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Preface

Philip Machanick, Overall Chair: SAICSIT'99

Running SAICSIT'99, the annual research conference of the South African Institute for Computer Scientists and Information Technologists, has been quite an experience.

SAICSIT represents Computer Science and Information Systems academics and professionals, mainly those with an interest in research. When I took over as SAICSIT president at the end of 1998, the conference had not previously been run as an international event. I decided that South African academics had enough international contacts to put together an international programme committee, and a South African conference would be of interest to the rest of the world.

I felt that we could make this transition at relatively low cost, given that we could advertise via mailing lists, and encourage electronic submission of papers (to reduce costs of redistributing papers for review).

The first prediction turned out to be correct, and we were able to put together a strong programme committee.

As a result, we had an unprecedented flood of papers: 100 submitted from 21 countries. As papers started to come in, it became apparent that we needed more reviewers. It was then that the value of the combination of old-fashioned networking (people who know people) and new-fashioned networking (the Internet) became apparent. While the Internet made it possible to convert SAICSIT into an international event at relatively low cost, the unexpected number of papers made it essential to find many additional reviewers on short notice. Without the speed of e-mail to track people down and to distribute papers for review, the review process would have taken weeks longer, and it would have been much more difficult to track down as many new reviewers in so little time.

Even so, the number of referees who were willing to help on short notice was a pleasant surprise.

The accepted papers cover an interesting range of subjects, from management-interest Information Systems, to theoretical Computer Science, with subjects including database, Java, temporal logic and implications of e-commerce for tax.

In addition, we were very fortunate in being able to invite the president of the ACM, Barbara Simons as a keynote speaker. Consequently, the programme for SAICSIT'99 should be very interesting to a wide range of participants.

We were only able to find place in the proceedings for 36 papers out of the 100 submitted, of which only 24 are full research papers. While this number of papers is in line with our expectation of how many papers would be accepted in each category, we did not have a hard cut-off on the number of papers, but accepted all papers which were good enough, based on the reviews. Final selection was made by myself as Programme Chair, and Derrick Kourie, as editor of the South African Computer Journal. Additional papers are published via the conference web site.

We believe that we have put together a quality programme, and hope you will agree.

Acknowledgments

I would like to thank the South African Computer Journal production team, Andries Engelbrecht and Herna Viktor, respectively from the Department of Computer Science and Informatics, University of Pretoria, for their work on producing the proceedings.

The reviewers listed overleaf did an excellent job: many wrote very detailed reports, sometimes after being called in on very short notice. Inevitably, there were some glitches resulting from the unexpected workload, but the buck stops with the programme chair: I promise to do better next time.

I would also like to thank my own department for putting up with the extra work and expense that running a conference entails. I tried not to burden them with too much extra work, but our secretaries, Zahn Gowar and Leanne Reddy, inevitably had to take on some extra work. John Ostrowick provided valuable assistance with design of our web pages and call for papers poster. Carol Kernick, who handles our finances and membership records, did a fine job of keeping up with the demands of the conference.

Finally, I would like to thank our sponsors, whose contribution made this conference been possible:

- PricewaterhouseCoopers – sponsored generous prizes and the conference banquet
- National Research Foundation (NRF) – provided financial support
- University of the Witwatersrand – provided financial support
- Programme for Highly Dependable Systems, University of the Witwatersrand – provided financial support
- Standard Bank – provided financial support
Editorial

- Apple Computer - provided equipment for the conference
- Qualica - provided technical support including helping with the conference web site

Web Site

For more information about SAICSIT, including a pointer to the conference site, see <http://www.saicsit.org.za>.

Referees

- Department of Computer Science, University of Pretoria
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  - Bruce Watson
  - Vali Lalioti
  - Andries Engelbrecht
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Co-operating to learn using JAD techniques

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Abstract

The role of the Information Systems' (IS) developer is changing. IS developers are required to be able to work with users and get a common understanding with them. In order to achieve this the developers must have, not only technical skills, but also good interpersonal and communication skills. This means that tertiary institutions will need to help IS students to develop these skills while they are learning the technical skills.

This paper describes two case studies that were done at the Port Elizabeth Technikon. The first case study is not described in detail but gives an overview of the use of Joint Application Design (JAD) techniques in the classroom to promote learning of group and modelling techniques. The second case study is described more fully and shows how the techniques of co-operative learning were combined with the JAD techniques in order to promote this learning.

Keywords: Information Systems Education, JAD, Co-operative learning

Computing Review Categories: K.3.2

1 Introduction

Information Systems Development (ISD) is changing. As the IS developer becomes more involved with working with users and working in teams, he or she will need to have more interpersonal and group skills. This means that as we enter the new millennium, tertiary institutions may have to change the way that they prepare Information Systems (IS) graduates for industry. Graduates will be expected to have the interpersonal and business skills as well as the technical skills for working in this ever-changing world of ISD.

For quite some time, conventional systems development approaches have acknowledged the importance of the social element of ISD. Nevertheless, they concentrate on the technical process of systems development. They equip the developer with, neither the tools, nor the knowledge, for dealing with the social processes intrinsic to ISD. Simple platitudes such as "get the support of senior management" or "involve the end user" are hardly sufficient to guide systems development. They tend to mask the social nature of ISD or portray it in simplistic ways. They do not allow developers to understand, let alone fully appreciate, the social nature of systems development." [9] This problem also occurs in tertiary institutions where students are prepared for the technical side of ISD but not the social.

This paper proposes a method of using Joint Application Design (JAD) techniques together with those of co-operative learning in order to promote the learning of some of the skills needed by the new IS developer. The paper first gives some background as to why it is believed that skills such as those for working in small groups, facilitation skills and argumentation skills are important for the IS developer in the new millennium. The paper then describes the research method that was used to investigate using JAD techniques in the classroom. Two case studies are then presented, one as an overview and the other in more detail to examine whether the techniques of using JAD in the classroom are effective.

2 The Changing Role Of The Information Systems Developer

Hirschheim, Klein and Lytinen [10] use Habermas' social action theory to divide ISD into four behavioural orientations that underlie the behaviour of the various actors during ISD. These orientations are used to capture the underlying values, goals and epistemological underpinnings that drive the development activity. These four behavioural orientations are:

- **Instrumental (control) orientation**, which is concerned with achieving the predefined end-results and treats everything in the domain as controllable objects;
- **Strategic (control) orientation**, which is also concerned with achieving the predefined end-results but treats each human active in the domain as an independent conscious agent with a will of his or her own;
- **Communicative (sense-making) orientation**, which is concerned with achieving a common understanding through communication; and
- **Discursive (argumentation) orientation**, which is concerned with achieving clarification and justification and providing reasons and evidence.

The first two orientations emphasise control but differ in how they see people as subjects of that control. The
first sees people as objects whereas the second sees people as intelligent agents. The control orientation can be compared to hard systems thinking. The communicative orientation emphasizes creating shared meanings through sense-making. This can be compared to soft systems thinking. The primary emphasis in the discursive orientation is argumentation, which makes sure that claims made during communication are clarified and called into question. The argumentation orientation can be compared to the critical or dialectic thinking [5].

Hirschheim et al. [10] predict that, although most IS efforts at the moment are directed at the control orientations, this is changing and that more effort needs to be put into the sense-making and argumentation orientations. As IS development moves from the control to the sense-making and argumentation orientations, the skills needed by IS developers are changing. IS developers need to be prepared for working in an environment where user participation is the norm and where they will be expected to interact with people who are diverse from themselves.

This need for people with both the technical, business and interpersonal skills has been acknowledged by the developers of IS Curriculum '97 [6]. The ability to communicate and interact with others are seen as being among the main characteristics needed by the IS graduate. Communication skills listed include listening skills, negotiating skills, facilitating skills, observation skills and presentation skills. The skills of leadership, small group communication and organization, and working with diverse people are listed among the interpersonal skills needed. The suggestion is made that IS departments should try to use methods of learning that foster the building of these skills while the students learn the more technical skills needed. The method of using JAD and co-operative learning techniques proposed in this paper is one attempt at achieving this.

First a bit of background into the research methods used for studying the use of JAD in the classroom will be described and then the method itself and its development.

3 Research Methods

Braa and Vidgen [3] propose the research framework given in Figure 1 for doing in-context information systems research. The points in the framework represent the research outcomes with prediction being aligned with reductionism as depicted by the positivistic approach, understanding being aligned with the interpretive approach and change with the critical approach.

The positivistic approach to research assumes that one can be objective. Human action is seen to be intentional and deterministic [15]. Conflict and contradiction are not seen as being normal so change is not sought. Research methods for the positivistic approach generally try to reduce any extraneous variables and use experimental methods with experimental and control groups. Prediction is shown as the outcome of the positivistic method of research as this method is seen as being able to control and predict. In the field of in-context IS research, the preferred method for a positivistic approach would be field experiments.

The interpretive approach to research tries to get a deep understanding of a situation and use this understanding to inform other people in similar situations. The interpretive paradigm is subjective and tries to get different people’s perspectives on the situation. Walsham [17] suggests that our knowledge of reality according to an interpretive belief, is a social construction of the people that participate in that reality. When doing interpretive research, the researcher studies the situation in context and tries to get a rich, comprehensive, in-depth understanding of what has happened from the perspectives of the participants. One of the more common methods of doing research in this paradigm is a soft case study. When doing interpretive research, the researcher needs to contextualise the research, interact with the subjects, must be sensitive to differences in interpretation, should be aware of bias and distortions and should study the whole situation and the parts [13].

Change is the outcome of intervention and the critical research method is motivated by the desire to improve the situation. Critical theorists see both the subjective and the objective sides of reality. The aim of critical research is to find alternatives to the status quo [15]. Critical researchers in information systems or education will study the information system and its place in the industry, society and culture within which it is found and attempts to change what needs to be changed. Action research would be a method of doing research in this paradigm.

The points of the triangle, in Figure 1, are seen as ideal and are not really attainable in practice, according to Braa and Vidgen [3]. The dotted lines represent the research dynamics as movements towards or away from these ideal types. The space of the triangle implies that all three dynamics, namely reduction, intervention and inter-

Figure 1: An IS research framework for in-context research (Adapted from Braa & Vidgen [3])
4 Case Study 1 - Using JAD In The Classroom

The first action case study took place during 1998. The method of using JAD techniques in the classroom was studied. This case study will not be described in any great detail as it has been previously published [16].

The Information Systems II students at the Port Elizabeth Technikon were involved in the first case study done during 1998. The students were doing either a Business or Technical stream in the National Diploma: Information Technology. The students were English, Afrikaans or Xhosa speaking.

4.1 The method

Preparation of the students for the JAD sessions
The students were given some training in the use of JAD in industry and were given some instruction in facilitation skills.

Group composition
The teams were made up of 6-8 students. The groups were not really assigned and students would form groups as they came into the classroom. This meant that many of the groups were made up of friends with a few later arrivals being added to the group. This caused problems within the groups.

Instructional material
The students were given problems in the domain of systems analysis and design. In other words, the problems were ones of modeling the current system in order to analyze problems, or designing a new system. The instruction included design of the data, the functions or the operations of the new system. All the students were given the same material. If, for example, the students were asked to model the data needed for a library system, they were given a page of information that told them about the library and the data that was needed. They would then be expected to draw the ER diagrams during the JAD session.

Layout of the classroom
The classroom was one that had five white boards around the classroom and each group was assigned to a board. The desks and chairs in the classroom could be moved and the students sat in the classic horseshoe shape with the facilitator at the board at the front as is suggested for a JAD session used in industry [4]. This shape allows all the students to see each other and the board thus promoting effective communication.

Running the JAD sessions
The students took turns being the facilitator or the scribe. The student facilitator's task was to make sure that all the students participated, that none dominated and that the group stayed working on the topic. If there was conflict, the JAD facilitator has to help the group to get to a consensus and negotiate a solution. The scribe documented the solution from the board onto paper.

The role of the lecturer
The task of the lecturer was not to solve problems or negotiate when there was a conflict but rather to make sure that the JAD facilitator was doing his or her job. The lecturer also checked the results of the design, discussing any problems with the group as a whole. Only in exceptional circumstances would the lecturer get involved in solving the problem with the students.

Assessment
No marks are given to the group and evaluation was done by testing the students individually later.

4.2 Overview of results - Case Study 1

As mentioned before, more detail of the results can be found in Thomas [16]. Overall the research showed that the students and lecturers both perceived that learning had taken place, both in terms of the technical and the group skills. There were, however, problems with the group processing and the interaction within the groups. Some of the students felt that they were left out of the group and not all of the students participated as they should. There were also problems for some of the people from the different language groups speaking in their own language rather than English, which was the only language understood by all.

4.3 Critical review and suggestions for change - Case Study 1

In terms of the methods of action case studies, we then tried to determine what the problems were and to suggest some methods of improving the method. Many of the problems experienced within the groups are ones that have been reported in the literature of co-operative learning and it was decided to try to take some of the methods of co-operative
learning and apply them with the JAD techniques to improve the group processing and learning.

5 Case Study 2 - Using JAD Cooperatively In The Classroom

Co-operative learning literature has many ideas for promoting co-operation. The five characteristics of co-operative learning are: that the method must be structured to promote positive interdependence, individual accountability, teach group skills, evaluate group processing and promote face-to-face interaction [12]. Various techniques are given in the literature to help achieve these goals and some of these techniques were combined with the techniques of JAD used in industry in order to promote learning as well as effective group processing.

The students were once again Information Systems II students at the Port Elizabeth Technikon during 1999. They came from diverse backgrounds and spoke English, Afrikaans or Xhosa as their home language.

5.1 The Method

Preparing the students for the JAD sessions

The cooperative learning literature suggests that putting students into a group and telling them to cooperate will not be effective [12]. They suggest that one should teach the students some of the skills needed for cooperation. A series of classes were set up to allow the students to learn some of the interpersonal skills and small-group skills needed for co-operation. Some of the skills taught included communication skills, listening skills, group dynamics and group decision-making skills. The JAD skills of facilitation, scribing and group participation were also taught to the students. The importance of these skills in industry was emphasized. The students were given opportunities to practice these skills.

Group composition

The ideal group size is seen by some as six, with smaller group sizes suggested for those who are not used to working co-operatively [11]. Using the white boards and having some structure to the group does allow students to be able to communicate more easily but the group size was kept to less than eight where possible. This allowed all team members to contribute while still offering different perspectives, which can be debated.

There is some debate in the co-operative learning literature about the use of heterogeneous or homogeneous groups with respect to academic ability, race and sex. As it was felt that getting the opportunity to work with people different from themselves was important so it was decided that a heterogeneous approach would be best. Miller and Harrington [14] warn against making people aware of the differences by placing too much emphasis on having the right group composition with respect to race or sex, however.

It was decided to create heterogeneous groups with respect to the students' knowledge of different business areas that would be modeled, their academic ability and language. The students were asked to fill in a questionnaire where they were asked if they had worked in, used often, used seldom or never used a particular business area. The business areas were chosen to get a wide spectrum of students within the groups, for example, a free clinic, a health club, a restaurant etc. Students from different language groups were placed together to try to have more heterogeneous groups so that the students would be "forced" to use English which was the only language understood by all.

Instructional materials

Methods of co-operative learning, like the Jig-saw method, propose giving the different students in the group different material in order to promote positive interdependence and individual accountability [1].

An example would help to illustrate how this aspect was dealt with. The students were asked to draw a Use-Case Model and an ER diagram for the library, for example. Instead of giving all the students the same material, only an overview was given to all the students. The rest of the material was divided among certain of the group members who were termed the "users" for the session. One of the members was given the material with details of what happens at the front desk, another for the ordering of books and a third for the financial aspects of the library. As the students were put into groups based on their knowledge of the different business areas, the students with the most knowledge of a particular business area would be made a "user" in that particular area. This put each of the students into the situation where they had to participate, as they were the only people with the information needed by the group. It was also more comparable to what happens in industry where the JAD sessions are meant to bring together users with different knowledge.

Layout of the classroom

This was the same as for Case Study 1.

Running the JAD sessions

The JAD sessions were run similarly to those for Case Study 1 although the training that the students received helped them to work together more effectively.

The role of the lecturer

The task of the lecturer was not to solve problems or negotiate when there was conflict but rather to make sure that the JAD facilitator was doing his or her job. The lecturer also checked the solution at the end and discussed any problems with the group as a whole as for the previous case study.
Co-operative learning literature suggests that the lecturer needs to monitor the groups both with respect to their understanding of the material as well as their group dynamics [12]. The lecturer tried to point out to groups where their group processing was causing problems. The students were still expected to get the solution as a group, however, and the lecturer did not act as referee in conflict situations.

**Evaluation of group process**

Co-operative learning literature suggests that students must be given time at the end of a session to consider their own group processing and what they need to keep and what they might need to change [8]. It was decided to do this by using questionnaires where the students were asked to evaluate their group, the interaction within the group and the group cohesion. The lecturer then looked through these and made a summary for each group of any problem areas that were encountered. The groups discussed these problem areas at the beginning of the next class.

**Assessment**

The lecturer would discuss the students' Use Case or ER diagram with the group when the group thought that they were satisfied with the result. No marks were given to the group, but this did not seem to stop the groups from trying to get the best solution. Individual accountability was also promoted in that the students knew that they would be tested individually on the modelling techniques in any subsequent tests or examinations. The students evaluated one another with respect to their participation in the group and their abilities to act as facilitator during the last of the three JAD classes.

### 5.2 Research Results - Case Study 2

The research used a variety of methods to study the situation. The students were given a questionnaire on their own group skills before the learning took place. A pre- and post test of their knowledge of the modelling techniques was done with the examination serving as the post test. The questions on the pre test and the examination were deemed to be of the same standard by the three lecturers involved in the subject. Group questionnaires were done to evaluate the group processing after the first and last JAD sessions and they were used to evaluate if the groups changed over time. The main questionnaire contained both open and closed questions and was administered at the end to get both qualitative and quantitative answers to determine how the students perceived the method. An observer was also present and evaluated four of the groups and their functioning. It is impossible to review all of these results in detail in this paper. An overview of some of the results will, therefore be given.

#### 5.2.1 Group Processing

The students' contribution to the group and their feelings of acceptance within the group did seem to improve from the first to the second case study as shown in Table 1. CS1 stands for case study 1 and CS2 for case study 2.

As one can see from the table, there was an improvement in the number of people who felt that they were always able to have their say, contribute themselves, who felt that others always or mostly contributed and who felt that they were accepted by the group.

(In the discussion that follows, the numbers in brackets indicate the number of people whose answers could be categorised into this idea.)

Some of the feelings of the students expressed in the open-ended questions were that everyone was able to have their opinions taken into consideration (19), that the facilitators tried to accommodate everyone (16), that people listened to them and took notice of their opinions (32) and that they could express themselves if they differed on some point (13). On the negative side, many of the students felt that while most of them contributed there were some who did not (40). They attributed this to shyness (11), laziness (3), domination by some (3) and minorities feeling intimidated (2).

Some of the comments made by specific students were:

"There must be respect within the session and this needs to be enforced by the facilitator";

"We were a well combined (sic) group. I found it easy to feel accepted. We took time to get to know each other at the beginning of our first JAD session."

This idea of getting the students to learn to know one another at the beginning of the JAD sessions is one that could be fostered in the design of future classes.

The main questionnaire also asked them if they felt more confident about working in groups, if they felt that they had learnt to interact with other people better and if they felt that they had learnt to speak in front of small groups of people. (Note that these questions were changed from the questionnaire in the first case study and that a comparison of the results is therefore, not possible.) An option ALREADY KNEW was given to cater for those who felt that they already were able to work effectively and, therefore, did not need to learn anything.

In the open-ended questions people described how they felt less intimidated about sharing their ideas (10), how they learnt about interacting with people different from themselves (7) and how they felt that they had overcome their fears and were now able to communicate better (4). They also wrote about how they learnt to listen to other people and get their ideas (6) and how they learnt to get ideas from many different people and come to a decision (6). They described how they learnt to speak in front of people that they did not know too well (4) and felt more confident about doing so (19). Some of the comments made by the students in the open-ended questions...
Research Article

Table 1: Learning to work in small groups

<table>
<thead>
<tr>
<th>Do you feel that the JAD techniques helped you to learn to:</th>
<th>Already knew</th>
<th>Helped a lot</th>
<th>Helped a little</th>
<th>Did not help at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feel more confident about how to act in a group?</td>
<td>18.6%</td>
<td>48.8%</td>
<td>26.8%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Interact with other people?</td>
<td>26.7%</td>
<td>36%</td>
<td>31.5%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Speak in front of small groups of people?</td>
<td>22.1%</td>
<td>46.5%</td>
<td>26.7%</td>
<td>4.7%</td>
</tr>
</tbody>
</table>

Table 2: Did JAD help students learn about group techniques?

were:

“"It made me realize that anyone can speak their mind no matter who he/she is.""

“I like to be in control and it made me realize that I should sometimes listen to other people and let them have a turn.”

“It was a wakeup call for me to actually see what talking in front of people was all about.”

The students filled in questionnaires on their group’s processing at the end of the first and third JAD sessions. Although no significant differences were expected, a Mann Whitney test showed significant improvements in seven of the twenty items tested. It would seem that the group members were better at making sure that the objectives were clear to everyone, that the groups were more sensitive to one another’s feelings and that they were better at handling conflict. The groups also seemed to structure the session more effectively and finish in time. The students also perceived an improvement in their facilitation skills, their ability to ask questions in order to clarify points and their ability to make sense of what the group was telling them.

5.2.2 Experiences of using JAD

The students were asked to say how they experienced working in the JAD groups. Their quantitative responses are given in Table 3.

As we can see, 89.5% of the students enjoyed it most of the time (64.4%) or all of the time (25.2%) with only 9.3% enjoying it very seldom and 1.1% not enjoying it at all. What is interesting for this question is the answers given to the open-ended questions where the students were asked to describe what they enjoyed the most and what they liked least about the method.

On the positive side the students enjoyed interacting with other people (20), hearing other people’s ideas (18), working as a team (15), getting a good solution together (9), debating, arguing and reasoning with one another (8), and meeting and working with people that they would not normally work with (7). On the negative side people disliked people who did not contribute (19), people who did not take their ideas into consideration (10), people who took over and dominated the group (8) and the amount of time that it took (5).

What was disappointing was to discover that 8 of the 10 people who mentioned that they did not like it when people did not take their ideas into consideration were Xhosa speakers, with the other 2 being English speakers. The problem of the African students being left out of the groups was also picked up by the observer in the classroom. One of the groups where she noticed this problem had an African student who was a very high achiever and yet his input was not sought by his fellow students. One of the English-speaking students made the following comment: “I think that JAD is a brilliant method of educating. If the members participated it would be beneficial. South Africa still has serious racial problems and language barriers. It is sad that students can’t even do mock JAD without racial conflict.” There did not seem to be the language problems of the previous case study and there was no open racial conflict. It would seem, however, that the students were not very open to the difficulties experienced by the students whose home language was not English and who were, perhaps, more afraid to speak their views in front of the group. It must be stated, however, that the individual questionnaires on the students’ ability to work in groups showed significant differences in the different population groups in their confidence levels. This could mean that the problems were not solely as a result of domination by one group but may be a lack of confidence of some of the students. The problem of domination was not only observed
The method of using JAD with co-operative learning techniques seems to have been an improvement over using the JAD techniques on their own. The levels of participation were higher, the problem of "cliques" seemed to have been overcome and group cohesion seems to have been improved. The teaching of group skills before the time seems to have been effective in allowing students to be aware of what should happen in groups, how to come to decisions in groups and various other aspects of group dynamics. The division of material also seems to have been effective in making students more accountable and "forcing" students to participate who might otherwise have been quiet. The students also seem to have learned both the modelling techniques and some of the group skills needed for working in the changing IS development world.

Dividing the students into heterogeneous groups instead of letting them form their own groups also seems to have been fairly effective. There were still some problems with some team members dominating others, however. One of the ideas of co-operative learning, not used in this session, but mentioned by some authors is to have a student observer. This observer is used to tell the group if there are problems with the way the group is functioning. It may be a good idea to try this.

Another aspect that could be worked on is to let the students get to know one another a bit better at the start of the sessions as suggested by one of the groups who seemed to function well. Psychologists tell us that we tend to stereotype people if we do not know them well [2]. When people learn to know one another and see them in terms of their personal attributes rather than their race or gender, they become less likely to rely on stereotypes. Part of the group training before the sessions could be to help the students be more aware of this problem. One must be careful, however, of overemphasising it as a problem and making the students more aware of their diversity, however [14].

6 Conclusion

As we enter the new millennium, we need to look for new and innovative ways of helping IS students to develop the skills that they will need in the changing world of IS development. ISD has changed from one where all objects in the domain can be treated as controllable to one where users and IS developers have to work together to create a common understanding of their world and to be able to clarify and justify why they are working in a particular way. It has become imperative that IS curricula at tertiary institutions try to develop some of the skills needed in their students.

The technique of using JAD together with co-operative learning techniques is not promoted as the only way of doing this or even the best way of doing this. It has been shown to be effective in getting the students involved in their own learning, in giving them opportunities to work

<table>
<thead>
<tr>
<th>Enjoyed it a lot</th>
<th>Enjoyed it most of the time</th>
<th>Did not enjoy it most of the time</th>
<th>Did not enjoy it at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.2%</td>
<td>64.4%</td>
<td>9.3%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

Table 3: Experiences of working in JAD groups
with diverse people in a way that is non-threatening and in helping them to think about their solutions and defend them to others. This seems to have been effective in helping the students to learn the modelling techniques while they are also learning to work together with other people.

The skills and dispositions needed by people in order to achieve success include "the capacity for critical thinking and complex problem solving, respect for people different from oneself, principled ethical behaviour, lifelong learning and effective interpersonal interaction and teamwork." [7]. The challenge to IS tertiary lecturers is to develop these skills in our students.

Table 4: Did the JAD techniques help students to learn the modelling techniques?

<table>
<thead>
<tr>
<th>Already knew</th>
<th>Learnt a lot</th>
<th>Learnt a little</th>
<th>No help at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5%</td>
<td>60.5%</td>
<td>32.5%</td>
<td>3.5%</td>
</tr>
</tbody>
</table>

References


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  - the author's affiliation and address
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  - an appropriate keyword list
  - a list of relevant Computing Review Categories
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