

# Student satisfaction with groupwork in undergraduate computer science : do things get better?

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## Abstract

Groupwork has a large and important role in computer science courses. Moreover, groupwork skills are among the most important generic attributes students should develop during their studies as preparation for the world of work (Candy, Crebert and O'Leary, 1994, Dearing, 1997). At the same time, all who have been involved in teaching that involves groupwork will be aware that it brings challenges. It is important to support student learning of group skills, to develop instruments for evaluating this aspect of teaching and to measure student development in groupwork skill as well as student perceptions of their groupwork experiences.

This paper reports on a cross sectional evaluation of student perceptions of groupwork. It is based upon both group interviews and a questionnaire. An important contribution of this work is the questionnaire which could be readily used in quality assurance elsewhere. Another contribution derives from the results of our study. They give useful insight into student perceptions across cross sectional cohorts and according to academic ability. We also report on ways that this study has helped us define strategies to improve the development of student skills in groupwork.

*Keywords:* groupwork, cross sectional study, quality assurance, first year experience.

## 1 Introduction

It is now widely accepted that groupwork skills are an important generic outcome for all students on graduation. This is particularly so in the area of computer science where the working environment of graduates is predominantly group or team based (Kidder, 1981). Initially, project work involving groupwork has been typical in the later years of computer science degrees when students have already acquired and applied technical knowledge (Farkas, 1988, Dietrich and Urban, 1996) and need to be oriented towards the world of work (Lowe, 2000, Chamillard and Braun, 2002).

Core courses or foundation courses have tended to be taught in more traditional ways, especially courses which

have large first year student intakes (Wills, Finkel, Gennert and Ward, 1994). There has been increasing recognition of the need to introduce groupwork components early in the undergraduate years to enhance both the educational and social experience of students new to the university context (Wills, Finkel, Gennert and Ward, 1994, Sabin and Sabin, 1994, Daigle, Doran and Pardue, 1996) and in this way to improve retention rates (Chase and Okie, 2000). Groupwork has been a component of the foundation course in computer science at Sydney University since the mid 90s when groupwork was introduced within an adapted Problem-based learning framework (Barg, Fekete, Greening, Hollands, Kay, Kingston and Crawford, 2000).

There were several motivations for introducing groupwork in the foundation year. One of the most important was to improve the first year experience, especially the isolation felt by many students at the very beginning of their studies. Another important goal for groupwork was that students would be able to tackle larger tasks and these would demand the power of an object-oriented programming paradigm. We also felt that the explicit teaching of groupwork skills meshed well with the philosophy of Problem-based learning, where time is taken to teach a range of broad problem solving skills. One of these is to learn to work effectively within a group (Boud and Felletti, 1991)

There is an extensive literature on the benefits and challenges of groupwork in education. In general, benefits have been reported in student learning and performance as well as in the development of higher level cognitive skills if groupwork encourages students to engage more deeply and actively with and reflect more on what and how they are learning. In addition, non cognitive benefits such as developments in interpersonal and social skills, as well as student self-esteem and self-motivation in learning have been reported (Slavin, 1992, Johnson and Johnson, 1992, Thorley and Gregory, 1994). However, although studies generally report that student achievement is enhanced through groupwork and particularly for low achievers, females and minority groups, the extent to which less able or passive students benefit has also been questioned (Webb, 1992, Thorley and Gregory, 1994). In addition, the need for group learning methods to incorporate group goals and individual accountability has been emphasised if effective learning is to occur (Slavin, 1990). The challenges of groupwork in terms of curriculum design, assessment and staff training are well known as well as issues of the

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quality of student learning and their attitudes and perceptions towards groupwork.

Much of the literature on groupwork in education is based on research at school level, although there is a growing literature on groupwork in higher education including case studies (see for example Kadel and Keehner, 1994, Thorley and Gregory, 1994) and teaching/learning guides (see for example, Goodsell, Maher, Tinto, Leigh Smith and MacGregor, 1992, O'Sullivan, Rice, Rogerson and Saunders, 1996, Kennedy, 1998, Hogan, 1999). Nevertheless, the success of groupwork is heavily dependent on both extrinsic factors, such as group formation, task design, assessment processes etc. and intrinsic factors such as group member personality, motivation, knowledge and experience, cultural background etc. and this needs to be taken into account when interpreting and adapting from the literature. In addition, one of the main justifications for groupwork in higher education, that of preparation for the world of work has been questioned as the contexts of workplace teams are significantly different from those of the university (Mutch, 1998, Berge, 1998). Despite the largely positive outcomes for student learning through groupwork reported in the literature, it is also acknowledged that groupwork processes can be negative experiences and may have deleterious effects on student learning, particularly in the area of team learning. These negative outcomes can occur despite the achievement of a successful group product (Berge 1998, Druskat and Kayes, 2000). As Thorley and Gregory emphasise, groupwork "is not appropriate for all learning occasions with all students" (1994, 179) and should be seen as part of a range of teaching/learning approaches for students at university.

## **2 Groupwork in the Undergraduate Program**

The first foundation unit begins with a month-long problem (Problem 1) as an initial experience of a form of group problem solving. The remainder of the semester's work is based upon a single group problem (Problem 2). The second semester unit has two equal sized problems. After these foundation units, there is considerable choice in later studies. Approximately half of the units available involve groupwork. Students typically take six units of study in each semester and we have found that there needs to be a balance between units involving groupwork against ones that involve individual practical work. In the second semester of the third year, students undertake a substantial semester long group project. We intend that this sequence of groupwork throughout the undergraduate curriculum should help students develop their skills in working in a team.

All computer science units are offered at two levels: regular and advanced. The latter is for students in about the top ten percent of the class, based upon previous academic performance. In all classes, but particularly in the advanced offerings, we aim to provide practical work and course content that will challenge even the most able of students. Groupwork can have a somewhat different feel in the advanced classes where students tend to be more conscious of their grades and are wary of

groupwork that might unfairly affect their final marks. Student numbers are large, with 800 to 1000 in the foundation units and over 300 students in the larger third year units.

There are some important differences in the way that groupwork contributes to assessment in different units. In the first foundation computer science unit, there is an explicit goal to teach and assess groupwork. At the same time, there are goals of individual mastery of programming skills. In line with this, the assessment of all programming is individual. Each student's individual code is graded and this accounts for the marks in the practical work. In addition, the final examination is dominated by programming aspects although it has some questions on generic skills including groupwork. The group-based assessment applies only to aspects that are to be done as a group: the group prototype design; group planning and monitoring processes; group demonstration.

In the third year group project, the core goal is that each group should operate as a unit to produce an effective solution to a client's needs. As is common in such capstone project courses, the assessment is generally a single group mark with all individuals earning the same mark. Even when this is not the case, the group mark dominates the grade. Other units have a range of other weightings and mechanisms for assessment of groupwork.

Explicit teaching about groupwork skills is focused in the first semester foundation unit. Our reasoning is that this is the point at which students begin group computer science practical work and it is a logical point for teaching some skills such as managing group meetings, brainstorming, group planning and monitoring, reflection about differing roles in the group and communication skills. Many units incorporate various forms of assessment of effective groupwork and this serves as a subtle, but powerful, form of teaching group skills.

## **3 Course Evaluation**

The foundation courses in first year computer science have been extensively evaluated since their inception. In addition, small samples of students taking third year computer science subjects and fourth year Honours have reported on their first year experiences in computer science courses. These evaluations have been reported in the literature (Barg, Fekete, Greening, Hollands, Kay, Kingston and Crawford, 2000). The impetus for the present evaluation was the introduction of Java as a new object oriented language for first year computer science students to learn and use in their group-based projects. As in previous evaluations, student satisfaction with groupwork was monitored after the first and second group based tasks, Problem 1 and 2, covering the whole of Semester 1 and at the end of Semester 2. On average, a sample of 200 students (100 from the advanced group and 100 from the regular group) completed a standardised questionnaire which sought both quantitative and qualitative data on their satisfaction with group components and group dynamics. Questionnaire design was based on previous instruments which have been used

to evaluate groupwork in first year Accounting programs (Bonanno, Jones and English, 1998). Additional information was sought in the areas of group contribution, student learning and feedback on different aspects of the course on the second questionnaire. On the third questionnaire, students were asked to compare their first and second semester groupwork experiences and identify their preferred method of assessment. Focus group interviews were also held at the end of first semester with both advanced and regular students. In addition, first year tutors were invited to complete an open-ended questionnaire on their perceptions of what students needed to learn in the first semester course and their approaches to teaching and assessing. The same first year standardised questionnaire was also administered to third year students for their evaluations of their third year groupwork experience. Additional information was also sought on their perceptions of their first year experiences. Although a larger sample was sought, only 36 students completed the questionnaire due to the logistical difficulty of sampling the students after completion of their second semester project but before they had left university. A focus group was also held with third year students, although this group consisted of volunteers from those students continuing their studies into the honours year.

Although evaluation is standard practice when new course materials and/or teaching and learning approaches have been introduced in the computer science curriculum (see for example, Sabin and Sabin, 1994, Brown and Dobbie, 1999, Lowe, 2000), such a large scale comparative evaluation across undergraduate years is rare in the literature. This extensive evaluation was undertaken to monitor changes in student satisfaction levels with group-based learning throughout the first year program and identify what factors influence satisfaction. In this way, recommendations could be made to improve the teaching and management of groupwork at this level in the curriculum. In addition, it was hoped that data from students in the later years of their undergraduate program would show improved levels of satisfaction with groupwork and an appreciation of the introduction of this method in the first year of their studies. This paper will report on the outcomes of these evaluations.

## 4 First Year Groupwork Experience

### 4.1 Satisfaction with Groupwork Components

Overall, most students were reasonably satisfied with groupwork components in both semesters as indicated in the mean ratings shown in Table 1a. These are based on a semantic differential with ratings of 1 to 5 where 5 was strongest agreement with the statement. Responses to statements on groupwork components (groupwork experience, processes, product and individual contribution) clustered above the middle range (3) in both semesters. Table 1b shows levels of satisfaction increasing from Problem 1 to 2 and at the end of Semester 2 groupwork. However, high levels of dissatisfaction were also reported by a small proportion of

the sample (Table 1c), and these increased slightly or remained the same across Problems and Semesters.

The most dramatic increase in student satisfaction occurred with students' rating of the group product from Problem 1 to 2. This change in the students' satisfaction was statistically significant (Wilks Lambda, Exact F = 8.176,  $p < .004$ ). Over both semesters, more than 50% of students consistently rated the group product as always or mostly good or better than an individual could produce. Although this high level of satisfaction with the group outcome is a measure of the success of the course, it should be noted that satisfaction levels with group experience and process declined in Semester 2. In fact about 20% of the sample reported negative experiences in these areas suggesting that the quality of their group experience was less than ideal despite a positive group outcome. This focus on the quality of the product rather than the quality of the group experience and process implies that students may well have avoided reflection on or improvement in their interpersonal and groupwork skills and undervalued the group process as a learning experience in itself (Jacques, 1984). This is despite the explicit teaching and practice of groupwork skills and structured discussion and reflection on group processes and dynamics in first semester. However, over 50% of students rated themselves as good team players on all questionnaires, rising to a high of 65% on the third questionnaire suggesting that they may well have been satisfied with their own team performance but not with that of their peers.

Evaluation statements	P1	P2	S2
I have had very positive experiences with groupwork.	3.4	3.6	3.4
I have had very positive experiences with group processes.	3.3	3.4	3.3
The product of groupwork has been as good or better than I could produce as an individual.	3.3	3.7	3.5
I am a good team player.	3.6	3.7	3.7

Key to rating scale:

- 5 = true always
- 4 = mostly true
- 3 = sometimes true
- 2 = rarely true
- 1 = never true

Key : P1 = Problem 1 (n=197)  
P2 = Problem 2 (n=201)  
S2 = Semester 2 (n=154)

**Table 1a: Mean satisfaction ratings with groupwork after completion of Problems 1 and 2 in Semester 1, and after completion of groupwork in Semester 2, 2001.**

Evaluation statements	P1 %	P2 %	S2 %
I have had very positive experiences with groupwork.	4	12	13
I have had very positive experiences with group processes.	6	10	11
The product of groupwork has been as good or better than I could produce as an individual.	14	24	24
I am a good team player.	11	15	21

**Table 1b: Comparison of % of highest (5) ratings of satisfaction levels with groupwork at the end of Problems 1 and 2 in Semester 1 and after completion of groupwork in Semester 2, 2001.**

Evaluation statements	P1 %	P2 %	S2 %
I have had very positive experiences with groupwork.	3	2	8
I have had very positive experiences with group processes.	2	3	6
The product of groupwork has been as good or better than I could produce as an individual.	4	6	4
I am a good team player.	1	1	1

**Table 1c: Comparison of % of lowest (1) ratings of satisfaction levels with groupwork at the end of Problems 1 and 2 in Semester 1 and after completion of groupwork in Semester 2, 2001.**

### 3.2 Satisfaction with Groupwork Dynamics

Most students assessed the group dynamics in both semesters as working well or working well most of the time (see Table 2). The main areas identified as not working well were time allocation to the problem and members being able to contribute where a significant minority of students (23% and 19% respectively) remained dissatisfied at the end of Semester 2. Problems with these aspects of groupwork are recurring themes in the literature (see for example Brown and Dobbie, 1999). Another area where a slight increase in dissatisfaction in Semester 2 was reported was in finding a convenient time for all members to meet. This problem area is also widely reported in the literature (see for example, Rebelsky and Flynt, 2000).

Dissatisfaction in another problem area, that of giving each member an opportunity to contribute, increased significantly between Problem 1 and 2 (Wilks Lambda, Exact F = 8.636,  $p < .000$ ). This suggests that although, by Problem 2, the groupwork experience had taught individual students some of the benefits of working in groups and that the product of groupwork is as good as or better than that completed by them as individuals, it did not teach the students to work in a more democratic and collegiate fashion. However, these negative changes were reversed in Semester 2 indicating that students were

attempting to work more as a team. Overall, 87% of students consistently rated their group as working well or working well most of the time in both semesters.

Generally, the quantitative data show reasonable levels of satisfaction with the way groupwork is organised in the first year courses in computer science and clearly some students have had strong positive experiences of groupwork during both semesters, although the converse is also true for a minority of students. At the end of second semester, most student ratings of their satisfaction with groupwork tended to be higher and in a positive direction, unlike first semester. This suggests that all of the interpersonal difficulties associated with sharing work fairly, individuals completing tasks allocated to them and sorting out issues around group dynamics have been largely resolved or at least not evident in the ratings on the third questionnaire.

These conclusions are generally supported by numeric analysis of the quantitative data using Principle Components Analysis and Multiple Discriminant Function Analysis. Principle components analysis was used to track key factors which describe students' experience of groupwork from Semester 1 to 2. Initial group dynamic and general satisfaction components expanded after students had experienced Problem 2 to include more positive general satisfaction variables indicating that students experienced increased satisfaction on the second problem by interacting more with one another to produce a better product on time. However, the contribution of others had become a significant variable by Problem 2 indicating that students became more "other" oriented the more they experienced groupwork and that other members contributing to work tended to be much less than that required of them. Finally, at the end of second semester, all key factors showed a more solid, homogenous and generally positive experience of groupwork. Similarities, rather than differences were highlighted, indicating the necessity to get on with the job and the sorting out of any interpersonal difficulties. However, multiple discriminant function analysis of all variables common across all three questionnaires produced 2 functions both of which suggest that the students strongly associate all individuals actually being able to contribute with group processes and if students do not make a contribution this detracts from group satisfaction. These findings are in accordance with the research literature on groupwork which identifies individual accountability as essential for successful groupwork (Slavin, 1990, Hertz-Lazarowitz, Benveniste Kirkus and Miller, 1992)

Qualitative data also indicate an overall and increasingly positive response to the groupwork experience, although this data was given on a voluntary basis. Nonetheless, the reasons given still broadly represent over half the students who responded to questionnaires 1 and 2 and approximately 20% to 30% of the students who responded to questionnaire 3. The incidence of positive comments increased from Problem 1 to 2 and to some extent, proportionately, in Semester two, although the decline in comments in second semester makes it difficult to generalise. The most frequent comments included:

Evaluation statements for group dynamics for Problem 1 and 2 and Semester 2 groupwork	Satisfaction ratings %								
	WW			WM			DWW		
	P1	P2	S2	P1	P2	S2	P1	P2	S2
We met at a time convenient to all members	47	43	51	44	48	35	9	9	14
We were able to spend enough time on solving the problem	29	24	22	53	58	55	18	18	23
We gave each member the opportunity to contribute	52	43	52	42	48	39	6	9	9
All members were able to contribute something	46	39	37	43	46	44	11	15	19
We worked well as a group	35	39	37	55	46	50	10	15	13

Key to rating scale: WW = worked well  
WM = worked most of the time  
DWW = didn't work well

Key : P1 = Problem 1 (n=197)  
P2 = Problem 2 (n=201)  
S2 = Semester 2 (n=154)

**Table 2 : Comparison of quantitative evaluation of the satisfaction levels with group dynamics, after completion of Problems 1 and 2 in Semester 1 and after completion of groupwork in Semester 2, 2001.**

- the positive evaluation of group performance and product,
- learning from more experienced members,
- learning how other people think,
- members being supportive and helping each other,
- fulfilling the requirements of the task,
- better/more communication (in Semester 2),
- groups more committed (in Semester 2).

There were also significant decreases in some negative comments:

- perceived social loafing,
- conflict.

Overall, at the end of second semester, the groupwork experience had improved for the majority of students (57%), although some still experienced dysfunctional groups and described their experience as worse than first semester. Better groupwork experiences in second semester were associated with more commitment on the part of group members and crucially, more contribution. Students felt more confident in their technical abilities and therefore more able to contribute, as well as more experienced in managing group relationships. However, negative comments continue to identify problems associated with non-attendance and non or poor contributions, and also point to a growing appreciation of the difficulties associated with the group task such as organising, planning, co-ordinating and integrating.

Despite improvements in satisfaction, only half the student sample preferred to be assessed using a group-based assignment rather than an individual assignment (53% of advanced and 44% of regular students). However, a number of students identified both group-based and individual assessment as necessary. Groupwork assignments are primarily valued as a preparation for future work situations and as productive peer learning situations. However if the group assignment is perceived to be unfair in terms of

assessment, especially with regard to equal member contributions, then students would prefer an individual assignment where they have sole responsibility for their work.

Having the students experience groupwork in Semester 1 and 2 takes them on a journey of self-discovery and skill acquisition. The first problem allows them to initially experience the interpersonal issues (positive and negative) of working in groups first-hand, including reflection on and evaluation of their own performance and abilities. The second problem teaches them the usefulness of the problems in providing them with work-ready skills and evaluating the performance of their peers in relation to themselves. Semester 2 problems allow them to integrate these experiences into interpersonal and technical abilities for future use both at university and in work. Throughout the entire process, they generally express a reasonable degree of satisfaction with groupwork.

## 5 Comparison of Advanced and Regular First Year Students

Discriminant Analysis determined which numeric variables significantly discriminated the regular from the advanced students. The advanced students rated the groupwork product significantly higher than the regular students while the regular students rated spending enough time on solving the problem higher than the advanced students. The advanced students believed they contributed more of their programming skills while the regular students contributed more conflict resolving skills to the group process. Therefore, it would appear that regular students rated themselves significantly higher on interpersonal and process skills like conflict resolution and time management while the advanced students focused more on technical details like programming skills and end product. These tendencies were borne out by

focus group data where the regular students emphasised the importance of developing interpersonal and group skills whereas the advanced students did not place so much importance on these aspects and felt that they would be learnt 'automatically' as part of working in a group and that learning about Java and programming was more important.

We note that the core of the assessment was based upon programming competence. Students who could not demonstrate programming skills and knowledge would not pass this unit, regardless of their performance on other aspects. It is only after this barrier is passed, that other aspects such as demonstrated knowledge contribute to grades. Ironically, this means that the regular students, who may have had more need to focus on the requirements for a pass, appreciated these generic skills more.

## **6 Comparison of First Year and Third Year Students Groupwork Experiences**

Since the third year sample is small ( $n=36$ ), it is difficult to generalise for all third year students. In addition, according to data collected on students' marks in their first year courses, there was a higher proportion of better performing students in our sample than in the cohort as a whole, although the student sample showed a normal distribution. Also, due to sample size, no multivariate analysis was done on the third year data and the analysis is therefore limited to the percentages of the ratings. Despite these shortcomings, the data provide some insight into third year groupwork experiences and allow comparisons to be made with first year data. However, interpretations need to be treated cautiously.

Overall, the entire sample noted that it was mostly true that they have had a very positive experience with working in their third year groups. Compared with first year students, this high level of general overall satisfaction is most noticeable. On all types of satisfaction surveyed (group process, group product and own performance), the third years consistently rated their experiences significantly higher than the first years.

Across most of the measures of group dynamics, there was remarkable consistency between third and first years. Most noticeable was the high number of worked well ratings for "We worked well as a group" for the third years (52.8%). It would appear that by third year, students have adapted well to working in groups as opposed to the autonomy and independence evident with the first years. It is interesting to note that third years also experienced dissatisfaction in the area of all members being able to contribute equally. Some 36 percent said that this did not work well. The division of labour continues to be a problem for some at third year.

## **7 Comparison of First year and Third Year Students Group Contributions**

Both first and third year students were asked to rate their contributions to team work in the areas of interpersonal social skills, computing and researching skills. Interpersonal skill contributions to the group were rated

highly by first years in the areas of communication, listening and managing, but not in the areas of motivating and even less strongly in the area of conflict resolution. Third years rated their contributions more strongly in the area of group communication and listening, similarly in the area of managing and conflict resolution and less in the area of motivating. They also rated themselves less strongly in the area of client/supervisor communication skills. This suggests that although there seem to be improvements in some aspects of communicating in groups from first to third year, students, even in third year, still lack strategies to use these skills in the more challenging aspects of communicating such as motivating, and conflict resolving. Difficulties in communication are a common theme in the literature of groupwork in computer science education (see for example Rebelsky and Flynt 2000, Brown and Dobbie, 1999) and much has been written about the kinds of communication skills needed and techniques to develop these to promote learning in groups (Johnson, 1990, Johnson and Johnson, 1991). In contrast to third years, it is not surprisingly that many first years did not rate their contribution highly in the area of programming, nor in the area of problem solving in this context. However, even though third years rated themselves higher than first years in programming, 25% still felt they had average or only minor contributions in this area. Focus group data suggests that this may be because the field is still daunting at third year level and students often feel overawed by how much more they feel they need to learn. It should be noted however, that focus group comments also pointed to the need for students to actually learn to program on their own and that if they did not, then they would remain weak programmers even in third year and would be 'carried' by the group in this area. Third years also rated their contributions in the area of researching skills more highly than first years. Focus group data suggests that the expectation of many students entering first year is that knowledge will be 'transferred' in the traditional way and learning independently and from peers in a group setting is a new way of learning which, if not carefully planned and structured, can be overwhelming (Diwan, Waite and Jackson, 2002).

## **8 Comparison of First year and Third Year Students Learning**

Student feedback on what they had learned from their groupwork problem or project was sought in a number of areas. For both first and third years, their main learning experience was their increasing knowledge about computer science and its application in programming and problem solving, the latter rated more highly by third years. Third years rated their learning in all the generic skills associated with the groupwork process more highly than first years, especially the ability to work in a team and oral and written communication. The latter two were not rated highly by first years as it was up to each group to decide on the role of each group member in the formal presentation of the project outcome and written report. Overall, 65% of both first and third years strongly associated the skills they had learnt with their usefulness in their future profession. Most students agreed that the

assessment criteria were clear and the work load was about right. However, a substantial proportion (approximately 10-15%) found the course overly demanding in terms of time and effort and this may well be a characteristic of groupwork where extra time is needed for organisation, co-ordination and integration of efforts in comparison to individual work (Rebelsky and Flynt 2000, Brown and Dobbie, 1999).

## 9 Third Year Students Perceptions of their First Year Experience

Although the data presented in this section is retrospective, it is still interesting to note students' reflections on their first year experiences from their third year perspective. Most students valued their first year group learning experience from both an educational (I learnt a lot 65%) and social viewpoint (I made friends 70%). However, groupwork was challenging (70%) and difficult (45%). Most students felt they had learned to learn independently and from their peers and had developed planning skills. The strongest disagreement was registered with Blue being a first good language to learn (16.1 %), as some students would have preferred to have learned Java. Some students also felt that they did not have enough support from staff in their first year learning experiences.

Most students recorded a definite and significant improvement in interpersonal and self-evaluation skills associated with groupwork between first and third year. For example, there were dramatic improvements in their assessment of the following areas:

Groupwork helps me find out about my own strengths and weaknesses;

I learn more in a group situation where we have to find the solutions;

I can encourage and help other group members;

I am able to confidently give my opinion to the group and justify it;

I learn a lot by listening to and questioning other group members.

However, students were more ambiguous in areas that related to their own and other members' contributions (I rely too much on other members to do the work. In a groupwork assignment, I do more than my fair share of work. I work better on my own than in the group) and this suggests that these are still areas of concern for some third year students.

## 10 Discussion and Conclusions

It is clear that by the end of first year and more so by the end of third year that most of the students sampled have had increasingly positive groupwork experiences. Those experiences are rather varied. For example, in the first semester unit, students are encouraged to form diverse groups. Countering this is the timetable, which tends to create tutorial class groups which are homogenous in their set of associated units. This is an explicit timetabling policy to overcome the problems of isolation and

loneliness in the first year. Students are allocated classes with a group of students so that they will spend most of their small group teaching with those students. Also, the split between regular and advanced classes tends to create advanced class groups that are generally more motivated and ambitious while the regular class is less homogenous. Over the three years of study, different units apply different group formative policies. This means that most students will have experienced several forms of group composition by their third year as well as varying degrees of success in groupwork.

Despite the generally positive groupwork experiences of most of the students sampled, unsatisfactory groupwork experiences were reported by a significant minority of students. In addition, the data from the third year sample has to be treated with caution as the sample size is too small to make generalisations. As a result, our evaluations have raised a number of issues for both students and staff.

First year students' lack of knowledge and experience both in terms of groupwork and programming present special challenges. Managing and taking responsibility for the successful completion of a group task is a new experience for many first year students and, although two thirds of our sample reported having some prior experience of groupwork, it is doubtful whether they had been taught groupwork skills or engaged in any structured reflection on what they had learned from the group process and how this may have contributed to a successful group product. It is also likely that, for many students, their past groupwork experiences did not involve an understanding of the special requirements of a team approach to solving a programming problem while at the same time learning the object oriented programming language in question, namely Java. The most critical issue for students was the management of task allocation within their group, primarily in terms of developing a fair and transparent approach to the allocation of tasks and ensuring delivery. Linked to this were problems in time allocation to the task as well as ensuring group members could and did attend meetings. An additional problem for first year students was managing the widely disparate range of programming knowledge within their group as well as diversity in terms of cultural and language backgrounds.

In response to these problems, changes are being made in the teaching approach to the first foundation unit, Problem 1, so that it is partly used as a way of modelling groupwork, both in terms of the group skills as well as the programming knowledge needed for successful completion of the task. In this way, students' initial experience of groupwork is strongly guided by tutor feedback and intervention at each stage of the groupwork process, for example, in deciding on an overall problem solving approach, planning for this, dividing up work fairly and integrating work. In addition, the questionnaire and focus group discussions from this study have been adapted for development of additional resources for teaching groupwork skills, namely reflection on groupwork experiences at key stages in the group life cycle with a particular focus on group process, dynamics

and contribution as well as understanding the role diversity - in knowledge, culture and language - plays in these areas.

The current study also serves as a base line for assessing the effectiveness of our attempts to teach groupwork skills within the context of teaching the content of our discipline and also our management of the group learning process in a large first year foundation course. Much of the teaching in groups and group management depends on the tutors for its success as it is the tutors who work continuously with their groups, monitoring progress and problems. Tutor turnover is high and tutors typically come with little or no training or experience in teaching or group facilitation and management. Therefore on-going tutor training, back up and support is essential if groupwork is to succeed. In general, the tutors in this survey felt their teaching had been successful or quite successful and they were comfortable with teaching. Although they were satisfied with the back up and support they were receiving, they were less sure that this had helped them with their development as teachers. Clearly, this indicates the need for additional tutor training. However, finding time and resources for training a large group of tutors - usually about 60 - is an on-going issue.

The main contribution of this paper is the report of a detailed study of student perceptions of groupwork skills development across the first semester, the first year and the third year of an undergraduate program. Our questionnaires and focus group activities can serve as instruments with value from both a teacher and student perspective. They can be used as a teacher's evaluation tool, as reported here. Equally, they can be used as the basis for classroom activities and discussion to encourage students to reflect upon and learn from their groupwork experiences.

In our future evaluations of student satisfaction with groupwork, we need to investigate cross-cultural experiences of groupwork processes and learning since a significant number of students entering first year computer science are from Non-English speaking backgrounds - 50% in our sample. Although this did not appear to be a significant factor in our data analysis, these students enter university with a range of oral proficiencies and this may well impact on their ability to engage successfully in group processes and hence in group learning. In addition, true longitudinal studies of the development of groupwork skills over the undergraduate years are rare in the literature. Therefore we need to follow our student cohort into their third year before we can argue conclusively that by third year they have substantially better and more mature views of their development as team members.

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