA is timetabled, voluntary, confidential and non-remedial and involves second year student 'SI leaders', trained in tutoring techniques, attending up to 4 first year lectures a week and running several SI sessions each week. This activity is paid and leaders act as student tutors. They meet their 'SI supervisor' on a weekly basis and the supervisor sits on some of their sessions to provide feedback on their ongoing performance.

Peer Supported Learning Groups (PSLG): adaptation of SI in UL

Historically, the first year of the two Bachelor of Technology (BTech) courses in the Department of Electronic and Computer Engineering (ECE) at UL has been identified as difficult. Students were experiencing difficulties in mastering course contents particularly in introductory modules in electrotechnology and computer programming. This was reflected in high failure rates (see Table 1) and increasing dropouts.

In an attempt to support the high-risk students, the department has initiated a number of traditional schemes, such as extra remedial/tutorial sessions that are usually managed by faculty, teaching assistants, or course leaders. Other measures include the introduction of mid-term testing in core first year modules and the introduction of CAL (computer-aided learning) approaches in teaching. However, the indication was that those schemes have not fully succeeded in motivating the students or alleviating the on-going situation. In fact, based on feedback from the students, the situation was found to be related to problems experienced by the students due to:

- Their previous experiences and expectations rather than ability;
- Lack of group work and communication between student-student and student-faculty;
- Poor study skills;
- Lack of structured support and student development, both cognitive and social.

TABLE 1 *Failure rates for first-year students, September 1999 entry (January exams)*

Programme	Cohort size	% of students achieving QCA of <2.00
BTech in Electronic Systems	20	40.0
BTech in IT&T	117	28.2

Accordingly, it was felt that a non-traditional approach was needed that would provide an effective learning environment and encourage students' active self-direction, involvement and critical thinking. Hence, in the academic year 2001/02, the department piloted a 'Peer-Supported Learning Groups (PSLG)' programme to target one first-year module. Encouraged by positive results, the programme was expanded to three modules and developed into a fully-structured scheme in 2002/03.

The PSLG is a new tutoring programme, which employs a collaborative and peer-learning approach based on the SI model. The programme is timetabled, confidential and non-remedial but has a number of differences compared to the core SI model: (a) second-year students are not required to attend first-year lectures but are encouraged to do so and to take any opportunity to meet and socialise with first-year students, (b) the concept of tutoring was replaced by facilitation as the method of active learning, (c) PSLG leaders work in pairs or in groups encouraging first-year students to process the material they receive in lectures and discuss their understanding in a safe and supportive environment free of assessment, and (d) PSLG sessions use the learning-by-doing approach and hence are effectively lab-based and hands-on oriented. The PSLG leaders are not allowed to teach content, only facilitate discussion and exploration of issues amongst the student group. Another difference between PSLG and traditional SI is the way in which the outcomes of the scheme are evaluated. While for the case of the SI this is done on the basis of final grade comparison between SI and non-SI students, the PSLG also includes data gathered from a start-of-semester initial PSLG and mid-term tests in the comparison (see section below on quantitative results and discussion).

Introducing and running the PSLG programme

Programme implementation

During the academic year 2002/03, the Department of ECE introduced the PSLG scheme to three BTech first-year modules: Electrotechnology I (ET4101) in the autumn semester, and Electrotechnology II (ET4102) and Computer Programming I (ET4702) in the spring semester. Based on recommendations from the faculty who teach these modules and on grades scored in the previous year, eight second-year students were invited for a short training programme in facilitation of study skills at the start of the autumn semester. The training focuses on how to help the students become active self-learners rather than teaching them. Six of these students volunteered after training to work in pairs as PSLG leaders to facilitate three study groups of up to 25 students each from 70 first-year students.

In addition to training, each leader was supplied with a *PSLG Leader's Handbook*, which explains the difference between a PSLG leader and a teaching assistant, and includes a full description of a leader's responsibilities and role, advice from previous SI leaders, a set of FAQ and answers, and tips on effective study skills. Brochures explaining what the PSLG is and providing a schedule of all available PSLG sessions were given to all first-year students of the targeted class. Similar posters were put up in various lecture halls, laboratories and students' common

rooms and social gathering places. This was then followed by a brief presentation to the targeted class in the first week of the semester, during which the six leaders were also introduced.

Prior to the commencement of the PSLG sessions, the students in the targeted class were given an initial PSLG test which is a form of aptitude test designed to assess their abilities and skills with regard to the targeted modules, based on their Leaving Certificate knowledge. Each PSLG group was then given a one-hour session per week, starting with the second week of the semester. Sessions were then increased to two hours a week mid-way through the semester. The whole process, including leaders' training, was facilitated, managed and monitored by the PSLG supervisor (the author).

The scheme was qualitatively monitored by feedback obtained from students (leaders and tutees) and faculty on both a formal and an informal basis. Formal feedback was sought during three meetings per semester held with the leaders, often taking place after visits to their sessions by the PSLG supervisor. A more formal feedback was also obtained from the leaders using a 'PSLG Leader End-of-Semester Survey and Debrief' form. There was a final review meeting between the leaders, the tutees and the supervisor at the end of each semester. During this meeting, each student tutee was asked to complete a 'PSLG Survey' questionnaire which includes asking whether they would consider working as future PSLG leaders. In addition, a number of quantitative measures of students' performance were used to evaluate the effect of the PSLG tutoring. Marks and final grades gained by PSLG-tutored students during mid-term tests and final exams were statistically analysed and compared to those scored in the initial PSLG test to monitor progress. Collected data were also compared to similar data collected from non-PSLG students (students who did not participate in the PSLG scheme).

Qualitative results and discussion

Both PSLG tutees and leaders showed a high level of interest and enthusiasm in the scheme throughout the year. Formal feedback obtained from the tutees showed that they found the sessions very beneficial and appreciated the support they were provided with. This was indicated by students' responses to rating how helpful the PSLG sessions were on a 5-point scale from 1 (not helpful) to 5 (very helpful). All tutees rated the sessions 5, except for one student who rated them 4. They all liked the tutoring they received, requested more to cover other modules and the majority expressed willingness in acting as future leaders. Regarding skills development, students' feedback indicates that the benefits of the PSLG as perceived by the tutees lie in the combined social interaction and academic support. Indeed, this is reflected in the following comments which sum up what the tutees felt regarding the strength of the PSLG scheme:

'Informal setting; ... Easy to ask questions; ... Small groups setting; ... The students help each other; ... Relaxed environment; ... Friendly students leaders; ... Close contacts with each other and with the tutors; ... Preparation for the exams; ... The group discussions; ... Practising what we learn from lectures;

... The leaders were in the same position last year as I am this year, so they made me feel comfortable with all aspects of the course and the discussions made the learning very easy'

For the PSLG leaders, the benefits were numerous. The PSLG experience helped them gain deeper knowledge of the subjects, increased their confidence, enhanced their study, communication and organisation skills and gave them a sense of enjoyment and satisfaction in helping other students. The following comments, made in response to how participation as a PSLG leader changed or helped the students personally and/or professionally, reflect this:

- *It has given me a lot of confidence in my communication abilities and it will make a great addition to my CV, thank you for this opportunity.*
- *I now feel more comfortable at speaking in front of a group and found it all a very worthwhile experience.*
- *I think being a PSLG leader has helped me to become more adaptable with working with small groups.*
- *It was a good experience, it helped me assess my personal attributes and social outlook.*

Here are samples of feedback regarding the most rewarding aspects of being a PSLG leader:

- *The most rewarding aspect of my role as a PSLG leader only revealed itself last week when I met some of the students who were very grateful for the group, they believed they could not have done as well as they had done without the advice and guidance provided by the PSLG.*
- *The most rewarding aspect of my role is the quiet respect people have of one's tutor. The sense of helping students learn and study gives overwhelming enjoyment.*
- *Not only was being a PSLG leader a great experience, but it helped me remember things from last year that I'd forgotten and that are quite useful this year.*
- *Because the groups were relatively small, there was real interaction between various group members. It was also very informal, as such it was easy to help each other.*
- *The respect people have for one's tutor, ... the scene of helping students learn and study gives overwhelming enjoyment.*

Quantitative results and discussion

In 2002/03, the results of the quantitative analysis of the effect of PSLG tutoring were very positive and encouraging with regard to: (a) students' performance in mid-term tests and final exams, and (b) participation rates of first-year students compared to 2001/02. PSLG tutoring has significantly improved the performance of all tutored students in all the modules in which PSLG was offered, compared to non-tutored students, as indicated in Fig. 1 where the average final marks scored in each of three targeted modules (ET4101, ET4102 and ET4702) are shown.

Analysing the performance of each group, Table 2 gives a breakdown of the final

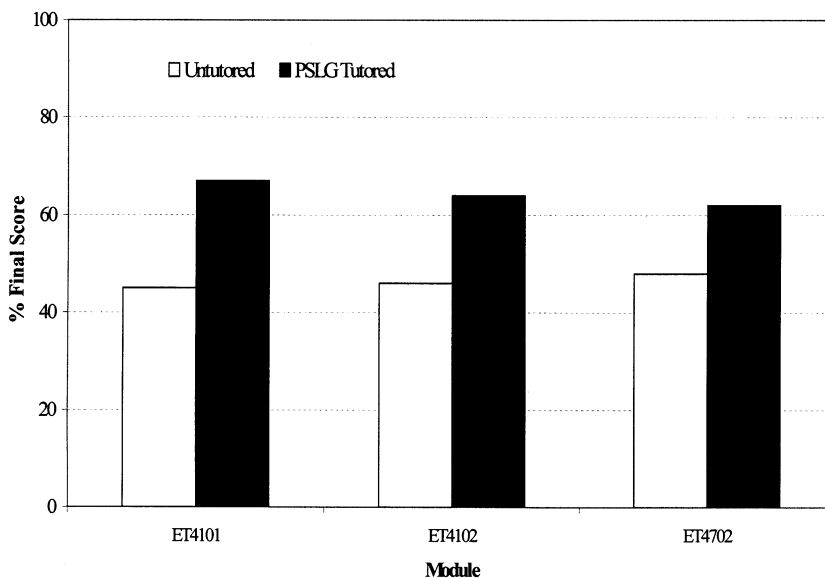


Fig. 1 Comparison of average final marks scored by PSLG tutored and non-tutored students in all targeted modules.

TABLE 2 Breakdown of final grades achieved by the ET4101 PSLG group

Grade	Number of students	Improved cases
A1	5	4
A2	3	3
B1	2	2
B2	4	3
B3	1	Even
C1	5	4
C2	2	1
C3	2	1
D1	0	0
D2	1	1
F	0	0

grades scored by the 25 tutored students who participated in the ET4101 PSLG group, noting that the student who scored D1 grade had only attended one PSLG session. As an indication of student progress, the Table also gives a breakdown of the number of students within this group who improved on their initial and mid-term test scores, where 'Even' refers to no improvement. Compared to non-tutored students, the ET4101 PSLG group performed significantly better and maintained a

fairly steady progress throughout the autumn semester, as evident from Fig. 2. Tutors achieved an overall pass rate of 96% compared to 83% for the class total. In fact, Fig. 3 demonstrates that the PSLG students raised their performance and maintained their progress in the spring semester with regard to the ET4102 module which is a continuation of ET4101. By comparing the average test/exam scores of tutored students who attended four or more PSLG sessions during a given semester with those who attended less than four sessions, Figs 2 and 3 also demonstrate the effect of consistent participation in the PSLG group on the continuation of progress and performance improvement.

Problems encountered

Most of the problems encountered in running our PSLG over the last two years were common to those usually experienced and talked about by SI and other peer-supported learning programme teams at various institutions around the world. Some of the problems have now been resolved. Solutions to some problems are yet to take effect, whilst others are currently being discussed by the PSLG team and support is being sought from various student learning and support units at the University of Limerick.

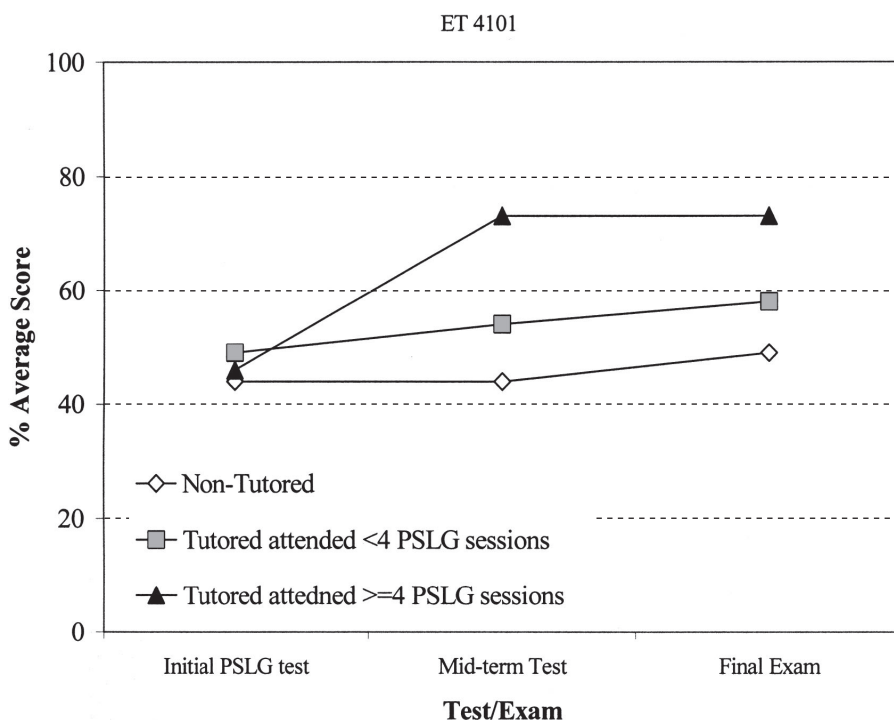


Fig. 2 Effect of PSLG tutoring on test scores and final examination performance for ET4101.

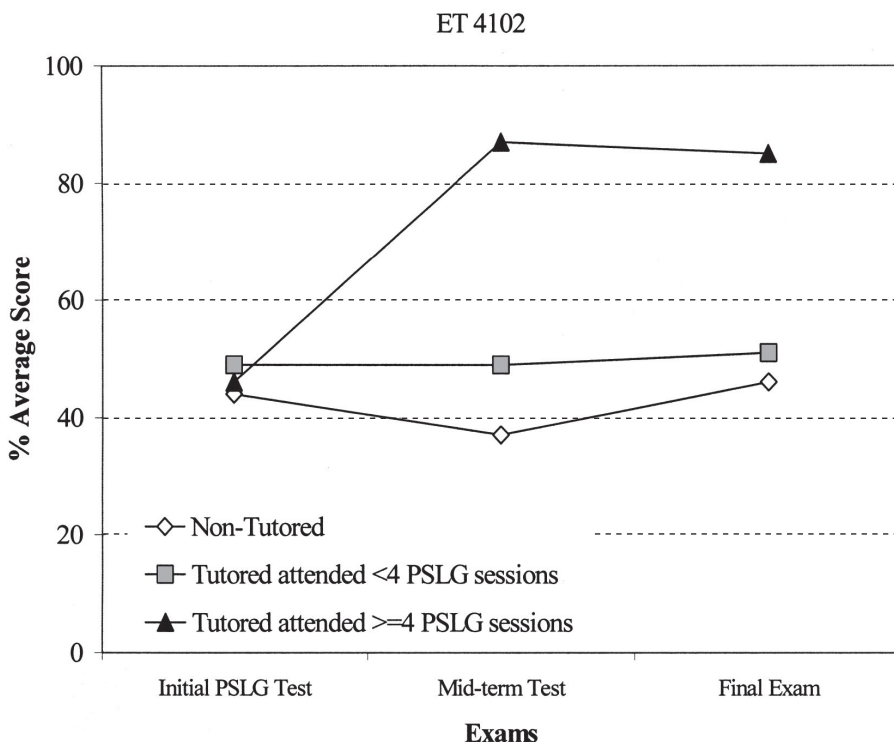


Fig. 3 Effect of PSLG tutoring on test scores and final examination performance for ET4102.

Scheduling arrangements

This was the first problem encountered during the implementation of the programme in its first year. Finding a suitable meeting room and allocating weekly time-slots that fit the already busy timetables of both the first- and second-year BTech students were (and still are) not easy tasks. The space problem has been resolved by the establishment of a dedicated 'Student Peer Support Centre' at the Department of ECE to facilitate all PSLG sessions and other related student support activities. Regarding scheduling, we have tried various arrangements, such as selecting different times and days of the week, and scheduling sessions between or after classes. However, we have yet to find an arrangement that best suits the tutees and the leaders and does not adversely affect participation.

Students' participation

Although participation in the PSLG sessions has been satisfactory, it has not been consistent. Participation was usually high at the beginning and towards the end of each semester. For the weeks in between, there was often a noticeable decrease in

participation. This was mainly attributed to scheduling of sessions, coursework/ assignments schedule and deadlines. The PSLG team are currently working on a number of measures to enhance and maintain student participation. These include various activities to publicise and sell the programme by the supervisor and leaders, and the setting up of a dedicated web site that would also include other resources such as previous test/exam papers and lecture notes. Support from colleagues within the department and from other learning and student support units to sell the programme is also being sought. The ideas of introducing accreditation system for tutees and leaders and integrating the PSLG programme into the curricula and the formal timetable of targeted courses are currently being discussed.

Support from faculty and colleagues

The support received from faculty members who teach the targeted modules has been excellent. The PSLG team is planning to draw more on colleagues' support within the department to help with advertising and 'selling' the programme to their students.

Training of PSLG leaders

So far, training of the PSLG leaders has been conducted by the author, being the PSLG superior and an accredited SI leader's trainer. The training is done via a one-morning programme during the first week of the Autumn semester. Recently, a new member of staff joined the PSLG team as a coordinator of the programme and the 'Student Support Centre'. Plans to seek the support of Student Counselling Services in UL to run a complete one-day training workshop prior to the start of the semester are currently being considered.

Conclusions

We believe that the PSLG scheme has improved first-year students' learning and academic performance within the Department of Electronic and Computer Engineering of UL. This has been demonstrated by the results of qualitative and quantitative measures, analysis and comparisons between tutored and untutored students, presented in this paper. We also believe that the PSLG can be a useful addition to all undergraduate courses in UL, and should be adopted by the university via a top-down approach, as a formal accredited student support programme. In fact, a properly set-up peer-supported learning programme would contribute significantly to increasing student motivation, enhancing their quality of learning, improving their academic performance, help students' adjustment to campus life/culture, reducing failure rates and increasing retention.

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