December 2005

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Recommended Citation

Blackshaw, Rebecca and Latu, Savae, "Group Work and Group Work Assessment for Computer Courses: A Systems Analysis and Design Case Study" (2005). *ACIS 2005 Proceedings*. 43.
http://aisel.aisnet.org/acis2005/43

Group Work and Group Work Assessment for Computer courses:
A Systems Analysis and Design Case Study.

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Abstract

Group work and group work assessment in higher education has been discussed, researched and written about widely. One of the driving forces behind the design and assessment of group work has been the need to expose, familiarise and equip students with the skills that they must possess to combat real world situations. Despite the call from employers for graduates who are able to communicate effectively with stakeholders from diverse backgrounds and who must be prepared to work within or direct a team, assessing individual contribution to group activities appears to be the most inhibiting factor that repressed some academics from implementing the idea. Moreover, some critics who conduct group work and carry out group assessment are simply doing that because they are required to do so.

This paper supports the established conviction that the ability to work as part of a team is one of the prerequisites for securing employment in the computing industry. The authors, both industry and teaching practitioners, use systems analysis and design as a case study to support their claim that computer professionals must be trained to be able to speak the languages of businessmen, politicians, technicians, computer users, managers, and so on. The study reported in this paper found that while students preferred to put themselves into groups (self select), teachers should be involved and give students guidance about the capability of each individual student and the various skills that are needed to complete group activities. The study also found that when it came to assessing group work, teachers were not considered by students as the experts in assessing group work because they did not know much about the contribution made by individual members of the group. The paper therefore recommends that self evaluation, peer assessment and individual assessment techniques should be used when assessing group work.

This paper is a contribution towards increasing the awareness of the importance to include group work as an integral part of preparing computer professionals for survival in the wider business environment.

Key Words
Group work, Assessment

INTRODUCTION

The subjects of learning through group work, and assessing group work in particular, have been discussed, researched and written about for years. The University of Technology Sydney (UTS), (1999) states that one of the contributing factors for the increasing demand for group learning has been the pressure from employers for multi-skilled graduates who are able to communicate effectively beyond their discipline base. Furthermore, Miller (2002) states that employers are increasingly looking for the ability to work in and direct a team as a key graduate skill. In support, Parsons & Kassabova (2002) state that employers value teamwork skills, and as part of professional practice, a graduate needs to be able to critically evaluate their own work and that of their peers. Accordingly, Burd & Drummond (2002) maintain that group work activities offer an ideal learning environment and a realistic situation for preparation for employment.

The motivation for this paper arises from the call from the Information and Communication (ICT) industry that computer professionals should not only possess the skills for designing systems and coding application programs, but must also be able to cooperate effectively with others in the work place in order to minimise development time. Therefore, it is of paramount importance that computer professionals must be able to

communicate and work together with system users, so that they may be able to design, build and deliver systems to the satisfaction of their clients. Since a number of students have expressed serious concern about the way in which group works are assessed and marked, it is therefore necessary for academic institutions to design and develop effective mechanisms with which to conduct and assess group activities.

This paper, after reviewing some of the relevant literature, presents a brief overview of group work and group work assessment in a Systems Analysis and Design (SAD) course in an undergraduate programme at Unitec New Zealand. The assessment for this course is 90% group work. The authors interviewed staff members about their views of group work and more importantly how they assessed group activities. A questionnaire was also given to fifty students, soliciting their opinions and experiences in relation to working in groups and how they felt about the way in which their work had been assessed. Finally, recommendations are proposed for the improvement of the current group work arrangements and the way in which group works may be assessed.

GROUP WORK and GROUP WORK ASSESSMENT – An Overview

Group activities can be employed to promote deeper learning and support student autonomy by transferring some of the responsibilities for teaching and learning to the students (Freeman, 1995). Moreover, Bourner, Hughes & Bourner (2001) claim that group work provides a vehicle whereby students not only develop skills experientially, but also are involved in deeper approaches to acquiring knowledge rather than surface or rote learning. However, Mills (2003) cautions that it is only when group work is well organised and functional that it will readily develop and enhance students' cognitive skills. According to Mello (1993, cited in Gatfield 1998) the five major advantages for students working in groups are:

1) Students gain insight into group or team dynamics.
2) With group assessment there is an increased development of a more comprehensive assignment.
3) Students' interpersonal skills, such as negotiation, team work and collaboration skills are further developed.
4) Students are exposed to others points of view.
5) Students are more prepared for the real world.

In relation to computer courses, Gardner (2003) complements Mello's conviction by stating that some of the benefits that may be obtained through organising students to carry out software projects in groups are:

1) Group activities allow students to participate in developing software of much larger scope than they can achieve by working alone. Students completing a group project may feel greater pride in seeing what they have accomplished.
2) Some software engineering activities, such as requirements discovery, requirements analysis, systems design and prototyping are difficult for individuals to carry out effectively on their own, and most activities benefit greatly from group review.
3) Working in groups helps weaker students learn theory and practical skills, because the more able students in a well-functioning group will explain the theory and demonstrate the skills. This benefit can be enhanced by intentionally forming the groups with students at different levels of competence.
4) Group work develops vital communication and relational skills that will be essential for success in students' future careers.
5) Group activities imitate the style of work that graduates will encounter in information technology projects, so they will benefit by getting prior exposure during their education.

Pertaining to assessment, Miller (2002) argues that the first and probably the most important step in designing assessment is to identify and evaluate learning objectives or the key skills and knowledge that teachers expect students to acquire from particular courses. With regard to assessing group work, Boud, Cohen, & Sampson (1999) affirm that assessment is the single most powerful influence in learning from formal courses and, if not designed properly, it can undermine the positive aspect of an important strategy in the repertoire of teaching and learning approaches.

Issues associated with group work and assessing group work

While Strachan & Wilcox (1996) announce that the educational literature is littered with ideas and methods of assessing group work, Reif & Kruck (2001) argue that the issue of assessing individual students' contribution to their group activities is problematic, because group members do not contribute equally to a group's success, and that lecturers normally make few or no observations to assist them in evaluating and determining the students' level of contribution to their group's ultimate success. Consequently, Conway & Kember (1993) have stated that if some members of a group are not co-operative and fail to perform their assigned tasks, the workload of other

group members may be too heavy to be accomplished successfully and the quality of the final product can be adversely affected. UTS (2004) claims that despite appearing easy, assessing group work can be extremely difficult because, no matter how teachers derive an individual member's mark, some members will always complain that they have been disadvantaged by the poor efforts of their fellow group members.

According to Race (2001), group assessment involves the assessment of the product of students' group work by the teacher, or the assessment of the product by fellow students from other groups (inter-peer assessment), or the assessment of the group work by students within a group (intra-peer assessment). With regard to computer courses, Lejk, Wyvill, & Farrow (1997) have stated that the nature of work in the computer industry requires a good deal of team activity. However, Schwalbe (2004) warns that the culture of computer professionals portrays them as nerds who like to hide in dark corners, hacking away on computers, and when they have to communicate with non-computer professionals, they act and talk as if they are talking to someone from another planet.

Lejk *et al.* (1997) further state that since computer products are so large and complex, and their development requires a team approach, group work and group assessment should be featured in most courses within computer and ICT related courses, especially in the first and second year of undergraduate study. However, Rothwell (n.d.) argues that group work and peer evaluations may not be appropriate for the first year undergraduate students because they may not possess the necessary prerequisites to handle group dynamics.

In endeavouring to formulate strategies which can be used to run and assess group work effectively and efficiently, the authors came across the following issues:

Issue	Cause/Effect
The make-up of the group when students are allowed to put themselves into groups.	May not promote sufficient diversity and communication amongst students to allow them to broaden their sphere of operation
Inequality of contribution and capability within the group. Some students are not pulling their weight while others are overloaded	Some students are not giving real evidence of their understandings of the subject matter to be investigated
Dissimilar intentions for outcomes/grades (I want the highest I could achieve versus I just want a pass)	Aspirations and efforts of the high achievers are not served or met. Some 'A' students worry that the group will affect their grades
Group size	The larger the group, the more likely that there will be free loaders. More active students dominate the discussions and decision making while quiet students tend to be ignored
Academic integrity	If one person in the group is at fault, the whole group will take the blame

Table 1. Issues associated with group work at the School of Computing and Information Technology (SCIT), Unitec New Zealand

CULTURAL ISSUES

Some indigenous cultures lend themselves perfectly to group activities such as those of Asia and the insular nations of the Pacific, while others appear to be immunised from group work when it comes to class work. The extended family concept, practiced in most developing societies, requires that an individual member of an extended family or clan has social responsibilities and is obliged to discharge his/her responsibilities according to the prevalent rules and norms of that particular society or family. It is observed that most Asian and Pacific Islands (PI) students prefer to study in groups so that they collaborate and help each other. Even when they attend lectures, they usually congregate from the middle to the back of lecture theatres, where they can talk to each other in their own languages. This mirrors children's place in most PI social frameworks where children are told to position themselves away from senior members of authority especially in public gatherings.

With regard to PI background students, in New Zealand, Latu and Young (2004) claim that culturally, PI students are not problem-based learners but are a combination of experiential and collaborative (working in group) learners. Collaborating learning has been defined in Bruffee (1983) as a reacculturative process that helps students become members of knowledge communities. Furthermore, the process enables two or more students to help and support each other to reinforce and expand their ability to comprehend the challenges, risks and opportunities that they may face in their career.

PI and Asian students suffer most of the time, academically, from language deficiency. Moreover, poor English reading and comprehending abilities, together with a lack of essay or report writing skills, affect their academic performance. Since some PI and Asian cultures are shame cultures, most PI and Asian students at tertiary level, may be reluctant to participate in class discussions, to ask questions or argue a point, simply for fear of exposing their language problem and lack of understanding. When more than one PI or Asian student are doing the same course, it is likely that the less able student will ask their more fortunate counterparts for clarification and help after class. This is why we often find small study groups of PI and Asian students, especially when they are preparing for exams or doing assignments.

THE SURVEY

The fourfold aim of the survey was to determine:
1) how students from different cultural backgrounds feel about group work,
2) whether group work contributes and enhances students' understanding of the content of the course,
3) whether students developed the skills that experts claimed group work would provide,
4) what were the students preferred modes of assessing group work.

The course chosen to be used for this study was a final year course for students undertaking either a Bachelor of Computing Systems (optional course) or a Bachelor of Business Studies (compulsory course) with a major in Information Systems. The course was an eighteen-credit course and ran for one semester with a total of 182 learning hours including lectures, tutorials, and self-directed learning hours.

The course had only one assessment, a group project consisting of 5 tasks: analysis, design, prototype, presentation, and individual reflection. The first four tasks were worth 90% of the total mark for the course. At the beginning of the course the students were asked to form groups of three. Each group was given a project as part of the programme for work in an IT consultancy. The tutor assessed the performance of each group throughout the semester by checking the group project plan and by acting as the Programme Director for the work undertaken. Each group member had an equal share of the product of their collective work.

The survey was conducted through a questionnaire, which was designed to enable students to provide relevant data that would allow the authors to address the purpose of the study. The questionnaires were hand-delivered to the students to ensure appropriate that cultural protocols were adhered to, and that the students would give their utmost attention and provide reliable answers to the questions therein. It was assumed that a request made in person would be given special attention when compared to a non-human delivery approach.

In the first few questions of the questionnaire, the students were asked to state their ethnic background and whether they preferred to work in groups or alone. These questions were designed to gather data about how students from different cultural backgrounds feel about group work. Copies of the questionnaire were distributed to 50 students enrolled in the course near the conclusion of their assessment items. One week later the questionnaires were collected from the students, with a response rate of 68%. The students were guaranteed confidentiality of the survey and told their responses would have no effect on the final grade for the course.

The Result

Survey Analysis	Result	Comments
Ethnic Background	Asian 65% European 23% Polynesian 12%	 (Includes PI & Maori)
Prefer to work alone and/or in groups	41% agreed	55% Asian 16% European 29% Polynesian
Work marked by others in the group (Peer Assessment)	50% agreed	47% Asian 29% European 24% Polynesian
Teachers to select students for groups	79% opposed	34% Asian 30% European 36%Polynesian
How marks should be distributed • Level of students contribution in group for marks. (Weighted marking) • Group work assessed on individual basis • Marks equally distributed	 41% 38% 21%	33% Asian 29% European 38% Polynesian 34% Asian 55% European 11% Polynesian 33% Asian 16% European 51% Polynesian
Free riders/slackers- identified/penalised	94% agreed	32% Asian 37% European 31% Polynesian
Peer Assessment form part of an overall course assessment.	76% agreed	45% Asian 23% European 32% Polynesian

Table 2. Summary of the survey

Overall, 71% of those in favour of peer assessment were PI and Asian students and 29% of European descent. This scenario exemplifies the communal (the extended family concept) and individualistic (the nuclear family concept) aspects of the different cultures involved.

Also noted is the high percentage of Asian and PI students who preferred to work in groups.

Culturally speaking, it is interesting to note that in the section of 'How marks should be distributed, Polynesian students weighted towards 'Marks to be equally distributed', European students weighted more in the 'Group work assessed on individual basis', and Asian students were more evenly spread over the three options.

MANAGING GROUP WORK - An approach

As information is made up of discreet but interrelated data items, an information system is made up of related subsystems including skilled people to make the system work, as well as those who use the information (the users), hardware, systems and application software, communication infrastructures, network technologies, and money to keep the system up and running. All these are needed to generate and provide the necessary information in a timely fashion. Accordingly, different skill sets are required to analyse the needs for a new system or to upgrade an existing system. To design a system to suit the requirements of its intended users, and to construct, implement and switch the system from development to operational mode with appropriate support, it is therefore necessary for teachers of information systems to not only train students in specialised fields, but also make sure that those specialists will be able to contribute their skills and work together toward a common goal in the real world, hence the need for students to learn and develop group or team work skills.

Even though group work has been promoted as one of the prerequisites for students' long term survival in the work place, managing group dynamics is not an easy task for students and teachers alike, especially when it comes to assessing individual contributions toward the achievement of the group objectives. The authors believe that one way of assessing individual contribution to group work, and understanding the subject matter of the

group work (assessing the product as well as the process), is to interview each member of the group to gauge his/her general understanding of the processes and the products of the group activities. Moreover, peer evaluation of each member's contribution by the rest of the group will provide teacher's insight to group's dynamics. Other issues such as selecting and designing group activities, forming groups, managing group dynamics should be considered and done carefully if we are to ensure that we have achieved the primary objective of introducing our students to group work.

Choosing and Designing Group Work

When choosing topics to be used as instruments through which students will develop and learn more about working in a team environment, it is important for teachers to remember that the object of the exercise is for the students to gain experience and be able to play their individual roles, efficiently and effectively, so that others can do theirs. It often happens that students are exposed to group dynamics when they are asked to discuss issues during lecture or tutorial sessions. However, when students are required, as an integral part of their training, to learn the skills that are needed to run and maintain a well functioning group such as listening, negotiating, managing, participating, planning, leading, controlling and following skills, it is important that group activities be designed in such a way that the students not only capture the needed skills for group work, but also learn more or dig deeper into their specialised fields and how their individual fields (the parts) can be integrated to form a whole system.

Group Formation

In its strictest sense, Isaacs (2002) claims that group formation is not an assessment issue. Rather, it is more to do with managing group activities. Concerning group formation UTS (1999), after stating that there is no single best way of setting up groups, suggested that possible methods for forming groups include:

- Random allocation using class lists, coloured cards, numbering systems and so on.
- Stratified random allocation, where students are divided into categories (eg from different disciplines or cultural backgrounds) then groups are formed by randomly selecting members from each category.
- Helping students form comfortable social or interest groups, based on "common interest" icebreakers or similar.
- Defining the different roles which will be needed for the group task and selecting students for groups based on role preference.
- Forming groups based on common meeting time or geographical location.
- Where possible, forming groups for large projects should be made of students with a range of complementary skills and backgrounds. Teachers and students need to be aware of individuals' strengths and preferences.
- Avoiding, if possible, groups where all students except one belong to the same social or other sub-group.

The survey reported in this paper found that 79% of those that responded to the questionnaire strongly opposed the idea of allowing teachers to put them into groups. The authors recommend that students should be guided on how to choose or look for others to form a group, before they are allowed to start forming their groups. Students should be reminded that the assessment of their work would focus on group activities, the processes involved in producing the final output, and how well each member contributes towards the final outcome, but not on the individual group member. When forming groups, Brown & Thomson (2000) suggest that there is a range of elementary skills needed for groups to get together and begin their work, such as moving into groups, courtesies of using each other's name, giving eye contact and encouraging each other to participate. It should be noted that the most effective groups are those where each individual knows and respects the others in the group and their roles. Also, everyone should clearly and unambiguously understand their unique role and perform those roles effectively in minimum time and with minimum but appropriate resources. In general, the number of alternatives for determining group membership include self selection or friendship based groups and staff assigning students to groups. When assigning students to groups, teachers should consider geographical distribution and proximity of the students and also identify students who have employment or family/community responsibilities.

Controlling Group Activities

Controlling involves monitoring and measuring group actual progress against planned actions and taking corrective actions to harmonise the performance of the group, to make sure that they work towards a common goal. Each group should have a group leader to manage group activities, similar to the roles played by project managers when managing projects. Mature, more capable students and students who have/had work experiences are suitable candidates for such roles. The leader must be able to cope with complexities but know where to go,

how to get there, what is the best mode of transport to get there given all the circumstances, and what resources are needed for the group to reach its destination. The leader should possess the qualities of a generalist and 'know a little about everything'. Group leaders should also be reminded that their job is not so much to police people, but to provide support and resources so that others can perform their tasks successfully.

Assessing Group Work

As shown in the result of the survey presented earlier in this paper, 41% of the respondents agreed that weighted marking approach should be applied. Furthermore, 38% suggested that group work should be assessed on an individual basis and only 21% proposed that the same mark allocation approach should be the norm. 76% of the respondents agreed and felt comfortable allowing other students to assess their work. A comprehensive and excellent survey of the methods of deriving individual marks from group assessment is presented in Lejk, Wyvill, & Farrow (1996).

Regardless of the assessment method used, whether individual assessment, self assessment, peer (inter or intra) assessment, same mark allocation, or weighted mark allocation, some students will argue that they should have done better, and achieved higher grades, if they worked alone. If the 'same mark allocation' or 'weighted mark allocation' is to be employed, teachers must be able to make an appropriate judgement of each member's contribution and level of participation in group activities. Because teachers do not have a good understanding of the level of participation of individual members in a group, it is therefore necessary that self evaluation and peer assessment techniques should be used to supplement the teachers' ignorance and harmonise the assessment efforts. However, Miller (2002) cautions that peer assessment should be anonymous, with teachers randomly choosing students so that friendship cannot influence the process.

Students assessing contribution of fellow students to group work- peer assessment

Assessing students' participation and contribution to group activities and the eventual group's success is not an easy task for teachers. Accordingly, students are now encouraged and asked to evaluate and judge the involvement and contribution of fellow students in the work of group assignment/project. After reviewing the techniques used at Unitec's SCIT Master of Computing programme, Hong Kong universities and the University of Central Lancashire on the subject of peer evaluation, the authors propose that, given the nature of systems analysis and system design, a more rigorous and thorough approach should be devised. The new approach has to be trusted and reduce students' criticism of the marking system thereby relieving pressures on teachers.

The Systems Analysis and Design group project has been designed to be divided into and would be assessed on four main tasks, as illustrated in Table 3.

Task number	Task Name	Task Mark	Comments
1	Systems analysis	35	Group activity
2	Design and prototype	35	Group activity
3	Formal presentation	10	Group activity
4	Individual performance evaluation/reflection	20	Individual activity
Total		**100**	

Table 3.　　　　Tasks and marks for Systems Analysis and Design group project.

The method proposed in this paper involves assigning a single mark for each report/product. Each group must submit a single group report and demonstrate the prototypes after each iteration for their project. Each student is then asked to peer assess the involvement and contributions of his/her fellow group members on the first three tasks, in Table 3 above, on a scale of 0 (no involvement) to 10 (outstanding performance).

For example, assume that we have one group consisting of the following three students: Mary Baker, Wang Ho and Ramani Lal and they have peer assessed each other as shown in Table 4 below.

Student Name / Task	Mary Baker	Wang Ho	Ramani Lal
Systems Analysis	8 + 7 = 15	4 + 6 = 10	6 + 6 = 12
Design and Prototype	7 + 8 = 15	8 + 8 = 16	7 + 8 = 15
Formal Presentation	8 + 7 = 15	6 + 5 = 11	7 + 5 = 12
Total individual score	45	37	39
Average group rating: 121/3 = 40.33			
Student's participation factor (individual score/average group rating)	1.12	0.92	0.97
If the report received 68 marks the student's contribution to his/her final grade is (peer assessed)	76	63	66
Tutor's assessment of student participation on meetings with clients and knowledge of the process and prototypes (process assessment)	0.8	0.8	0.9
Total marks gained from the report	61	54	59
Project Log including not attending group meetings with client (out of 20)	14	16	12
Student's final grade	**75**	**70**	**71**

Table 4.   An approach for assessing group assignment

The tutor's assessment of student participation in meeting with clients and knowledge of the process and prototypes is an element that is introduced in this approach to guarantee that friendship issues and any agreement between students to give each other high marks is dealt with carefully.

RECOMMENDATIONS

Pursuant to the above discussions the authors recommend that:
1. Criteria for assessing group work should be considered when designing group works, and the assessment techniques should be made clear to the students at the beginning of their work.
2. Inter and intra peer assessments of group work should be formulated and introduced as integral parts of the assessment procedure.
3. Multi-skilled and multi-cultural issues should be taken into account when forming groups to reflect the situation in the real working environment.
4. Lecturers should be involved in setting up groups for students and making sure that clear group ground rules, procedures, policies and guidelines are in place to ensure that the groups are functioning effectively. The group, with the help of the teacher, should choose a leader to manage the group.

CONCLUSION

The study that triggers the production of this paper shows that developing and assessing group work definitely needs careful planning and monitoring if the quality of student learning is to be enhanced. The literature that has been reviewed reveals that there has been work done in the area in an effort to provide students with opportunities to develop key skills and qualities that are required by potential employers. Views of students involved in group work, on group work and the associated assessment procedure, were secured through a questionnaire. In addition, lecturers' views were solicited via a semi-structured interview. Finally, recommendations on how to improve the current assessment mechanisms to discourage 'free-riders' and enhance student's learning and communication skills are presented.

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