# A Method to Increase Student Interaction Using Student Groups and Peer Review over the Internet

DILVAN DE ABREU MOREIRA and ELAINE QUINTINO DA SILVA
*Department of Computer Science and Statistics, Institute of Mathematics and Computing,*
*University of São Paulo, Brazil*
*E-mail: dilvan@icmc.sc.usp.br; elaine@icmc.usp.br*

*Abstract*

A method of peer review for student groups is proposed. In this method, groups of students publish their assignments results over the Internet. A fellow student group reviews their work and publishes their findings (on the Internet). Finally, the two groups debate their points of view in front of the class. The debate and healthy competition among groups give the students a chance to learn how to give and receive criticism in a constructive way. This should increase the students' ability to interact and work in groups, an important skill for computer science professionals.

**Keywords:** peer review, Java, student interaction, Internet education, social skills

## 1. Introduction

In the context of higher education, many efforts have been made to introduce Internet technology in the educational process, to take advantage of its communication and cooperation features. As a result there are many tools available today to produce multimedia material for the Web, such as the Classroom 2000 (Abowd, 1999), WebCT (Fuller *et al.*, 2001), etc. However, teachers are not sure how to use these tools to create effective models for teaching over the Internet. After a teacher puts classroom slides, schedules and other static information in his Web pages, what more can this technology offer?

The first author has been using Internet technology to teach a variety of computer science classes. And, since 1997, he has been using and refining a teaching method based on student groups and peer review. This method is used today, side by side with traditional methods, in different computer science courses at the Institute of Mathematics and Computing, University of São Paulo (ICMC-USP) (http://java.icmc.usp.br).

## 2. Student Groups with Peer Review Method

The peer review process is well known in the academic world. One proposes an article, project, course, etc. and peers judge the merits of the work. But seldom this method is applied to students' work (such as projects, essays, software, etc.).

In the peer review method, shown in this text, students are joined in groups. Each group has to do an assignment (a software project, writing a paper, etc.). After that, this assignment is made public, using the Internet, and is judged by another group of fellow students, who write a review presenting their opinions about the work. Again this review is made public using the Internet. Finally the first group has a chance to present their work to the class and defend it from the criticisms on the review. The reviewers will be there too, to defend their review. The two groups debate the work done in front of their classmates and teacher. Usually, the teacher is able to grade the assignment based on the review and the debate.

This process can be applied without the Internet, but it will be overly complicated to publish the assignments and reviews in paper for every student in the class, to control deadlines, group formation, and manage the whole process. In this case, the benefits of the proposed method would be largely reduced by the work needed to implement it.

The assignments defined by the teacher can consist of (but are not limited to) bibliographic research, laboratory experiments, software design or implementation, or seminars about a subject. As a practical example, the next section shows how a very common kind of assignment, for computer science courses can be handled using this method.

## 3.   Software Programs Assignments

A classic assignment in a computer science course is a software project. The students have some options of software projects, these projects have specifications to be followed, others require a solution for a particular problem (the students have to work out the specifications for the code).

An effective Student Groups and Peer Review method requires good management of the assigned activities (a software tool is highly recommended). The management tool used in this example is the Web Course Manager – WebCoM (Silva and Moreira, 2000). It is freely available (under GNU License), but many other software tools, commercial and free, can offer the needed functionality. WebCoM's main objective is to provide graphical interfaces to get, store, manipulate and present information that is generated by both students and teachers during a course. Using the WebCoM tool the teacher can:

- define assignments and deadlines dates;
- define other activities such as reports and tests;
- define which group a reviewer will review;
- associate grades to students or groups.

  And the students can:

- create groups;
- turn in assignments and reports;
- view and access works of others groups;
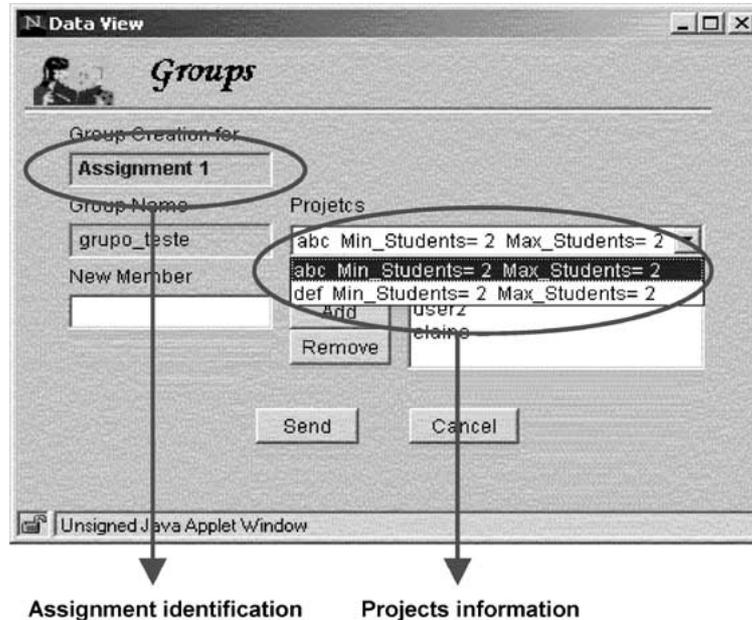- access their grades.

*Figure 1.* WebCoM group formation tool.

At the beginning of the course, the students have access to the course Web pages, where they can find the usual material (lecture slides, course calendar, etc.) and a list of available software projects. These projects are related to the subject being taught. In addition, they find the buttons of the WebCoM. The process includes the following steps:

### 3.1. Group formation

The students will sign into the WebCoM tool and form groups, usually 3 to 4 students per group. At this stage they can choose a project they want to work on. There is a limited number of projects, as the groups are formed, the options are reduced to a first come first served basis. Figure 1 shows the tool for group formation.

### 3.2. Assignment upload

Before the deadline, the student groups can upload their work (as many times as they wish) using the WebCoM FTP tool. To submit software, the students have to upload the code and a structured report called UDF (Unit Development Folder). Other kinds of structured reports can be used, but it is important to have a structured report about the code being uploaded.

### 3.3.  Choosing review groups

After the deadline for hand in (upload) the assignments, the teacher can determine which group another group will review. This is an opportunity to pair complementary projects, avoid cross reviews (two groups doing the review of each other), or any other strategy devised to improve the quality of the reviews and final debate.

### 3.4.  Review upload

Before the deadline for the reviews, the groups of reviewers can upload their work (as many times as they wish) using the WebCoM FTP tool. The reviewers will test the programs and read their reports. After that, they will try to answer specific questions in their review, for instance: design quality, code quality and documentation quality. It is important that judging parameters for each question are clearly defined.

### 3.5.  Classroom debate

Classroom debate is the most interesting part of the process. In the classroom, one group after another stands up and has a chance to defend their software projects and documentation (usually after a brief explanation of their project to the audience). The correspondent reviewer group then defends its points of view. The two groups can debate the project problems and qualities for some time; these debates can be quite lively at times. The process goes on until all groups have presented their work.

Usually the teacher can give a grade to the groups based on the reviews and the debates. During the debates, it is easier to notice if a group really understood the theory and key concepts behind their software project. It is recommended that the teacher plan the course schedule to leave sufficient time for the debates. Some groups debate more than others. If the time for debate is too short the students will not have time to expose their points of view. Figure 2 shows a WebCoM page with all groups, links to all projects and reviews, and grades (the grades for reviews are optional).

The example of a software project assignment describes well how the method works, but this method has been used for other kinds of assignments. When used in seminar assignments, where groups have to present a seminar about a subject to the class, the review strategy is slightly modified. The groups upload the text and slides they intend to present, and then the reviewers (usually after a week) upload their opinions. Now the groups have the chance to modify their text and slides based upon the opinions of the reviewers, if they agree with them. After the seminar presentation, there is the debate between the group and the reviewers (the audience is invited to take part too) where the reviewers can present their opinions about the seminar presentation, analyze if the modifications they proposed were properly implemented (if they were accepted) and point out the qualities and problems of the work. Again the group is free to challenge the opinions of the reviewers. This strategy improves the quality of the seminars and helps to promote a good debate about the topic after the presentation.
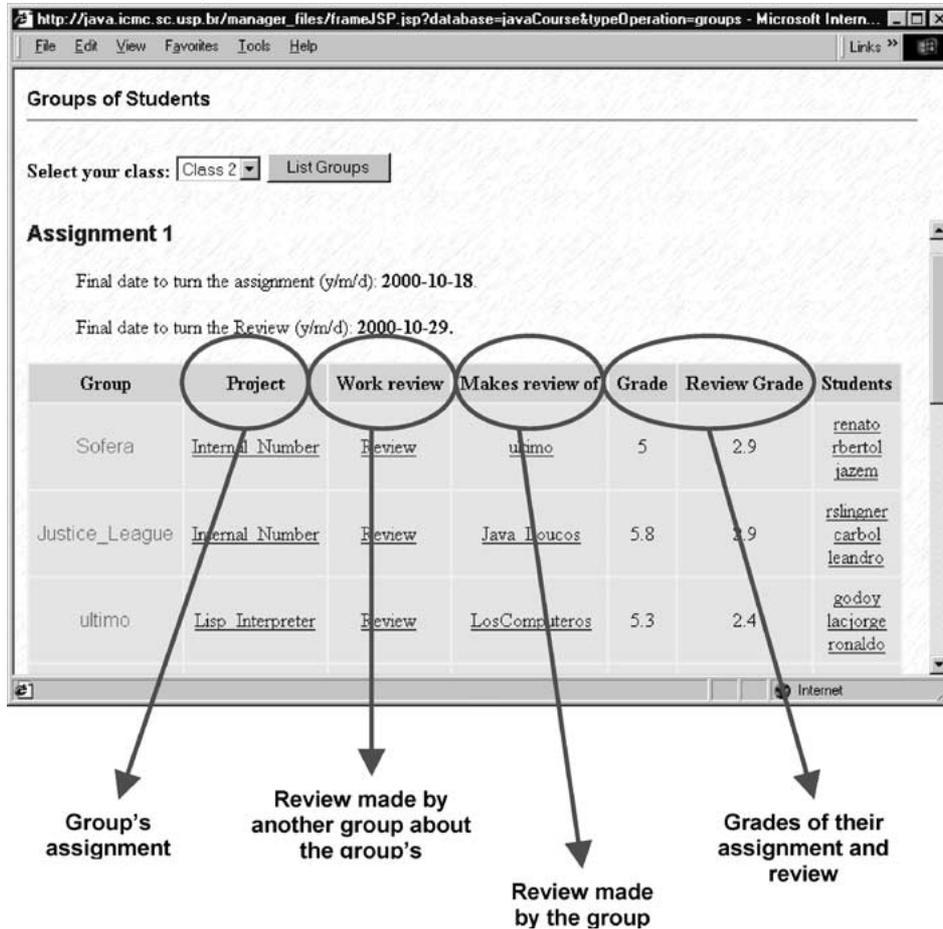
*Figure 2.* WebCoM tool for viewing assignments results.

## 4. Advantages of this Method of Peer Review

This method of Student Groups and Peer Review has many advantages. First it is less demanding on staff. With the same number of people (teachers, assistants, etc.) one can manage a larger number of student groups. This translates in the creation of more work groups per class with fewer students on them. In small groups, students tend to get more involved in a project or assignment. Their personal contribution will have a greater impact on the group's final grade. In big groups, it is easier for a student to be left behind.

But the big gains in this method come from the experience of student groups judging the work of fellow students. In the classes, where this method was used, the evaluations were fair in the great majority of cases. In the process, students learn to master the following skills:

1. The ability to present their work to peers.
2. The social skills for making criticism of their peers' work in a respectful and polite way.
3. The social skill for accepting criticism to one's own work from peers in a positive and constructive way.

   Those are skills the students will use throughout their lives in the software business. They will have their work criticized by fellow colleagues and will have to learn how to deal with these criticisms and to take advantage of opinions of others to improve their work. They will also have to learn how to point out errors and make suggestions about the work of others in a constructive and polite way. Why not to begin this training at school?

   Finally, because of the public discussion of the assignments and reviews, there is a healthy competition among the groups. Nobody wants to stand up and have nothing to say. In this way, the reviewers tend to make a thorough review of the assignment, uncovering problems and errors that a teacher, reviewing tens of assignments, would miss. The groups know that the reviewers will do their search for errors and they tend to be more careful with details (what is very important in software development). At the end, there are the presentations, where reviewers make their criticisms and the groups have a chance to contest the ones they disagree with. The presentations can became a lively debate, but they are always interesting and engaging to the students. Cheating is discouraged by the open nature of the process.

## 5.   Experiences with the Method

This method of Student Groups and Peer Review has been in use and refinement since 1997 with good results. It was used in computer science graduate and undergraduate courses. In addition, it was used in a distance education course. To get a picture of how the students see this method, the students of a graduate and an undergraduate course were asked to answer some questions. Their answers were in line with what students from past courses have said. The 3 most relevant questions were:

1. Does the use of the WWW make the course easier?
2. What is your opinion about the idea of Internet support?
3. What do you think of the peer review evaluation?

   Eighteen graduate students responded, ~50% of the class. Thirty undergraduate students responded, ~75% of the class (Table 1).

*Table 1.*   Students' answers to the three questions.

|  | Graduate | | | Undergraduate | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Yes or liked | Neutral | No or disliked | Yes or liked | Neutral | No or disliked |
| Question 1 | 72% | 17% | 11% | 83% | 3% | 13% |
| Question 2 | 72% | 22% | 6% | 87% | 13% | 0% |
| Question 3 | 50% | 22% | 28% | 77% | 13% | 10% |

Few students who responded disliked the use of the Internet in general. The majority of the students had a positive response to the peer review method. More interesting are the issues raised by the students in their answers about the method:

**Interaction:** 12.5% of the students stated in their answers that the method increased interaction or that they learned more about the project of the group they reviewed.

**Fairness:** 10.4% of the students were concerned about having clear judging parameters for correction. As the students themselves are doing the evaluation, they are concerned that different reviewers may be using different parameters for their evaluation. This highlights the need for clear judging parameters being explained before the reviews. If a group thinks its reviewers did not stick to these parameters, they can bring up the issue during the debate.

**Embarrassment:** 22% of the graduate students felt embarrassed or uneasy during the debates. They were not comfortable exposing their work and receiving criticisms. These students will have to overcome those feelings, as they will be exposed to criticism throughout their carriers.

**Workload:** 7% of the undergraduate students complained that the reviews increased their workload. That is true, but they also increased their interaction.

This method of peers review seems ideal for distance education courses, where contact with the teacher is smaller. Up to now, there is data about just one distance education course (Rosa and Moreira, 2000), an introductory course on Java. The complete set of data can be found at http://java.icmc.usp.br/dilvan/papers.

Even though one course does not provide much data, some of the students' answers seem interesting. The main question was "*What do you think about the use of Peers Reviews for the assignments reviews? (Choose as many options as necessary)*". This question was asked to students who had assignment grades good enough to entitle then to come to the university and take a certification test. Some students were not interested in the certification or lived too far away and did not come (Table 2).

Some of the students' comments were:

"Many (students) do not accept criticism as something good"
"It was one of the most interesting parts of the course"
"The old way is better, with the teacher doing the corrections"

In a general way, the students accepted the method well. The debates were done using a newsgroup plus email list system. Again the skills for accepting and making criticisms appear to be an issue.

*Table 2.* Distant education course students' opinions about the peer review method.

|  | Students that did not make the test | Students that made the test |
|---|---|---|
| Useless | 20% | 7.1% |
| Generates conflict | 30% | 42.8% |
| Increases commitment | 30% | 35.7% |
| Useful for learning | 60% | 71.4% |

## 6.    Conclusion

Using this method of Student Groups with Peer Review is one of the ways to explore the real potential of the Internet in computer science courses. The method uses the communication capabilities of the Internet to stimulate more interaction among the students, create an environment to foster constructive debate, give the students a chance to learn how to give and receive criticism in a polite and constructive way, and provide an engaging environment for the participants, helping with dull topics.

The method can help the students learn how:

- to present their work, as they have to show their results and opinions (to another group and to the rest of the class); they have to learn how to convince people about a subject;
- to evaluate the quality of the work of others, because they have to present constructive criticisms about them;
- to accept and understand criticisms from their colleagues; which is very important for computer science professionals.

The teachers can save time letting part of the evaluation work be done by the students themselves. This extra time can be used to manage more groups of students (with fewer students per group) or to focus on problematic students, who may need extra help.

The main negative point of this method is that some students let personal involvement interfere when they receive criticisms of their work from fellow students. However, this is something that students should begin to change when they are still at school, rather than later, as computer science professionals.

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