

What are the perceptions of civil engineering lecturers towards using cooperative learning?

Dr. Aoife Ahern
School of Architecture, Landscape and Civil Engineering
University College Dublin
Ireland
Aoife.ahern@ucd.ie

Abstract - This paper examines the use of group learning in civil engineering courses. The objective is to examine how common the use of group learning in civil engineering courses is and why it is used. The paper will also look at how group learning is implemented by lecturers and if that implementation maximizes its potential benefits. Finally, the paper will address the reservations held by lecturers regarding group learning and examine if using a more structured approach to group learning, such as cooperative learning, would address some of these reservations. In engineering and technical courses, the use of group work is relatively common. This paper will examine how common its use is in civil engineering departments in 3 Irish universities and will look at the perceptions of lecturers to group work and cooperative learning. One reason that is often given for using group work is that students learn the “softer” skills that they need to be good civil engineers: they learn to work in teams, they learn how to communicate and they learn how to solve problems in a group. However, what evidence is there that simply asking students to work in a group will bring about good teamwork skills or will result in good communication skills? If students are still assessed individually and there is no perceived reward for working in teams, surely the advantages of group work may be lost? There is a lack of awareness of how group work can be structured to ensure maximum impact and lecturers have serious worries regarding the academic and educational value of work submitted by groups of students. This paper looks at the use of group work by civil engineering lecturers and postulates that using a more structured form of group work, such as cooperative learning may achieve the objectives the lecturers set out for group work and may overcome some of the reservations, as outlined in the survey below, that lecturers hold towards group work.

Index Terms – Cooperative learning, Group learning, Perceptions of learning.

INTRODUCTION

Group learning is widespread in civil engineering courses, where students are asked to work in pairs for laboratory exercises and in groups for case studies and design studies. Group work is used in civil engineering courses to allow students to learn those softer skills that they need to be good civil engineers: communication skills, team-work and how to solve problems in a group [1].

However, many lecturers have negative perceptions of group work – seeing it as a necessary evil. Students must participate in group work in order to learn certain skills but the assessment of that group work is difficult and many lecturers see assessment of group work as being unfair. Therefore, students are still assessed individually and there is often no perceived award for working in teams. If students are still assessed individually and there is no perceived reward for working in teams, surely the advantages of group work may be lost? As Felder and Brent [2] state “there must be a better way of getting students to work together than simply putting them in groups and asking them to do something.”

This paper describes a survey into the use of group work by civil engineering lecturers in 3 universities. It postulates that using a more structured form of group work, such as cooperative learning as defined by Johnson, Johnson and Smith [3] may achieve the objectives the lecturers set out for group work and may overcome some of the reservations, as outlined in the survey below, that lecturers hold towards group work.

GROUP LEARNING AND COOPERATIVE LEARNING

The definition of cooperative learning in this paper is that given by Johnson, Johnson and Smith [3]. Group work involves a number of students working together on a project or problem, while cooperative learning, involves people working in teams under the following very particular conditions:

- Positive Interdependence – all team members rely upon each other. Positive interdependence can also be structured by ensuring that the team has mutual goals, joint rewards and shared resources [3]. This can be ensured by forming groups are heterogeneous in ability

levels and chosen by the lecturer. In addition, students should be given pre-defined roles within the group. These roles should be rotated from one session to the next. Each student needs the each other member of the group to perform his or her tasks adequately in order for a high mark to be achieved. In addition, lecturers can question any member of the group on the project or piece of work and therefore, each member of the group needs to understand what has been taking place.

- Individual accountability: each team member must have some individual accountability for the work that is presented. Ensuring individual accountability can be done by examining each student in the group on all the work carried out within the team. Peer ratings of team citizenship can also be collected which are then applied to team grades for individual grades to be determined.
- Face to face promotive interaction –some work must be done as a team and not parceled out to individuals in a group.
- Appropriate use of collaborative skills: Students need to develop and use communication skills, decision-making skills, conflict management and teamwork.

Simply putting in place group work is not the same as using cooperative learning in the lecture theatre. By ensuring that these conditions are present in any group work or teamwork, lecturers can help students to learn the softer skills required by civil engineers – good communication skills, teamwork, and lifelong learning.

THE SURVEY

The lack of the use of cooperative learning in civil engineering departments may be due to a lack of understanding of what is cooperative learning. It may also be that the negative perceptions that civil engineering lecturers have towards group learning may be due to problems that could be overcome using cooperative learning. In order to study these ideas, a questionnaire has been issued to lecturers in civil engineering departments (University College Dublin, Trinity College Dublin, and University College Cork) in Ireland.

The purpose of this questionnaire was to establish how familiar lecturers were with group learning and also with cooperative learning. The questionnaire looked at whether lecturers used any form of group learning within their classes and what the objectives of introducing group learning were. Lecturers are firstly asked to describe if they use any form of group work or teamwork in their courses and to describe

what that work is. If they use group work and teamwork, the lecturer is asked to describe the objectives they hope to achieve using that work and the skills it is hoped the students will learn. The lecturers are asked is how the group work is assessed and what the theoretical background to the work is. They are asked how the work is structured in terms of individual accountability. All lecturers, whether they use group learning or not, are asked to state whether they are aware of the term “cooperative learning” and what they think it means. They are also asked to describe their reservations regarding group work. Lecturers were asked about “group work” rather than cooperative learning specifically, as the objective is to discover the perceptions of lecturers towards group work, to uncover how many are using group work to teach students teamwork and communication skills, and to find out if they structure this work in any particular way in order to ensure those skills are learnt. The author hypothesizes that many lecturers are using group work to achieve these skills but do not structure the work in a particular way and are unaware of what cooperative learning is or what it entails.

The questionnaire was sent to the civil engineering departments in Trinity College Dublin, University College Dublin and University College Cork. There were 20 responses.

RESULTS

This section outlines the results of the survey. The objective of this survey was to uncover the perceptions of lectures to group learning and to establish how they implement group learning to maximize its impacts. The level of awareness of cooperative learning is also examined. Table 1 shows a summary of lecturer responses.

TABLE I
RESPONSES

Question	Yes	No
Do you ever ask your students to work in pairs or groups in any of your courses?	20	0
Do you use group work to assess students' performance?	17	3
Awareness of educational theories?	2	18
Do you ensure that there is positive interdependence in your groups?	3	17
Do you ensure that there is individual accountability in your groups?	2	18
Is any of the work done interactively?	20	0
Do you teach your students how to use collaborative skills for group work?	2	18
Do you encourage your students to reassess their group goals and to examine what they are doing as a team on a regular basis?	1	19
Have you heard of cooperative learning?	0	20
Do you think you need training or help in introducing group learning into the classroom?	18	2

None of the respondents were aware of what cooperative learning was but all used group learning in their classrooms. Some use groups in laboratory work, others use groups for in-class exercises while others use group work for students to work on projects outside of the classroom.

The sizes of the groups formed by lecturers range from 2 students to 8 students in a group. Most researchers (Felder and Brent, 2003; Johnson et al, 2000) recommend that groups comprise no more than 5 students but groups of 6-8 students were most common in these civil engineering courses. Lecturers stated that this was due to the large class sizes and lack of time and resources, which would allow more and smaller groups.

All lecturers, except for one, allowed the students to select themselves or used random allocation to form the groups, although one lecturer used results from examinations to ensure groups were of mixed ability. No other lecturer mentioned that this was important in forming the groups. This was despite the fact that several lecturers later mentioned that in some groups there were problems due to too many strong or weak students being in the group. One lecturer stated that he had allowed students to pick their own groups in the past but that he found that female students were often not given the opportunity to voice their opinions in predominantly male groups. This is a factor that Felder and Brent (2003) discuss at length. They advise that groups

should be formed by lecturers and should be mixed ability. In addition, they state that minority students (females or ethnic minorities) should not be put into groups where they are in the minority as their research has shown that these students are not given the chance to voice their opinions or to put forward their ideas within these groups.

The group work was usually assessed – only 3 lecturers did not assess the group work – but all lecturers stated they had difficulties with the assessment of group work. For this reason, group work in all cases comprised only a small percentage of a student's overall mark. As one lecturer stated:

“The group report is marked but I feel that this is a flawed method. I think group work is important for students to learn skills but it is unfair. To address the lack of bias and the unfairness of this I give only a small number of marks for the exercise and the exam has lots of marks.”

Another lecturer stated

“I assigned 10% of the final mark to group performance. The work is actually worth more as the project is quite big. But I think it's unfair. I got so much resistance from students about having their marks dependent on others.”

This opinion was very common with lecturers feeling group work was important for students to learn skills and that it had to be assessed to be of any academic value but that it was dangerous to allow it to count for too much as it was “unfair”, in particular on strong students: “assessment of group work is so difficult. It tends to level out the strong and weak students and rewards the weakest students.” Lecturers were unaware of the concepts of individual accountability or positive interdependence as outlined in Johnson et al's (1998) work, which can help for these difficulties to be overcome. When asked if they tried to ensure that there was positive interdependence and individual accountability, the vast majority said that they did not. It is not surprising, therefore, that they felt that stronger students were disadvantaged in groups and that group work was unfair. A typical response from lecturers was:

“This (positive interdependence) is impossible to ensure.”

“I don't see any way of ensuring individual accountability.”

Another lecturer stated:

“I do not ensure that there is positive interdependence or individual accountability. I would love to know how it is done. It is certainly possible for one student to do everything in the group work I set. Indeed there is anecdotal evidence that the group members take turns to do the projects.”

Many lecturers cite the difficulty of ensuring individual accountability as a major reason for not using cooperative

learning [4]. In this study, some lecturers had extremely negative perceptions regarding how to ensure positive interdependence and individual accountability:

“Positive interdependence and individual accountability – that’s very theoretical. It’s impossible. You can only do it if you have lots of supervision and I don’t have time.”

Researchers [5], [1] suggest several ways that ensuring positive interdependence and individual accountability, as outlined in the sections above. Both state that positive interdependence and individual accountability are absolutely essential to successful cooperative learning. Research has shown that a peer-rating system can be used to account for individual effort in group-work [4]. This research suggests that students are asked to rate themselves and their peers confidentially. Using this rating and correlations between ratings and self-ratings, weak students “piggybacking” on the work of others, strong students carrying the group, dysfunctional teams and teams where agreement to rate everyone equally were identified. This was found to be an excellent way of allowing for individual effort and found strong correlations between self-rating and peer rating, with self-rating more likely to be deflated rather than inflated [4]. In addition it was possible to identify weak students who used the group’s work to achieve good marks by identifying those students who consistently were awarded low ratings from others in their group. However, it is apparent from the responses of the lecturers in this study that many lecturers feel that it is impossible to take individual accountability into account and these lecturers are unaware of work like this [4].

Table II shows what they hoped to achieve from using group learning. At the start of this paper, it was stated that within civil engineering many lecturers use group work to achieve the softer skills required for being a civil engineer. From this survey, it was evident that this was very much the case with the lecturers questioned. All who responded stated that teamwork skills were being learned through group-work. However, these objectives were not the only reasons for using group learning and there were several lecturers who stated that along with these objectives there were more pragmatic reasons for using group learning such as large class sizes. Group projects meant that these lecturers could assign resources more efficiently and would have less marking to do than if projects were assigned individually.

TABLE II
OBJECTIVES

Objectives	Number of times this objective is stated
To encourage teamwork and to learn skills required for teamwork (dealing with conflict, allocation of tasks)	20
To encourage students to be able to work in multi-disciplinary settings	5
To allow more complex problems to be tackled	4
To become lifelong learners (learn from each other and themselves)	4
To encourage class participation	4
To allow efficient use of classroom and laboratory resources	4

When asked how these objectives were achieved, few lecturers had real strategies for ensuring these objectives were achieved. Most lecturers left this to the students themselves to ensure that teamwork skills were achieved. One lecturer stated that teamwork was achieved as otherwise “students would know that they would be ridiculed by class members” if the team was ill prepared for presentations made at the end of the year. Most lecturers used assessment to see if the objectives had been achieved. By examining the students’ performance, they felt they could ensure the objectives were achieved, although the assessment did not in any case mentioned by the lecturers specifically measure team work or teamwork skills. Instead, it was assumed that a group that achieved a high mark in the assessed work would have mastered these skills.

Table III shows the reservations held regarding the use of groups in learning and the obstacles that lecturers felt existed when they wanted to introduce group learning.

While all lecturers used group work in their courses, lecturers had some strong reservations about how useful it was and how difficult it was to introduce. Many of these reservations centered on topics already mentioned in this paper and most lecturers were worried about the lack of individual accountability and the lack of fairness to high-achieving students as has already been discussed.

“Care needs to be taken to avoid unfairness to one member of the group whose capability is substantially out of line with that of the group as a whole.”

Lecturers also expressed concerns regarding what they felt was the lack of support of using group learning (and other innovative techniques) within their classrooms. They had insufficient time to supervise or design group exercises and insufficient resources to implement exercises. The exercises also took up too much time within the class.

“The main difficulty with group work is devoting sufficient time to it within the module to make sure that it does achieve the required learning objectives. Resources for running these sessions are becoming issues with increasing numbers.”

Another lecturer stated: “I think team projects need more time input and organisation from the lecturer, and time is a precious commodity.”

While another stated that his schedule was already “too overcrowded” with research, administration and teaching for him to implement group work more effectively.

Only one lecturer had no reservations regarding group work, considering it to be extremely effective.

Table III
Reservations about group work

Reservations about group work	Lecturers who mentioned this
Lack of accountability	18
Lack of fairness to students in assessment	15
Takes too much of lecturers' time	12
Takes too much class time	8
Insufficient resources	8
Assertive students manipulating others	5
Lack of enthusiasm from students	3
No reservations	2
Gender divide in teams	1

The main objective of this research was to ascertain answer several questions:

Is group learning used in civil engineering courses and why? When used, is it being used to maximize its potential impacts?

Could cooperative learning help to address some of the reserves lecturers have regarding group learning?

It would appear that group learning is used extensively in civil engineering courses in Ireland but lecturers are not sure if its benefits are being maximized – with many lecturers worried about the fairness of the group learning, believing that it is impossible to ensure positive interdependence or individual accountability. However, using Johnson et al's (1998) model of cooperative learning there are many ways in

which positive interdependence and individual accountability can be introduced into group learning.

With this in mind, lecturers were asked about their familiarity with educational theories, cooperative learning and group learning techniques such as TAPPS and Jigsaw. Only one lecturer was familiar with any educational theories (social cognitivism) but was unsure what this theory meant. None had heard of TAPPS or Jigsaw or any other learning techniques.

In cooperative learning, Johnson, Johnson and Smith [3] state that the group should regularly reflect on how well they are working together, on what is working and what is not working in their teams and should be able to make changes to allow the team to work more effectively. Lecturers were asked if students were asked to reflect on these issues. Only 2 lecturers asked their students to reflect on the work done and on the team work process but did not ask students to do this in any collaborative way.

Finally, lecturers were asked if they felt that they needed help or training in introducing group learning. Only 3 lecturers said that they felt they did not need any help or training with most lecturers stating they needed help with the assessment of group learning.

To conclude, this section it appears that lecturers in the 3 universities recognize the benefits of group learning in terms of teaching students certain skills and all respondents use it in some form. However, the general opinion is that group learning is unfair to more able students, and cannot be used in assessment or should not make up a significant proportion of marks awarded to students. There is a lack of awareness of how positive interdependence or individual accountability can be ensured with most lecturers believing it is impossible to ensure these. The benefits of group learning are, therefore, not being maximized. The general opinions can be summed up the by following quote:

“The fundamental problem remains. Students are graded as individuals and group work blurs the contribution of individuals. Its unfair to the best students. Therefore, while group work is worthwhile and necessary for students to learn about work in the real world, I am reluctant to make students engage in an activity for which there is no academic reward and the students are also reluctant to engage in those activities”

This is despite significant research demonstrating how cooperative learning can actually improve students' performances.

CONCLUSIONS

This paper has examined the use of group learning in civil engineering courses. The objective were:

To establish if group learning is used in civil engineering in order to teach students the soft skills required by professional bodies.

To discover how group learning is implemented in civil engineering courses.

To examine the reservations held by lecturers with regard to group learning.

To examine if cooperative learning and a more structured approach to group learning could maximise its impacts on students' skills.

The research demonstrated that group learning is widely used in civil engineering departments but tends to be introduced by lecturers individually with little or no training and without being linked to assessment practices. While lecturers assess group learning, they are unlikely to allow it to contribute significantly to students' grades as they perceive it to be unfair to the highest achievers. They also tend to feel that it is impossible to introduce individual accountability into group learning or to make the assessment fair.

Lecturers use group learning, as students need to learn certain skills to be civil engineers that they do not learn in lectures or examinations. These skills include team working and communication. Lecturers assume that by introducing group work these skills will be learned. They do not structure the work in any particular way to ensure the skills are covered and they do not generally check if these skills have been learned.

While lecturers have a great many reservations regarding the perceived unfairness of group learning and the difficulties associated with assessing group learning, there is a lack of awareness of cooperative learning. Cooperative learning has been shown to have very positive impacts on students' learning, in particular in relation to the softer skills that it is the objective of the lecturers to teach their students when using group learning [2]. In addition, using cooperative learning could help lecturers address their difficulties regarding the unfairness of group learning and the lack of individual accountability. Many researchers [1], [2], [4], [5] give examples of how the conditions of positive interdependence and individual accountability can be introduced to group learning. For group learning to be effective, positive interdependence is essential [5]. Yet the lecturers surveyed generally felt that this was impossible. Team members should need each other to succeed so there must be some link between the performance of individuals and the group [3].

REFERENCES

- [1] Felder, R and Brent E, Designing and Teaching Courses to satisfy the ABET engineering criteria, *Journal of Engineering Education*, 92, No. 1, 2003, 7-25
- [2] Felder, R.M., and R. Brent.. Effective strategies for cooperative learning. *Journal of Cooperation and Collaboration in College Teaching*.10 No. 2 2001,: 63–69.
- [3] Johnson, DW , Johnson RT, Smith KA *Active Learning: Cooperation in the College Classroom*, Interaction book company. 1998
- [4] Kaufmann, D and Felder, R Accounting for individual effort in cooperative learning teams, *Journal of Engineering Education*, 89, No 2, 2000, 133-140.
- [5] Johnson, DW, Johnson RT, Stanne MB Cooperative learning methods: a meta analysis, 2000 Found at: <http://www.co-operation.org/pages/cl-methods.html>