An Alternative Teaching Approach for Information Systems

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Abstract: Interpersonal skills and communications are the two topics in Curriculum'95, compiled by the joint task force of the ACM/AIS-ICIS/DPMA, where both academics and industry expect the level of knowledge of the students to be at the application level. One of the reasons for this may be because most of the work that people do requires some degree of cooperation and communication with others. Although students generally do not learn cooperatively, they are eventually expected to work cooperatively every day. The social structure used in tertiary education is therefore out of synchrony with the social skills needed in a technological-based economy.

This paper proposes that computer-supported cooperative learning (CSCL) can help to overcome the deficiencies in our education system and equip students with the required level of interpersonal skills and communication abilities. In three different case studies a CSCL environment were established with positive learning results. Possibilities which exist for enriching the teaching of Information Systems when a CSCL approach is followed, are discussed.

Keywords: Computer-supported cooperative learning, computers and education, IS teaching

Computing review category: K.3.1, K.3.2

1. Introduction

Interpersonal skills and communications are the two topics in Curriculum'95, compiled by the joint task force of the ACM/AIS-ICIS/DPMA, where both academics and industry expect the level of knowledge of the students to be at the application level. One of the reasons for this may be because most of the work that people do requires some degree of cooperation and communication with others. Although students generally do not learn cooperatively together, they are expected to do so every day in their work. The social structure used in tertiary education is therefore out of synchrony with the social skills needed in a technological-based economy.

This paper proposes that computer-supported cooperative learning (CSCL) can help to overcome the deficiencies in our education system and equip students with the required level of interpersonal skills and communication abilities. Cooperative learning provides an organisational structure which can change the educational process, engage the minds of students and connect learning to the working world. CSCL methods are structured, systematic instructional strategies capable of being used in any learning environment.
Different methods exist to implement such an environment. Three case studies, using different CSCL methods, will be described and the conclusions drawn from these case studies will be discussed. In particular, attention will finally be paid to the possibilities which exist for enriching the teaching of Information Systems when a CSCL approach is followed.

2. Computer-Supported Cooperative Learning

Cooperative learning can be defined as an organizational structure in which a group of students pursue academic goals through collaborative efforts. Students work together in small groups, draw on each other's strengths, and assist each other in completing the task. This method encourages supportive relationships, good communication skills and higher-level thinking abilities [Hilke, 1990:8].

According to Johnson & Johnson [1991], the following five basic elements should be present in a cooperative learning environment:

1. **Positive goal interdependence**, which occurs when learners undertake a group task with a feeling of mutuality.
2. **Face-to-face promotive interaction**, which occurs when a verbal interchange takes place where learners explain how they obtained an answer or how a problem may be solved.
3. **Individual accountability**, which means taking responsibility for learning material.
4. **Social skills**, which involve knowing how to communicate effectively and how to develop respect and trust within a group.
5. **Group processing** to reflect on how well the group is working and to analyse its effectiveness and how it may be improved.

The presence of these elements is important to ensure a successful cooperative learning experience.

Cooperative learning methods are structured, systematic instructional strategies capable of being used in any learning environment. Although the methods are based on social psychological research and theory, they have been adopted to meet the practical requirements of the learning environment. The main objective for all the methods is always the same: Heterogeneous groups working toward a common goal [Slavin et al, 1985:8]. These methods include Jigsaw, Students-Teams-Achievement Division, Team-Games-Tournament, Circles of Learning and Group Investigation.

A CSCL environment exists when the instructional use of information technology is combined with the use of cooperative learning methods. Learners are assigned to cooperative groups and are given a task to complete in which information technology is utilised.

3. The use of CSCL to teach a course on systems analysis and design

Students at the University of Pretoria enrolled for the course on systems analysis and design in first-year Informatics participated in the case study. There were three classes consisting of 40, 70 and 39 students each, thus a total of 149 students. Students were both Afrikaans and English-speaking. The classes consisted of students from different ethnic groups, although they were predominantly white. The case study was conducted during normal class sessions and all the students doing the course were involved in the case study. Not all groups were, however, observed due to the number of students enrolled for the course and no control groups were used. The topic under discussion was an introduction to the analysis of Information Systems.

A full description of the case study will be published in the South African Journal for Higher Education [De Villiers & Grobler, vol. 9, no. 2, 1995].

The Jigsaw cooperative learning method was implemented as follows:

1. **Assemble needed materials**: The lecturer assembled reading material consisting of a number of articles on five different subtopics. Some of the reading material was stored on a hypertext system, called SuperText, for retrieval by the students as needed.
2. Divide into groups and do group-building exercise: The lecturer divided students into groups of approximately five members each. Students were assigned randomly to the groups before the class. To make sure that the students knew each other, they had worked in the same groups on a previous assignment, although not in the same learning environment.

3. Explain to students the idea of group work: The theory behind an effective group was explained to the students. Extensive use was made of the book by Johnson, D.W. and Johnson, F.P. 1991. Joining Together. Group Theory and Group Skills. Englewood Cliffs: Prentice Hall. The elements of cooperative learning, as previously described, and the dimensions of an effective group (Johnson & Johnson, 1991: 21-24) were discussed.

4. Explain the goal and the task: The lecturer explained the objectives of the group work that had to be done, as well as the objectives of the topic to be covered.

5. Work in groups to obtain key concepts/subtopics: Students were given ten minutes to identify the key concepts of the topic to be covered in their group. They had to reach consensus on the five most important subtopics.

6. Lecturer review: The lecturer reviewed the subtopics and, with the help of the groups, determined five subtopics that would be investigated by all the groups. The subtopics were: The modern system analyst, building blocks of the information system - people, data and activities; building blocks of the information system - people, technology and networks; principles of systems development; and the systems development life cycle.

7. Groups decide: The groups assigned one student per group per subtopic.

8. Meeting of expert groups doing the same topic: The members from the different groups doing the same subtopic met and discussed the topic. The study material per subtopic was available for the expert group via the network on SuperText. Students were also encouraged to link onto the library system to find more information on their subtopic and to consult the extra journal articles reserved in the library. They also had access to word-processing facilities. A list of objectives to be met on the subtopic was given to each expert group and they were advised by the lecturer to meet outside the normal class sessions for further discussion. A questionnaire was completed by the students on their experience with the expert group. Students also had to write down their contribution to the knowledge gained by the expert group.

9. Report back to groups: Students reported back to the original group on the subtopic that they had studied. The five subtopics within one group were then combined into one written (word-processed) report that was evaluated to obtain a mark for the entire group. An observation list was completed by the observer for one group per class. Tape recordings were also made of the discussion of three groups.

10. Report back to class: The lecturer called on any group and any member of the group to report back to the whole class.

11. Lecturer summarises: The key points were summarised by the lecturer to enable all the students to study the topic for examination purposes.

12. Evaluation: A short, unprepared, computerised, multiple-choice class test and questionnaire were given to all students. The questionnaire was divided into five parts:

- **Part A:** Questions on the student's behaviour in the group
- **Part B:** Questions on the level of acceptance of the student as a group member
- **Part C:** Questions on group cohesion
- **Part D:** Questions on group work in general
- **Part E:** General information and open-ended questions

The observation lists were evaluated and summarised by the observer. Informal interviews were conducted with groups to clarify uncertainties.
Final evaluation: A prepared, computerised, multiple-choice class test was written by all students. Their total mark for this topic consisted of the written group report, the unprepared class test plus the prepared class test.

Steps 1 to 5 of this procedure were done during the first class period of 50 minutes. Steps 6 and 7 took up the second period. Step 8 was done during the third period. Step 9 was completed during the fourth period. Step 10 was done in a fifth period. Step 11 was completed in the sixth period. Step 12 was done in the evaluation period in the computer laboratory, using a computerised test. A separate test period was used to complete the final evaluation (step 13).

The results of the case study can be divided into four sections, namely the evaluation of the expert groups using the questionnaire; the observations done using the observation lists and tape recordings; the evaluation of the group work using a questionnaire; and an analysis of the marks obtained by the students.

The use of expert groups is an important part of the Jigsaw cooperative learning environment. The expert groups were evaluated separately in this case study and can be judged to be effective. The following are some of the positive observations made during the case study: An enthusiasm amongst students about interacting with fellow students; an increased respect for diversity, implying that students learn to appreciate and respect one another; highly motivated students; increased self-confidence and self-esteem; an initial horizontal learning curve which later changed into a steep learning curve; a willingness to be successful; a growing interest in the subject; and an awareness of the working world, where teamwork is essential. Very few negative observations emerged: No group cohesion in a few groups; preference for individual, lecture-driven studies; free-rider effect (although this applied to only about 7% of the students); and too time-consuming from a student perspective.

The questionnaire showed that students have high expectations about the cooperation between group members, as well as their own cooperation in a group. At the beginning of the case study, the lecturer observed an unwillingness amongst students to participate in group work. However, their attitude changed during the case study, as they showed increasing willingness to express their thoughts, feelings and reactions to the rest of the group. Although the students were briefed about the purpose and advantages of group work, it is interesting to note, on conclusion of the case study, that the majority still believe that group work prepares them for the working world. It is also interesting that very few students remarked on the fact that group work may involve less work for them, while most of them liked the social interaction in a group. From this case study the researchers gained insight into group dynamics and the social skills involved in a cooperative learning environment. The case study was experienced positively by the students and created an awareness of the working world, where teamwork is essential.

4. The use of CSCL to teach a course on word-processing

A CSCL environment, structured around a course on word-processing, was implemented using a group of school teachers. The main purpose of this case study was the comparison of individual learning approaches with group learning approaches, where both were supported by a computer. The use of a control group (individual learners) in this study necessitated the use of teachers and not students who had to write an exam on the course. The researchers did not want to jeopardize the marks of students by involving them in an experiment, which might have faile. Most first year courses on Information Systems include the teaching of basic computer-literacy, such as word-processing, spread sheets and database packages. This case study is therefore of relevance to the teaching of Information Systems despite the fact that teachers were used as learners.

Thirty percent of the teachers involved in this case study indicated that they had previously worked on a computer, but this was mostly limited to their school's administration system. From this information one can conclude that virtually no-one was computer-literate at the outset. Cultural diversity and ethnic relations, as specific elements of the cooperative learning environment, were emphasized in this case study.

Circles of learning (or learning together) was chosen as the cooperative learning method. This method was developed by Johnson & Johnson [1991] and is structured around a group goal, the sharing of ideas and materials, a division of labour when appropriate and rewards given to the group. The following steps were identified by Johnson & Johnson [1991] as essential for the successful implementation of this method:
1. Clearly specify instructional objectives. These objectives were given in the description of course contents.

2. Limit group size to no more than six, but if the group members are new to cooperative learning, groups should be smaller to ensure that everybody participates. The group members in this case study had no or very little previous experience of group work and were, therefore, divided into groups of three or four members.

3. Structure groups to achieve heterogeneity in terms of ability, sex and ethnicity. Due to the specific aim of this case study, not all of the groups were heterogeneous, as explained in previous paragraphs.

4. Arrange groups in a circle to facilitate communication. The use of computer support made the use of half circles in front of the computer essential.

5. Use instructional materials to promote interdependence among students. Each group of students had only one computer to work on, only one photocopy of the different WordPerfect functions and only one copy of the CBT lessons [Du Plooy et al, 1994]. Each group member had to study one part of the WordPerfect functions and was given only the relevant pages.

6. Explain the academic task. At the beginning of the course, the learning objectives of the course were explained as well as the aims of group work and cooperative learning. The five basic elements of cooperative learning were discussed and implemented in the following ways:

   a. **Positive goal interdependence** was achieved by having the group produce a single assignment at the end of the second session, constituting a group mark. They also had to complete the tests incorporated in the CBT lessons as a group.

   b. **Face-to-face promotive interaction** occurred because learners each had to study certain WordPerfect functions and explain and demonstrate them to the other group members.

   c. **Individual accountability** was obtained by an individual test at the end of the course to test their ability to use the word-processing functions.

   d. **Social skills** were established by giving the group members time to get to know each other. Each group member got a turn to explain some word-processing functions to the other group members.

   e. **Group processing** was done by monitoring the behaviour of the groups continually by the course leader. Assistance was given when necessary in the form of clarification of instructions, answering of questions, encouragement and teaching of academic skills.

7. Provide closure to the course. At the end of the course a summary of the functions used was given by the course leader.

8. Evaluate the students' work. This was done by means of a group assignment, CBT tests done as a group and an individual test.

9. Assess group functioning. This was done through ongoing observation while the groups were busy with the course, as well as through the completion of a questionnaire by each individual at the end of the course.

A full description of this case study will be published in the South African Journal for Higher Education [Grobler & De Villiers, vol. 10, no. 1, 1996].

The most striking result that emerged from the questionnaire completed by teachers (in the cooperative groups) was the fact that when they had problems assimilating the course material, they received help from the other group members. Teachers continuously, throughout the questionnaire, expressed their enjoyment of the group work, the value of sharing ideas and feelings, and the motivation and support they experienced in their groups. The positive experience of group work resulted in an average mark of 70.54% for cooperative groups on the course, in comparison with 54.69% for the individuals. With the individual WordPerfect test there was even a bigger difference in marks: 54.24% for cooperative groups in comparison with 34.00% for the individual learners. The course drop-out rate for individuals was 40% compared to 24.24% for the groups.

It is clear from these results that in this case study the implementation of CSCL was much more successful than the traditional individual learning approach. Results of this case study also indicated that teachers had a better understanding of the study material and that they learned quicker. This shortens the educational life-cycle. One thing about group work that many teachers disliked was the pace of the group, which were either too slow or too fast. It is therefore very important in the composition of groups to try and minimize the variation in ability to ensure a more effective group.
5. The use of CSCL to teach an honours course on the theory of programming languages

A CSCL environment was implemented in a course for the honours degree in Computer Science at the University of South Africa (Unisa) - a distance teaching university. The honours course in Computer Science deals with the theory of programming languages. The five basic elements that should be present in a cooperative learning environment were implemented as follows:

1. **Positive goal interdependence**: In this case study, students had to participate in the learning process by completing a group project and the mark that they obtained, depended on the group effort.

2. **Face-to-face promotive interaction**: Communication with other students had to be by means of electronic mail. Promotive interaction took place, although not face-to-face.

3. **Individual accountability**: Each student had to do one subtOpic of the project, but they had to be able to write the examination on any of the subtopics.

4. **Social skills**: Students had to develop respect and trust within the group.

5. **Group processing**: To achieve this, all electronic mail messages sent during this project had to be saved and forwarded to the lecturer, to monitor the progress of the group. A questionnaire was provided at the end of the case study, for completion by the students.

For this case study it was decided to follow a simplified version of the group investigation method and do the evaluation of the cooperative learning environment using a structured questionnaire, printed documentation of all communication via electronic mail, as well as a group written report. The group investigation method requires from the learners to take responsibility for deciding what to learn, how to organise their learning and how they are going to communicate their knowledge to the rest of the class. This is the most complex of the existing cooperative learning methods.

Only four students in the group of forty students had electronic mail facilities. They were willing to participate in the case study. The students used the electronic mail facilities at their work places in Pretoria, Soweto, Mmabaho and London (United Kingdom). As students in the honours course, they had to complete a compulsory project on the design principles for a new programming language. The five most important design principles, according to the students, had to be discussed and compared with existing high-level programming languages. Due to the fact that there were only four students, the number of design principles for this group project was limited to four.

To create a successful learning environment students had to follow a specific procedure. Although the group investigation cooperative learning method leaves the responsibility of the learning with the learner, guidelines, to make it easier for the students to complete the task, were provided by the lecturer:

1. **Assemble needed materials**: Each student had to assemble reading material on the design principles of a programming language.

2. **Do a group building exercise**: Students had to contact the other students, using electronic mail facilities and get to know each other, for example by asking questions such as "What's your occupation?", "Are you married?", "Do you have children?", "Why are you doing this course?", etcetera.

3. **The lecturer must explain to students the idea of group work**: The theory behind an effective group was explained in a document that was posted to the students. Extensive use was made of the book by Johnson, D.W. and Johnson, F.P. [1991]: Joining Together. Group Theory and Group Skills. Englewood Cliffs: Prentice Hall.

4. **Explain the goal and the task**: The objectives of the project that should be done were given to the students in their first tutorial letter for 1994.

5. **Work as a group to obtain key concepts/subtopics**: Students had to contact the other students via electronic mail and identify the four key principles to be covered in their project. They had to reach consensus as a group on the four most important topics.

6. **Lecturer review**: The lecturer had to be informed via electronic mail of the four topics that will be discussed.

7. **Group decides**: The group assigned one student per topic. While they were studying their particular topic, they had to be on the lookout for information on the other three topics, and had to pass the information on to the relevant group member.
8. *Report back to group.* The students had to report back to the group on the topic that they had studied. The four topics had to be combined into one written (word-processed) project that constituted a mark for the entire group.

9. *Evaluation of group processing.* A questionnaire was given to all students. Students received a mark for the written project. Printed electronic mail messages had to be submitted to the researcher.

Although a very small group of students was involved in the case study, it is interesting to note that they all agreed on the following: They share sources of information that they have with other group members in order to promote the success of the individual members as well as the group as a whole; computer communication skills will open new opportunities in their careers; they would like to do other courses in groups while studying at a distance teaching institution; they believe the group learning approach can open alternative approaches to education and training and that it can be successful in distance education. On the negative side students did not always offer facts and relevant information, express their feelings or give their opinions and ideas freely during the discussions.

6. **The use of CSCL to teach information systems**

A study done by Froneman and Roode [in this proceedings] indicates that businessmen and IS managers require systems analysts and end-user support personnel to be proficient in business communication, writing skills and presentation techniques, as well as interpersonal skills. The recently published [at ICIS 95] IS'95 curriculum also includes, amongst the desired characteristics of IS graduates, communication skills, and state that 'IS graduates must communicate in a variety of settings using oral, written and multimedia techniques'. To achieve this objective, IS'95 identifies five supporting courses should be included in an IS curriculum, dealing specifically with composition, technical writing, listening skills, public speaking and small group discussion. It is important to note that IS'95 actually describes the area of communications as a required area of study for IS graduates.

In the South African context, this recommendation or requirement of IS'95 might be difficult to implement. In general, IS graduates in South Africa spend three years in undergraduate study in contrast to the typical four year courses which IS'95 has in mind. This makes it virtually impossible to find room for additional external courses in various communication skills and competencies. As a result, most South African implementations of IS curricula would indeed require students to acquire requisite communication skills, but go about how this should be achieved in a rather haphazard way.

We conclude from the work reported on in this paper that there is a way out of the 'time dilemma'. Instead of teaching communication in its various forms as separate subjects, using an alternative teaching approach could actually, through experiencing various forms of communication themselves, enable students to acquire these skills by practising them. The different case studies reported on in this paper all had in common that their success depended to a large extent on effective communication between members in a group and across group boundaries. The variety of ways in which CSCL exercises can be implemented makes it possible to deliberately include a wide spectrum of different communication modes to expose students to them and provide them the opportunity to become proficient in them by actually practising their skills.

There is a further advantage to using CSCL in teaching IS. If students are taught to work in a CSCL environment and thus become used to and acquire working habits which are required in order to make a success of group work, they will find it much easier to adjust to team and group work in the work environment they will enter after graduation. There is virtually no limit to the range of topics in the typical IS curriculum which could be taught and could benefit from a CSCL approach. Computer support can include computer-assisted instruction, computer conferencing, interactive video and hypermedia. Each of these technologies could demand different skills from the student actively engaged in a CSCL project. This can further be enhanced by varying the cooperative learning method across different projects and topics.

Lastly, communication technologies make it possible for students from different IS departments in South Africa to work on joint projects, as was demonstrated on a small scale in the third case study discussed above. This means that IS departments at different tertiary institutions could cooperate to offer certain courses jointly, making more effective use possible of scarce expertise and human resources.
7. Conclusion

In this paper three different case studies were discussed in which a CSCL environment was established to support the learning process. The paper first examined the concept of cooperative learning and then showed how a CSCL environment is created when the instructional use of information technology is combined with the use of cooperative learning methods.

Each of the three case studies is described in detail and brief summaries are given of the conclusions drawn from them. The general conclusion was drawn that CSCL can be effectively implemented in an IS teaching environment and can be utilised to achieve specific objectives, apart from simply enhancing the teaching process. In the first place it is argued that the emphasis on the communication skills of IS graduates expressed by various interested parties (business, IS industry, curricula designers) can be addressed by making active and wide use of CSCL in the actual teaching of an IS curriculum, instead of requiring students to include separate courses on communication in their study program.

It is argued that such use of CSCL would have the added advantage of preparing students for a work environment where they will be expected to work cooperatively. Traditional learning environments actually discourage cooperative work, promoting and instilling an approach of going it alone'. Using CSCL in a variety of settings and with a variety in its implementation structure, could expose students to a diversity of group work from which they, by actually participating therein, could have rich learning experiences.

Finally it is pointed out that the use of CSCL could enable South African tertiary institutions to share certain workloads and thus make more effective use of their scarce resources. The technology which we profess to teach to our students can make this all happen, and a better demonstration of our mastery of technology could scarcely be dreamt of.

8. References


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