GROUP CONSTITUTION FOR SMALL GROUP LEARNING IN THE FIELD OF INFORMATION TECHNOLOGY

by

Isabella Margarethe Venter

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SYNOPSIS

CANDIDATE: Isabella Margarethe Venter

PROMOTER: Prof. J.D. Roode

CO-PROMOTER: Prof. C. de Villiers

The research focuses on a different approach to the tertiary teaching and learning of certain subjects in computing in South Africa. It is a context in which the students are linguistically and culturally diverse, and where the prior educational backgrounds of many students have not provided them with a secure foundation for undergraduate-level study. Systems such as teamwork, cooperative learning and patterned note making, were developed in order to help students to learn more effectively.

This longitudinal research effort stretched over four years (1995 – 1998) and the data was from the same population - students at the University of the Western Cape (UWC). As part of the research approach to investigate the problem, Soft Systems Methodology (SSM) was adopted. Both qualitative and quantitative instruments of measurement were implemented.

The cultural diversity of the South African student population was acknowledged and the evolvement of the more dimensions of learning was promoted. Students were placed in groups using Belbin's team-role concept. Rather than presenting conventional lectures, students came prepared to class to discuss personal insights gained through individual learning in a group situation. Plenary discussion sessions as well as formal lectures were held at various points during the course. Access to the Internet allowed students to research topics for projects and communicate with team members.

The majority of the students indicated that working in teams contributed to their understanding of the subject, they gained on a personal and social level and learnt more in the group than they would have by learning individually. Most felt that the individual Belbin team-role profile provided them with insight into the contribution that they could make to a team. The more informal format of the lectures, and the presentation of mind maps were experienced positively by most students - they learnt new ways of ordering facts, which enhanced their understanding of the work.

SSM was an effective encompassing method to deal with the research process. A framework for group constitution for small group learning was developed using an inductive interpretation. The three perspectives used in this induction were Habermas' knowledge interests, hermeneutics, and Giddens' "*consequences of contemporary modernity*" theory.

The development of lifelong learning skills such as positive intergroup relations, the ability to write and communicate effectively and to work productively in teams, are needed to bridge the gap between tertiary education and the job market. It was found that students achieved academically significantly better when this method of teaching was implemented.

In the first chapter of this thesis the research problem is analysed and the "story" of the longitudinal research is told. The second chapter deals with literature on teamwork, cooperative learning, learning styles, mind maps and assessment. The research approach used in conducting this study is that of Checkland and Scholes and it, as well as the interpretive approach is presented in Chapter 3. In the fourth chapter each of the five study periods (case studies) will be discussed in more detail.

In Chapter 5 the results (of these case studies) are inductively interpreted. Chapter 6 contains the results of this induction in the form of a framework.

Finally, in the last chapter, the findings of this thesis are discussed and evaluated.

[Keywords: Computer Science, Information Technology, Education, Cooperative Learning, Teamwork, Team or Group Constitution, Lifelong Learning, Mind maps, Learning Styles, Conceptual Framework.]

TABLE OF CONTENTS

CHAPTER 2

LITERATURE SURVEY

CHAPTER 3

RESEARCH METHODOLOGY DISCUSSED

CHAPTER 4

THE PROBLEM REVISITED

CHAPTER 7

FINDINGS, DISCUSSION AND EVALUATION

APPENDICES

LIST OF ILLUSTRATIONS

LIST OF TABLES

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GLOSSARY (NOMENCLATURE)

COOPERATIVE LEARNING Learning in a group setting in order to maximize own learning and the learning of the group members. Hilke [1990] defines cooperative learning as an organisational structure where students can pursue academic goals through collaborative efforts creating opportunities to develop communication skills and higher-level thinking abilities. Johnson, Johnson and Holubec [1994] suggest that for the successful implementation of cooperative learning the following five elements should be implemented:

- **Positive interdependence** – if positive interdependence is lacking no cooperation can take place;
- **Individual and group accountability** – the group must be accountable for achieving its goals;
- **Promotive face-to-face interaction** – to promote each other's learning face-to-face;
- **Interpersonal and small group skills** – students must know how to provide effective leadership, decision-making and trust-building and how to communicate and manage conflict;
- **Group processing** – groups need to be able to describe which actions are helpful and which are unhelpful.

INFORMATION RICHNESS is defined as the ability of information to change understanding. It is, however, time dependent. A communication transaction that can overcome different frames of reference is considered rich. Similarly communications that clarify ambiguous issues, and in so doing change understanding over a certain period of time, are considered

rich. If the communication requires a long time to enable understanding or is such that it cannot overcome different perspectives, it is considered lower in richness. Richness is thus the learning capacity of a communication [Ngwenyama, 1997].

INTERNET A worldwide network that is a collection of many smaller networks linked by a vast array of network equipment and communication methods.

GROUNDED THEORY This is not a theory that is first generated and subsequently tested - it is *"inductively derived from the study of the phenomenon it represents. – Rather, one begins with an area of study and what is relevant to that area is allowed to emerge"* [Strauss & Corbin, 1990 :23].

HBU Historically Black Universities

THE HUMAN CONDITION

<table>
<tr><td rowspan="2">Ultimate structures</td><td>Society</td><td>Culture</td></tr>
<tr><td>Personality</td><td>Behavioural system</td></tr>
<tr><td>Physico-chemical nature</td><td colspan="2">Human organism</td></tr>
</table>

The upper left square (ultimate structures) contains the general structures of world understanding that determine how participants can relate to something in a world with their communicative expressions. The lower left square (physicochemical nature) represents the objective world of possible relations of this sort, the lower right square (human organism) the

subjective world, and the upper right square (society, culture, personality, behavioural system) the social world [Habermas, 1987: 251].

KNOWLEDGE INTERESTS The three basic areas of interest of society and other social organisations are the concepts of work (*technical knowledge interest*), mutual understanding (*practical knowledge interest*), and emancipation (*emancipatory knowledge interest*). Specific types of knowledge need to be acquired for each of these domains. Habermas refers to these as *"knowledge interests"* [Habermas, 1971, 1974].

LSI Learning Style Inventory. An inventory to assess individual orientations toward learning. It is used as a means of discussing the learning process with those tested and giving them feedback on their own learning styles.

MIND MAP Non-linear or patterned note-making. Concept as described by Tony Buzan.

OBE Outcomes-Based Education. The approach aims to increase the general knowledge of learners and to develop their skills, critical thinking, attitudes and understanding.

OUTCOMES are results of learning processes and refers to knowledge, skills, attitudes and values within particular contexts. Learners should be able to demonstrate that they understand and can apply the desired outcomes within a certain context.

REFLECTIVE CONVERSATION PROTOCOL A methodology for interviewing proposed by Schön [1983]. The interviews are mostly unstructured and conversation-like so that it is possible to probe directions and topics which emerge during the conversation. These emergent themes are normally not the themes that the researcher planned to discuss or evaluate. As in a conversation, the discussion progresses naturally –

resulting in the emergence of themes which otherwise would have been overlooked.

SAQA South African Qualifications Authority

SSM Soft Systems Methodology. SSM (as described by Checkland and Scholes) is: *"...an organized way of tackling messy situations in the real world. It is based on systems thinking, which enables it to be highly defined and described, but is flexible in use and broad in scope."*

TEAM-ROLE concept as described by Belbin. Each person has specific intrinsic personality traits (strengths) that can contribute to effective team functioning. Nine team roles have been identified and each person's profile will be a combination of all of these roles. The dominant roles are those that are easily assumed by the person. The remaining roles can be assumed by the person but only with great effort.

TEAMWORK Working on a task as a team.

TCI METHOD (Theme-centred interaction method) This method has three constituent factors (each of equal importance), namely, *"the 'I', the 'we' and the 'it'. For discussions to be productive the 'I' of individual interests must be balanced with the 'we' of group relatedness and the 'it' of the theme or topic"* [Jaques, 1995:26].

UNSTRUCTURED INTERVIEWS Interviews where questions posed are just posed to start a discussion. The interview is more like a conversation, it progresses naturally and themes emerge unintentionally. It allows the researcher to probe directions and topics he or she did not set out to discuss or evaluate.

UWC University of the Western Cape

WORLDWIDE WEB A vast worldwide network of servers that provide access to voice, text, video and data files.

Chapter 1

STATEMENT AND ANALYSIS OF THE PROBLEM

> *Learning is no longer a separate activity that occurs either before one enters the workplace or in remote classroom settings – learning is the heart of productive activity. To put it simply, learning is the new form of labour.*
>
> Shoshana Zuboff, *"In the Age of the Smart Machine: The Future of Work and Power"* [1988]

Introduction

The accessibility of information, the result of the enormous growth of the Internet and Worldwide Web (allowing remote access to powerful computers, digital libraries and information in general) as well as the growth of access to these international networks have changed the approach to university education. This paradigm shift away from the mere acquisition of knowledge to the demonstration of competence and skills [Denning, 1993] must impact on learning. Surface-level processing of texts in which students take a **passive approach** to learning is fast becoming *passe* and will have to be replaced with the **active approach** of deep-level processing. The classical approach of lectures with little contribution from the class has now become inappropriate as students (with such an approach) merely focus on the reproduction of information. Critical thinking, reasoning and reflection should replace rote learning, as knowledge gained today is outdated tomorrow. And this is especially true of the field of computing.

Academic programmes in computing and related disciplines have been in constant flux since the first official curriculum, Curriculum '68, was published and endorsed by the Association for Computing Machines

(ACM) and the Institute of Electrical/Electronic Engineers (IEEE) Computer Society. Most recently there has been the Curriculum '91 report ("Computing Curricula 1991" – Report of the ACM/IEEE – Computer Society Joint Curriculum Task Force, ACM Press, 1991) providing recommendations for Computer Science, and the IS '97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems, completed in 1995 and published in 1997 by the ACM, the Association for Information Systems (AIS), and the Association for Information Technology Professionals (AITP). At the 1999 Americas Conference on Information Systems held in Milwaukee, Wisconsin, USA, the Information Systems Centric Curriculum 1999 (ISCC'99) was presented [Lidtke *et al.*, 1999].

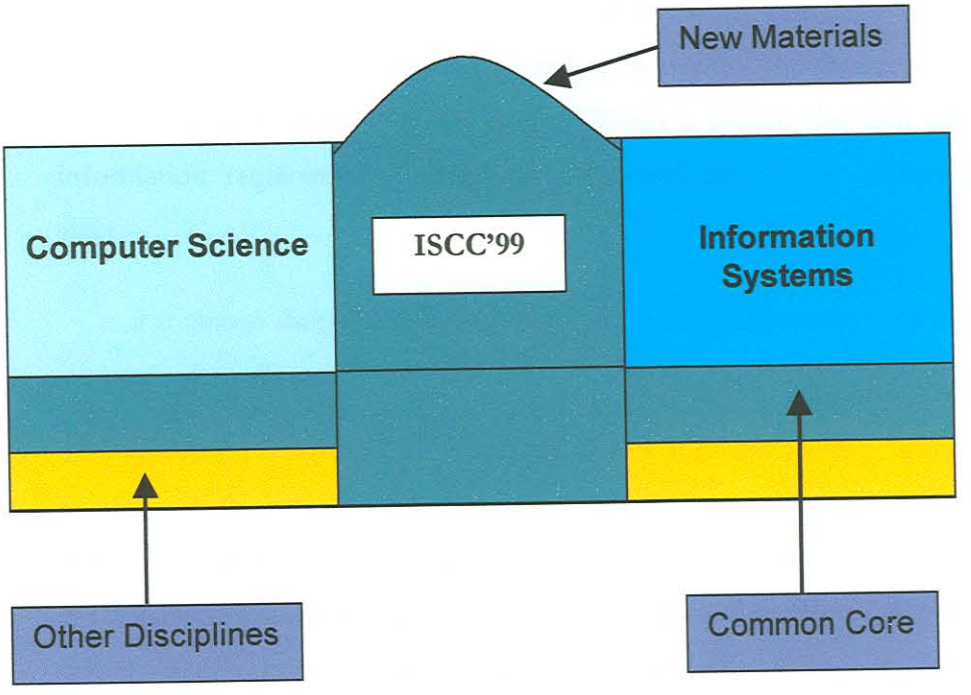


FIGURE 1: ISCC'99 [Lidtke *et al.*, 1999]

These recommended programme guidelines are applicable to existing and new degrees in Computing Information Science, Information Science,

Information Systems, Information Technology, Information Systems Specialists, Information Systems Engineering and related computing programmes. The relationship between Computer Science, ISCC'99 and Information Systems is shown in *Figure 1*. Contained in the **common core** are the courses IS'97.4 (Information Technology Hardware and Software which includes operating systems) and IS'97.6 (Networks and Telecommunications) underlining that topics such as operating systems and networks are common to all the above programmes.

Throughout this thesis, when reference is made to Computer Science, Information Systems or any specific part of the field of computing, the above more general meaning is intended.

Most work in the workplace is not done individually. Groups collaborate on tasks often because of the complexity of the task or the requirement for broader expertise [Olsen *et al.*, 1993]. Within a group, the task and its information requirements can be discussed and thus better understood, since –

> *...it is through dialogue that we accomplish and reaccomplish meaning, and thus bring order to the social world* [Boland, 1987: 366].

The formation of groups at university allows students to learn skills and concepts of the subject discipline, but groups also create the opportunity to learn about groups, thus developing abilities in co-operative work for later life. Students are adults - groups allow for an adult-adult relationship which brings about a more productive teaching and learning relationship between lecturer and student [Jaques, 1991].

This then is the background that needed to be sketched to establish **why** a **re-"think"** of the traditional teaching approach of subjects in the field of computing is necessary.

Framing the context

To frame the context of this study, it is necessary to tell the "story" of this longitudinal research effort. Even though the study was started in 1995 and is still evolving and continuing in 1999, it cannot be described as being longitudinal in the real sense of the word. Longitudinal research is defined as follows:

- Data is collected from the same group or population at more than one point in time.
- The variables are not experimentally manipulated. In short, the researcher has no control over the independent variables.
- Data is collected only; the researcher does not intervene in any way.
- And finally, the researcher may draw conclusions and attempt to find a correlation between variables by analysing the data.

To summarise, longitudinal research is ideal to research change over time in order to predict change in future [70]. The research methodology of this study is similar to a longitudinal research effort in the following ways:

- data was collected from the same population (students at UWC) at more than one point in time (from 1995 to 1999);
- it is a study where the investigator has practically no control over the dependent variables;
- and it was attempted to find a correlation between variables by analysing the data;

but the researchers did intervene in some ways. Thus the research cannot be considered to be nonexperimental and is therefore only a "*quasi*-longitudinal" study. In the account of the "teaching tale" I will adopt a confessional genre of representation.

The year this study was started, 1995, just over 50% of the student intake at UWC was African. The university was originally established in 1960 as an Afrikaans-medium university for so-called Coloured students but the student population has since evolved into a multicultural, multilingual population. The language of instruction is now by and large English; however, for most of our students English is still a second or even third language. Nearly all these students are first-generation university students. A small number will have come from well-resourced schools but most are from very poor families and with varying school backgrounds. Much of the schooling of these students will have been in an African language and school libraries, even access to a community library, will have been the exception [Hart *et al.*, 1996].

The initial idea to try group work with my third-year Computer Science students stemmed from my experience of lecturing to postgraduate students at a nearby business school. There the students were grouped into what was called a "syndicate", and they worked together as a group for the entire year of their Masters of Business Administration course. In many of their MBA courses, the syndicate had to produce a project which drew on the expertise from within the group and which would have been almost impossible to realise if it had been set for an individual student. Students in the MBA course are from a wide variety of backgrounds as the course is open to all postgraduate students. Thus it was not unusual to find a music graduate, a management science graduate, an engineer or even a professor of pediatrics in a syndicate, each bringing different expertise with him or her.

From course evaluation questionnaires I learnt that these students found the projects and presentations stimulating and challenging as these bridged the gap for them between the academy and business. It inspired me to apply the same concept here at UWC with the third-year courses I teach. I

believe that at third-year level students should have achieved the level of maturity to realise the importance of collaboration, as well as the establishment of working relationships with peers.

Thus in the third-year courses that I have been lecturing for several years now, I have always used group work as an approach to active learning. Students work in a group, constituting anything from three to six students, towards a combined goal such as presenting or writing a paper. Science students are seldom expected to write reports or verbalise their understanding of a concept. This is probably the reason they do not feel compelled to develop communication skills and why many lack the necessary skills needed to present or write a paper.

Students in a modern working environment will find that the knowledge gained at their tertiary institutions will mostly be insufficient to deal with unfamiliar challenges. This is the case for most students, but is **particularly** true for Computer Science and Information Systems students, since computer applications change very rapidly and knowledge gained today is outdated tomorrow. Therefore, it is unacceptable for students to memorize the prescribed work without the necessary understanding of the underlying concepts - it became apparent when students were examined that they could reproduce the prescribed text almost verbatim, sometimes inappropriately.

My decision to make group work an integral part of the courses that I lecture stems from the fact that I consider it to be important to foster and promote the acquisition of lifelong learning skills and to address the deficiencies of the traditional teaching methods. In the first semester of 1995 students were grouped into teams "geographically". That is: students who lived near to one another were grouped together to allow them to work together even when not on campus. In addition, I decided to enhance teamwork by introducing cooperative learning in the classroom.

Reginald Revans states in his model of Action Learning that knowledge which is a given can be acquired as individual (P-learning) by rote learning but that evolving knowledge is best acquired through interaction with colleagues "in adversity" (Q-learning) [Revans, 1980]. Olsen *et al.* are of the opinion that what is called for, is the analysis of group work to guide research of computer scientists on the aspects of technology that seem to impact most on the group interaction [Olsen *et al.*, 1993].

The cooperative learning approach I chose was that of Johnson *et al.* [1994]. According to Johnson *et al.*, five basic elements form the essential elements of **cooperative learning**:

Positive interdependence. Members perceive that they are linked in such a way that one cannot succeed unless everyone succeeds.

Individual and group accountability. The group is accountable for achieving its goals and each member for contributing his or her share of the work.

Promotive, face-to-face interaction. Students do real work together in which they promote each other's success by sharing resources, helping, supporting, encouraging and praising each other's efforts to learn.

Interpersonal and group skills. The acquisition of social, conflict resolution, management and leadership skills.

Group processing. This allows the group to reflect on how effective their team is functioning and if goals have been achieved, but also if relationships are conducive to effective group functioning [Johnson *et al.*, 1994].

In the second semester of 1995 Belbin's validated and standardised questionnaires were used to determine each student's psychometric profile. These profiles were then used to constitute so-called "balanced teams" based on Belbin's team-role theory. The students' lack of communication

and interpersonal skills, their inability to articulate the knowledge that they had gained and then possibly the way groups were constituted often resulted in students being excluded from their group, groups falling apart or groups not being able to deliver on time. When a team excluded a student, this student was literally "out in the cold" and had to present his or her own presentation as he or she would typically not be allowed to share in any of the team's achievements. Although I usually tried to mediate and intervene in such cases, the group in some instances were adamant that this excluded person did not contribute and therefore could not benefit from the group's efforts. There is obviously nothing wrong with this reasoning from the group's perspective but for the excluded student this can result in unnecessary hardship.

To understand why this sometimes happened and to try to prevent it, I drew on Belbin, who developed the **team-role concept**. He argues that to constitute an effective team, the team members of a team should *collectively* have certain intrinsic personality traits. Some of these traits should, however, not be duplicated amongst the team members as it could cause tension and consequently result in a dysfunctional team. He remarks that people need to know how they relate to others in order to succeed in establishing working relationships [Belbin, 1993]. In a similar study focusing on group work (teamwork) conducted by Michael R. Poppleton of Coventry (UK) over a 13-week period, it was found that students develop enterprise skills, team function and appreciation for each student's role within the team [Poppleton & Robinson, 1994].

The teamwork and cooperative learning of this study is thus based on a **combination** of insights derived from Johnson *et al.* [1994] and Belbin [1993]. The reader may now ask how these methodologies have been combined and implemented.

To facilitate cooperative learning in my classes, the five basic elements (of cooperative learning according to Johnson *et al.* [1994]) are discussed with the class:

Positive goal interdependence. The learners are told that they will truly cooperate if they feel that they will only succeed if everyone succeeds.

Face-to-face promotive interaction. Students are instructed to sit in a circle (face-to-face) and are encouraged to facilitate each other's learning in order to reach the group's goals.

Individual accountability. The students are told that each student will eventually be tested on his or her individual knowledge. Thus they will be tested individually on the work that was learnt within the group.

Social skills. Students are asked to respect differences within the group. They are instructed in ways to communicate effectively.

Group processing. Students are encouraged to reflect on the group's achievements and to find ways to improve their effectiveness.

According to Johnson and Johnson [1990: 30] –

> *People do not know instinctively how to interact effectively with others. Nor do interpersonal and group skills magically appear when needed. Students must be taught these skills and motivated to use them.*

Thus in order to achieve mutual goals students should be instructed how to communicate accurately and resolve conflicts constructively.

Groups were constituted with the aid of Belbin's team-role methodology. Belbin maintains that optimal team functioning is only possible once team members delegate tasks related to their personal weaknesses to other team members who have these skills as strengths, and when team members

accept responsibility for those tasks related to their personal strengths. Belbin identified these strengths and weaknesses as **team roles**. He maintains that each of the nine team roles has a distinctive contribution to make to successful team functioning. These team roles are summarised by Stoltz [Venter & Stoltz, 1995: 4] as follows:

The **Plant** should do most of the problem-solving or be responsible for generating any new strategies or ideas and proposing solutions to the rest of the team.

The **Resource Investigator** should be responsible for developing outside contacts and exploring any new opportunities. The Resource Investigator needs to be given a chance to conduct negotiations.

The **Co-ordinator** may be the last person to co-operate group effort, ensure that everyone has a useful role and that the team works towards a common and agreed goal.

The **Shaper** is the person best suited to overcoming obstacles and opposition, creating a sense of urgency and ensuring that talk is turned into worthwhile action.

The **Monitor Evaluator** should be made responsible for ensuring that all worthwhile options are considered by the team, needs a key role in planning and can act as an arbiter in the event of a controversy.

The **Teamworker** should play a floating role, using his/her versatile qualities to help with any features of the work that others cannot manage. The Teamworker has diplomatic skills which should be used to overcome conflict.

The **Implementer** should be appointed as the organizer, responsible for procedures and practical steps to be taken once the team reaches significant decisions.

The **Completer-Finisher** should ensure that the team's work meets the necessary deadlines and conforms to the highest standards, and should be responsible for ensuring that there are no inaccuracies or errors.

Belbin does not allocate a specific team task for the **Specialist**, because when a person operates in this mode, he/she tends to be a solo performer. However, it should be remembered that each team member usually has more than one strength (team role) and therefore the Specialist does not need to be excluded from the team.

Furthermore, a team need not consist of nine members only. According to Belbin, a team of three or four members can also be very successful if their collective dominant roles represent the nine team roles.

Although Johnson *et al.* [1994] also mention categories of roles that can be *assumed* to enhance team performance, roles such as:

- Forming
- Functioning
- Formulating and
- Fermenting

the Belbin approach in which team roles are *identified* by psychometric tests and are allocated to each team member in line with his/her intrinsic personality traits, was the preferred method for role allocation in my own class.

The Computer Science major in 1995 consisted of four blocked modules. The subject Operating Systems was lectured in the first part of the first

semester and each team had to present a short paper on new developments in the computer environment after the short midsemester recess. For the second semester module (Communication and Computer Networks) the teams were expected to set up a small network as a practical, but also to write a project on the acquisition of a small network for a fictional (or real) company. Finally each team had to give a short (10-minute) presentation on how they tackled the project, difficulties experienced, and why they decided on certain products. The tasks set for the team are almost impossible to attain individually, thus making the team effort imperative. Cooperative learning was used to share personal insights gained through individual learning. Thus each student learnt or read through the work before attending the class so that they could share their insight into the work with the group in a group situation. This was done for the purpose of conceptual insight but also to foster effective oral and written communication.

Qualitative data on the study was collected in the form of interviews (using Schön's "Reflective Conversation" protocol [Schön, 1983]), evaluation questionnaires, minutes of team meetings and field notes. Quantitative methods were used to analyse a questionnaire administered each semester from the second semester of 1995 onwards.

In both semesters of 1995 and the subsequent years of the study (1996, 1997 and 1998), the lectures deviated from the traditional presentation style. Students were expected to come prepared to class and were seated in their respective teams/groups (see *Figure 2*). The groups had to discuss areas that they found problematic. If none of the team members could provide a satisfactory explanation for the problem, the team could call upon the lecturer who would then give a brief presentation-style lecture on that particular section of the work.

To prevent students from rote learning the study material and to help students to get the "overall picture" and not to get bogged down by all the technical detail, the concept of "mind mapping" was introduced. (A mind map is a clear and concise graphical representation of relevant, associated, categorized and hierarchically ordered information.) Students were expected to brainstorm a section of the work and to produce a mind map as a group.

FIGURE 2: Students seated in their respective teams

The use of mind maps was first advocated by Tony Buzan. In his book "The Mind Map Book" he devotes a chapter to the group mind map.

In it he says that it is –

> *... extremely beneficial to work in a group, rather than studying alone, and to engage in active conversation about the material you are studying, rather than studying in silence -- very active verbalising leads to greater efficiency in the processing of the information, and to a greater recall.*

He contends that –

> *...working with others will result in the unique perspectives and associations of each individual contributing to a greater overall mind map and a much more comprehensive and integrated learning* [Buzan, 1995].

In all the years of the study (1995 – 1998) I have used cooperative learning, teamwork, mind maps and a more informal class situation to study the effect it had on the individual's perception of the work, but also to broaden the students' learning experience.

The group mind map could be used during the writing of tests. For the final examinations each group/team was therefore allowed to use their own two mind maps (both sides of an A4-sized paper) which covered all the work.

Team functioning did not always go smoothly, even though Belbin's method was used to constitute so-called balanced teams from the latter half of 1995. During interviews of the 1995 cycle, students indicated that teams gelled sooner in the second semester (when Belbin's team-role theory was used to constitute teams) than they did in the first semester (when teams were constituted geographically). This could be ascribed to the fact that the students had gained some experience in teamwork during the first semester and could therefore adjust sooner to the new teams. Or it could be that by using Belbin's theory in the second semester the teams were more balanced and therefore team functioning was more harmonious. It was interesting to

note that a student who was excluded in the first semester of 1995 (when teams were constituted on a non-Belbin basis), had no problems with the new team in the second semester (when Belbin's method was used). Another student had problems with both his teams, during the first semester as well as in the second semester of 1995. Most students (during this longitudinal research effort) indicated that they found the team-role profiles uncannily true. Some had their reservations but the majority indicated that they gained new insights into themselves and it made them realise their strengths and weaknesses.

The introduction of the group mind map was received very well. At the start of each course the mind maps were not inspiring at all, but as the groups/teams developed, their mind maps became more interesting. Eventually most teams produced excellent mind maps (see *Figure 3*). In the interviews students commented that the mind maps, but also the presentation of the mind maps by other teams, especially the repetition, helped them with the understanding of the underlying concepts. I found that the students attended classes regularly, perhaps because of a feeling of responsibility towards the group or possibly because they had to produce mind maps each week for presentation.

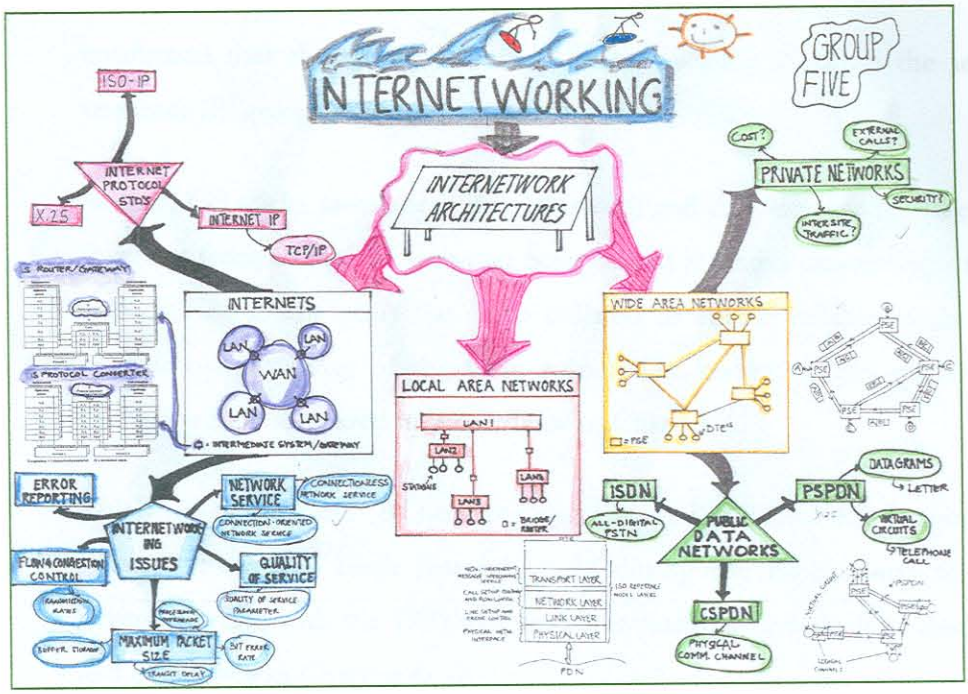


FIGURE 3: An example of a group's mind map

As this method of teaching seemed to be effective it was continued with slight adjustments in the next cycle. For example, Belbin was now the preferred method used to constitute the teams and the number of formal lectures was reduced. In the 1996 cycle it was decided to use a self-administered questionnaire to collect quantitative data to complement the qualitative data (only qualitative data was collected in 1995).

In the second semester of 1997 my colleague, who teaches Statistics and who helped me with the quantitative analysis, decided to implement this teaching method with her class as well. She had already lectured to this specific group using the traditional "chalk-and-talk" method during the first semester of 1997 and we were interested to see how the class would adapt to the group method. In this case study the lecturer, the class (student body) and the subject remained constant and it was the ideal opportunity to see if the new method had any academic merit. Our quantitative data

confirmed that the students in fact did significantly better in the second semester [Blignaut & Venter, 1998b: 6].

In the 1998 cycle, assessment was reviewed, and data was again collected – this time from both the Computer Science and Statistics classes. The team-role data of all the years has been collated to enable reliable quantitative analysis on groupings of the team roles. The results of this quantitative analysis will be discussed in more detail in Chapter 4.

This then is the "tale" of how the study started and how the longitudinal research evolved. Each research cycle during the longitudinal research period, starting with the 1995 first semester research cycle, will be discussed as a case study in Chapter 4.

The specific problem studied

At UWC (and now probably at most universities in South Africa) students are linguistically and culturally diverse and their prior educational backgrounds and experience are often not on par. For example: some of the students that enter for a first-year Information Systems or Computer Science course would have done Computer Studies at school whilst others would have had very little or no exposure to computers. This educational backlog is most pronounced in the first year but is mostly eradicated by third-year level. However, only a small percentage of students reach the third year within three years. The majority of students take four or more years to complete a three-year degree. In the 1998 research cycle 67.8% of the third-year students had been registered for four or more years and many of these students did not complete their studies in 1998, but were still – in 1999 - in their third academic year.

Teamwork was initially introduced in the third year of the Computer Science course (at UWC) to enable students to complete large tasks which required broader expertise. These teams were often observed as being

ineffective and disrupted by an imbalance of personality traits. However, it would be simplistic to place all the blame for dysfunctional teams on the imbalance of personality traits. Most of the students do not speak English at home and therefore they find it difficult to verbalise their understanding of concepts in English. This inability of some students to express themselves well in English contributed negatively to their team function in that it sometimes created the impression that the student did not understand or was "slow" in understanding the subject matter. Furthermore, students with a poor use of English resort to verbatim studying of the text, as they do not have the vocabulary to express their understanding in words other than those that appear in the text.

The "dated" method of lecturing exacerbates this inclination to memorise material, as students are never expected to communicate in the language of the subject, but rather to be passive listeners. The half-life of the contents of most subjects is diminishing and thus learning, just to stay abreast of events, is increasingly becoming an occupation for everyone [Kolb, 1984]. To memorise chunks of information is thus totally counterproductive. The exponential growth of knowledge requires of the "*learning species*" to *learn* to adapt to a changing world. Students should thus rather learn to learn and come to grips with new material quickly than to "*accumulate a storehouse of facts*" [Kolb, 1984: 26].

Since many students resort to verbatim studying of the prescribed text, it was felt that cooperative learning could foster more effective oral and written communication and thus limit the need for memorisation. According to Craig –

> *Dialogue, conversation, debate, discussion and argument among peers seem a neglected and yet an obvious move in the case of unprepared students* [Craig, A.P., 1989].

It could thus be argued that cooperative learning, where students are expected to converse with peers, is a more desirable teaching method for these students who typically come from varied academic and socioeconomic backgrounds. However, cooperative learning requires of teams to spend more of their time working together. It becomes more important therefore to constitute *balanced* teams, or rather, teams that function effectively and where the team members interact efficiently.

Research questions

The specific problem of group constitution for small group learning in the field of information technology raises some research questions, which will be raised now. In Chapter 3 it will be shown *how* these questions were derived and *why* they are important. The research questions are addressed throughout Chapter 4 and are revisited in Chapter 7.

Team constitution

How should teams be constituted? Should it be fluid in the sense that teams change for each setting? Can teams be put together in such a way that learning/work is enhanced and not influenced by team dysfunction?

According to Johnson *et al.* [Johnson, 1994] there is no ideal group membership. They are of the opinion that a group's productivity *"is not who its members are, but rather members' teamwork skills"*. And these skills can be acquired through training. They do, however, give consideration to the group's diversity and feel that there are advantages to heterogeneous groups in some cases and advantages to homogeneous groups in other cases, depending on what needs to be achieved. When students group themselves, they usually form homogeneous groups – if the lecturer forms the groups it may be either.

Jaques [1991] is of the opinion that as the size of a group increases, its characteristics become more fixed. For instance, in large groups positive leadership is vital to success.

In this study several methods of team constitution have been investigated. Teams were initially constituted to allow students in geographical proximity to work together even when not on campus. These teams, however, often fell apart because members never gelled into a synergistic team. (Senge is of the opinion that a synergistic team reinforces or changes groupthinking patterns effectively. When team members discuss notions and assumptions, a deeper understanding and insight may result [Senge, 1990].)

To remedy the above-mentioned shortcomings in team construction, teams in the latter part of the study were all constituted using Belbin's team-role theory. Belbin's validated and standardised questionnaires (a self-assessment as well as the minimum of four observers' assessment questionnaires) and the software Interplace IV, were used to determine each student's psychometric profile. These profiles (without any reference to either gender or academic achievement) were then used to constitute so-called "balanced teams" based on Belbin's team-role theory. In the current application of Belbin's method of team constitution, care is taken that students within groups are academically diverse (thus that there is a good mix of high achievers and low achievers in a team).

Belbin, who developed the team-role concept, identified nine team roles, each with its associated strengths and weaknesses. He argues that to constitute an effective team, team members should *collectively* have certain intrinsic personality traits. Each person's profile will be a combination of these roles; therefore a team need not consist of nine members to be balanced [Belbin, 1993].

A consultative session is used to explain to students why they are grouped in a particular way; at the same time feedback is given to each student on the psychometric tests conducted. It is made clear to them that in their work environment they will not necessarily have a choice with whom they want to work. Time is set apart in the course to explain the underlying concepts of teamwork as well as cooperative learning (as defined by Belbin and Johnson *et al.*) to the class. It is emphasized that they will probably gain insight into the role they will be able to play in a team and will gain personal growth through this exercise. Each student receives a summarised report of his/her rating of himself/herself compared to the ratings of his/her four observers and a final weighted rating indicating his/her dominant team roles. They receive a further personalised report, which highlights the student's traits that will positively contribute to a team as well as his/her allowable weaknesses within the team.

In general, our teams have five members, with the odd exception where a team will consist of six members. The size of the team is mostly determined by the size of the class and the available resources such as computers, etc. A group size of six is considered to be the largest group where leadership can be fluid or where it can be democratically shared among the members of the group. Democratically-led groups, compared to authoritarian-led and *laissez-faire* groups, although slower in getting into production, are believed to be more motivated and productive with time and learning [Jaques, 1991].

Teams will be a unit for the period of instruction. This period is usually a term - approximately seven weeks - or a semester - thirteen weeks. Johnson and Johnson [1994] refer to such groups as "formal cooperative learning groups", as opposed to "informal groups".

It is felt that this longer period will allow the team to develop the required elements of cooperative learning as suggested by Johnson and Johnson [1994], namely:

- Positive goal interdependence
- Face-to-face promotive interaction
- Individual accountability
- Social skills
- Group processing.

Similar to the Belbin team roles, Johnson *et al.* also mention categories of roles that can be assigned to team members, namely:

- Explainer of ideas or procedures
- Reader
- Recorder
- Encourager of participation
- Checker of understanding
- Observer
- Support giver
- Clarifier/Paraphraser, etc.

Students are instructed in the use of social and interpersonal skills such as **forming** (staying with the group, using quiet voices), **functioning** (contributing, encouraging others to participate), **formulating** (summarising, elaborating) and **fermenting** (criticising and asking for justification of ideas). Each of these skills has its associated roles. The rationale of assigned roles is that team members get the opportunity to develop a variety of skills. (Different skills are needed for each of the roles.)

However, these roles, as advocated by Johnson and Johnson, are assigned to students arbitrarily and in a "role-playing" mode. In contrast, Belbin team roles are the roles assumed naturally by a team member. It is "natural" in that it is the role he/she will normally assume in a group and it is in line with his/her intrinsic personality traits.

Formal/informal lecture ratio

How often should discussion groups/teamwork be alternated with plenary sessions and formal lectures to make learning successful?

Although students need to accept responsibility for their own learning and group work is the ideal environment for the fruition of this ideal, formal lecturing can still be of value when in certain cases the whole class has problems understanding a section of work. Plenary sessions allow groups to share comments with other groups on problematic topics or topics of shared interest.

A plenary session and formal lecture are scheduled for approximately 20% of the total lecture time. Plenary sessions will be used only to clarify work that is not understood in the group sessions. This may be subsequent to the group discussions or it could also be anticipated that a section will be difficult to grasp. It is being recognised that tertiary education is not solely the ability to understand, analyse and know the subject material, but also the ability to communicate, apply and interpret the material. These skills can best be acquired by practising [Jaques, 1991]. Talking about these skills, as would be done in a formal lecture, is therefore not ideal. Small group learning is a vehicle to transfer these abilities and to aid learning in more than the perfunctory sense.

Students who experience this teaching method for the first time in their second or third year at university find it difficult to adapt. However, with careful monitoring, the majority find the method satisfactory once they are

accustomed to it. They experience small group learning as a more mature approach to learning.

Successful learning

What could be considered a successful learning experience? Perhaps the following quote says it all:

> *The things we know best are the things we haven't been taught.*
>
> Vauvenargues, "Reflections and Maxims" [1746]

Ross is of the opinion that while most learn easily, many find it difficult to be taught –

> *All normal, healthy children learn happily and naturally, yet schooling no longer builds on this* [Ross, 1997].

If students can nurture their individuality and build on their talents and achieve this in an informal way, learning can be considered to be more natural. Can informal learning therefore be considered a successful experience? According to Kolb, we will have to –

> *...cast our lot with learning, and learning will pull us through*

– if we want to keep up with a rapidly transforming world.

> *But this learning process must be reimbued with the texture and feeling of human experiences shared and interpreted through dialogue with one another* [Kolb, 1984: 2].

Unfortunately the reality is that daily school and university practice is "*learning to the test*" and students usually equate successful learning with high scores [Dochy & Moerkerke, 1997]. It is therefore important to investigate the "real" definition of a successful learning experience.

Measuring "success"

According to De Villiers [1996b] the success of cooperative learning depends on the ability of learners to teach each other. However, how is this measured?

Cohen, on the other hand, suggests that the productivity, effectiveness or successfulness of teamwork and cooperative learning can be measured using the following criteria [Cohen, 1994]:

- Academic achievement – this type of achievement stresses basic skills such as memorisation of factual materials
- Conceptual learning and higher-order thinking - stresses learning through thinking
- Equity or equal status within the group – this is typically measured by noting the participation rates of students of differing statuses
- Positive intergroup relations (in a multi-ethnic setting) and desirable prosocial behaviours such as being cooperative and friendly.

Assessment

A new teaching paradigm necessitates new assessment instruments. But how should students then be assessed? Johnson *et al.* suggest involving the students in the assessment process. This can be implemented as peer evaluation and can be used in conjunction with the lecturer's evaluation. However, it is accepted that students gear their learning according to the method of evaluation. If evaluation is a written examination, students tend to work through previous papers, giving rise once again to rote learning.

Dochy and Moerkerke are of the opinion that assessment should be integrated with learning and instruction. Reform in assessment leads to changes in instruction [Moerkerke, 1996], but the opposite is also true - changes in instruction will lead to changes in assessment.

Raters and candidates need to know the criteria of assessment and the rater needs to give a rating which is valid with respect to the skill being assessed [Dochy & Moerkerke, 1997]. There is thus a need to reconceptualise assessment instruments. The question that can be raised is thus: what evaluation method reflects learning best?

New types of evaluation instruments are required that allow the assessment of understanding (or misunderstanding) as well as the differences in learners' approaches to challenging learning situations [Dochy & Moerkerke, 1997]. On the other hand, do present structures of examinations adequately test the dimensions of learning we wish them to?

Conclusion

In the first chapter of this thesis the "story" of a longitudinal research effort has been told. (The study cannot be considered a true longitudinal study as the definition of a longitudinal study rules out any intervention implemented. However, the research was done over a long period, namely from 1995 to 1998.) The "story" of the study paints a picture of how a linguistically and culturally diverse student population can be drawn together and accommodated by a different approach to the teaching of subjects in computing. This approach included teamwork, cooperative learning, mind maps and a methodology of team construction designed by Belbin. The problem areas that necessitated a new approach, namely underprepared students, the language barrier, the "dated" method of lecturing and verbatim studying, were stated and analysed.

In the second chapter, the literature on teamwork, cooperative learning, learning styles, mind maps and assessment will be discussed. The research approach used in conducting the five case studies (which will be discussed in Chapter 4) was that of Checkland and Scholes [1990]. This methodology, as well as the grounded theory approach, is presented in the

third chapter. The research problem is revisited as case studies in the fourth chapter. Each study period (considered as a case study of a particular intervention) with its quantitative and qualitative results will be stated and explored in more detail in this chapter. In Chapter 5 the results, obtained from the case studies, will be inductively interpreted. Chapter 6 contains the results of this induction in the form of a framework. Finally, in the last chapter, the findings and the contribution of the research are evaluated.

It should be noted that no claim is made that the results of this study are particularly relevant to the field of Information Technology rather than any other discipline. The researcher happened to work in the field of Information Technology, where the research problem presented itself. The case studies should also be seen in this light: not planned to represent the or a discipline, but rather to help the researcher gain an understanding of the problems related to group constitution for small group learning.

These practicalities implied that the researcher did not "plan" a longitudinal action research programme, but rather utilised elements of action research during the series of cases studied from 1995 - 1998.

Chapter 2

LITERATURE SURVEY

There is no subject so old that something new cannot be said about it.

Dostoevsky, *"Diary of a Writer"* [1876]

Introduction

In the previous chapter the specific problem of a linguistically and culturally diverse student population was touched upon. Several related problems where highlighted, such as the problem of the underprepared student; the learning methods - verbatim studying; inability to use the language of the subject; and the dated lecturing method. In this chapter the literature that deals with these problems will be discussed.

Learning, more specifically learning in groups, cooperative learning, lifelong learning and experiential learning, is a topic that has interested many researchers. The literature on cooperative learning and team constitution will be explored in more depth and the literature on related topics such as methods of assessment, learning styles and methods of knowledge representation will also be discussed.

Cooperative learning

Hilke defines cooperative learning as an organisational structure where students can pursue academic goals through collaborative efforts creating opportunities to develop communication skills and higher-level thinking abilities [Hilke, 1990].

Some researchers differentiate between the terms "collaboration" and "cooperation" whilst others use them interchangeably. Argyle [1991] is one of the researchers who use the concepts interchangeably. In the Oxford dictionary "cooperation" is described as "*work or act together; help, assist*" whereas "collaborate" is defined as "*work jointly, especially in a literary or artistic production*".

The differences that some of the researchers draw between the concepts of collaboration and cooperation are as follows:

- Hoyt [1978] sees collaboration as a term that implies sharing of responsibility whereas cooperation is the working together of separate autonomous parties to make their separate programmes more successful;

- Hold [1986] is of the opinion that the concepts differ in terms of time (more time is needed to collaborate than to cooperate);

- Freer and Enoch [1994] find the difference in the interplay between instructor and learners. According to them the teacher in the cooperative learning environment assumes the traditional role of the transmitter of knowledge, whereas the teacher is a facilitator and co-learner in a collaborative learning environment.

In this study the term cooperative learning is used but collaborative learning could just as well have been used. Furthermore the lecturer in the cooperative environment will be seen as a facilitator and co-learner. Why co-learner?

As the editor of the *British Medical Journal*, Richard Smith, says in the editor's comment of the August 1999 edition:

> *In the Old World you were expected to know what you should know, learning was complete at the end of training, and uncertainty was discouraged and ignorance avoided. In the New World the most important thing to know is what you don't know. And you should feel good about not knowing.*

And this holds true even for the lecturer.

Researchers who have written several books on cooperative learning are David and Roger Johnson. In their books they advocate that the use of cooperative learning will accomplish several goals: raise the achievement of all the group's participants; create a learning community in which diversity is valued; and allow students to develop socially, psychologically and cognitively [Johnson, Johnson & Holubec, 1994]. For the successful implementation of cooperative learning they suggest the implementation of the following five elements:

1. **Positive interdependence** – if positive interdependence is lacking no cooperation can take place;

2. **Individual and group accountability** – the group must be accountable for achieving its goals;

3. **Promotive face-to-face interaction** – to promote each other's learning face-to-face;

4. **Interpersonal and small group skills** – students must know how to provide effective leadership, decision-making and trust-building, and how to communicate and manage conflict;

5. **Group processing** – groups need to be able to describe which actions are helpful and which are unhelpful.

They furthermore suggest that groups should extend cooperation to include other groups too. According to their model, base groups are groups that last from one to several years, formal groups can be maintained for any length of time that suits the lecturer, and informal groups last for only a few minutes or at most one class period.

Johnson *et al.* suggest that the lecturer should monitor group work closely and intervene if necessary. They suggest that there are certain aspects of intervention that must be heeded:

- intervene only when absolutely necessary (don't jump in frequently to solve problems);
- intervene at eye level (don't look down onto group);
- label actions, not students (don't embarrass or insult a student by labelling the student);
- have whole group focus on you, the lecturer (don't have a *tête-à-tête* with one student);
- allow students to solve the problem, etc.

If groups experience problems Johnson *et al.* suggest that they should **not** be changed. That is, members of a problem group should not be transferred to another group, as this – according to Johnson *et al.* - would be counterproductive. Johnson *et al.* are of the opinion that students need to acquire the skills to resolve problems in collaboration with each other.

Discussion groups allow students to explore their understanding of the work and can bridge the gap in language proficiency as Lotan and Benton experienced with Spanish-speaking Americans [Lotan & Benton, 1990].

Jaques [1991] notes:

> *Many of the issues (concerning learning in groups) may seem far-fetched to academic tutors, especially those in the physical sciences and engineering whose central concern is not with personal feelings ... but with imparting a body of knowledge.*

Contemporary life, in particular in the industrial section, demands of people to get on with each other and to be able to handle interpersonal problems. Small group work creates the opportunities to practise these qualities [Jaques, 1991].

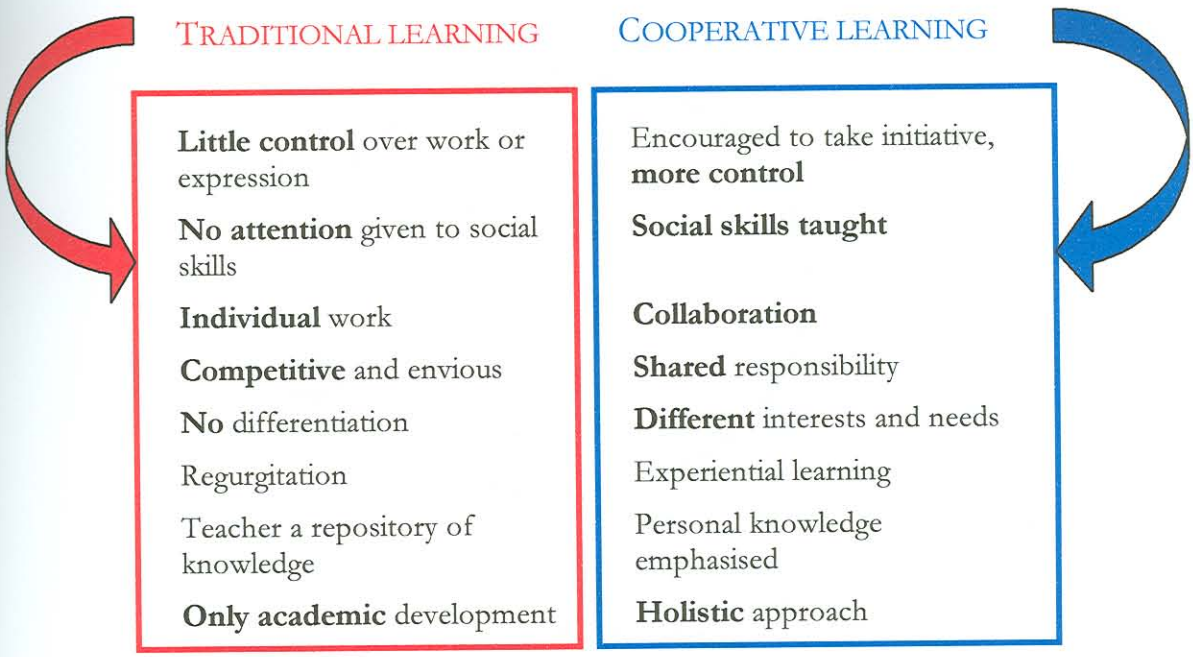


FIGURE 4: Comparison between traditional and cooperative learning [Source: De Villiers, 1996b: 4]

Cooperation is the key to learning in groups, according to him. Competition within a group may be an inspiration for some to work harder and reason with more persuasion, but for others it may only result in the dulling of their appetite for discussion. Cooperation does not happen by itself – it is only learnt through experience. It is therefore necessary to have

a clear strategy for learning about working together and to improve skills in cooperation. For cooperation to be successful each member of the group must participate and share the responsibility for the group's success or failure. Cooperative learning is more than just learning IN groups - it is also learning ABOUT groups.

For effective group interaction Jaques suggests the theme-centred interaction (TCI) method. TCI has three constituent factors (each of equal importance), namely, the "I", the "we" and the "it" as seen in *Figure 5*.

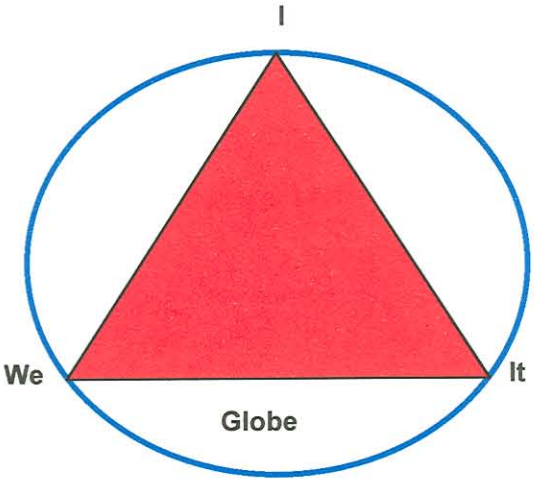


FIGURE 5: The theme-centred interaction triangle and globe
[Source: Jaques, 1991: 26]

The "globe" that contains the three elements comprises the physical, social and temporal setting of the group. It includes the shape of the room, arrangement of furniture and the emotional milieu of the group.

Two of the principles that guide TCI are:

- thought and feeling should not be separated; and
- that each person speaks for himself or herself.

The latter means that no one can speak for the group without first checking with the rest of the group. And it encourages group members to speak in the first person rather than generalising by using "you". A further principle of TCI is the fundamental rule that if a group member is unable to focus on the group task because of some reason, they should say so. The emotional background is thus revealed. According to Jaques, TCI is strongly influenced by both existentialism and psychoanalysis:

> *... it provides a framework for each individual to internalise and understand his or her own place and function in a group.*

According to Kolb [1984], learning is a continuous process grounded in experience. Knowledge gained through personal experience has more significance when it was gained through own insight or discovery and when participation with others is valued. Thus –

> *...the sense of belonging which a student can gain from a well-run group (team) should not be underestimated* [Jaques, 1995: 10].

Cohen suggests that the effectiveness of teamwork and cooperative learning can be measured using the following criteria: academic achievement, conceptual learning and higher-order thinking, equity or equal status interaction within the group, positive intergroup relations and desirable prosocial behaviours [Cohen, 1994].

According to Craig, dialogue and discussion among peers seem to be neglected in the case of unprepared students [Craig, 1989]. Cooperative learning, where students are expected to converse with peers, is thus

probably a more desirable teaching method for our students, who typically come from varied academic and socioeconomic backgrounds.

Yael and Shlomo Sharan have written extensively on the topic of cooperative learning. They are of the opinion that group investigation, where each group member carries out his or her part of a cooperative investigation, harnesses each student's individual interest and thus gives them more control over their learning [Sharan & Sharan, 1990].

According to Ivancevich and Matteson [1996] groups learn just as individuals do and the performance therefore of the group depends as much on individual learning as on how well the members learn to work with one another.

A model of group development suggests that groups develop in five stages [Tuckman & Jensen, 1977]:

1. In the **forming** stage, groups are uncertain about the group's purpose, structure and leadership. According to Tuckman and Jensen this stage is more pronounced in multicultural groups. At the end of this stage group members feel part of the group.

2. The **storming** stage is when group development hits a rough patch and conflict and confrontation is experienced. While some members may accept the group, they may still resist the control the group imposes on them. During storming the group's tasks and goals can be redefined and the individual group members are likely to decide their commitment to the group. Storming needs to be managed rather than suppressed as suppression creates negative effects that can seriously hinder group functioning at a later stage.

3. During the **norming** stage group cohesion develops and this stage is characterised by cooperation and collaboration. Members accept

differences of opinion and actively try to achieve their mutually agreed-upon objectives.

4. **Performing** is the functional stage of the group. The group structure has been determined and each member's role is understood and acknowledged. The accomplishment of the set task is now the focus of the group. This process of learning and development within the group will be ongoing if the group accomplishes their task well or can become stagnant if the group does not perform. The way the group will go depends on the earlier stages of group development.

5. The **adjourning** stage involves the termination of group activities. This stage can be a positive experience for all the group members, especially if the task the group set out to complete was accomplished successfully. However, there may also be a feeling of loss and disappointment when the group's task has been completed and the group disbands.

In his discussion on the new interpretation of higher education, Denning mentions the necessity to learn how to work in teams. He is of the opinion that the lifelong skills that employers, parents, and business executives are now looking for in our graduates are:

- Being a power user of computing systems and a competent builder of applications
- Balance between practical and theoretical knowledge
- Awareness of need to function in an international, networked world
- Ability to work with clients and produce satisfaction
- Skills in communication written and oral
- Ability to communicate a vision and a mission
- Ability to work productively in teams

- Ability to understand and follow instructions
- Eagerness to learn (continuing education)
- Ability to bounce back from adversity
- Flexibility and adaptability in job and career

> *We cannot create an environment in which students learn these skills by the tradition of presentation-oriented lectures* [Denning 1993: 102].

Although all these skills (that a student needs to "*be competent at living and working in the world as it is now and will be in the years ahead*") are equally important, I would like to focus on the necessity to learn how to work in teams, and more particularly the effect that the team can have on an individual's learning experience.

It would seem as if the construction of the team could have an impact on the effectiveness of the group or team. It is thus necessary to investigate what the literature says about the mechanics of group/team construction.

Team construction

Different cooperative learning models such as Jigsaw, Jigsaw II, Teams-Games-Tournament, Student-Teams-Achievement Division, etc. have been thoroughly researched and documented [De Villiers, 1996b]. A short description of each of the above learning models will highlight their application, similarities and differences:

Jigsaw. Each member of a team is instructed on a topic together with counterparts from other teams. They discuss their understanding of the topic with these students before returning to their own teams. On their return to their own group they teach their team members what they have learnt.

Jigsaw II. An adaption of Jigsaw where teams compete for group rewards, and each student's achievement contributes towards the group's points.

Teams-Games-Tournament. Teams compete face-to-face in tournaments. Tests and quizzes determine students' individual scores.

Students-Teams-Achievement Division. Learners tutor each other in preparation for a competition. Teams are constituted to have similar abilities. Learners can earn points for their team by improving their individual performance. The team's achievement is acknowledged publicly on bulletin boards or in newsletters.

In most of these above-mentioned models, teams range from three to seven members and are heterogeneous with regard to ability level, race, sex and personality factors.

As far as group constitution is concerned Johnson *et al.* [1994] feel that there is no ideal group membership. They are of the opinion that a group's productivity *"is not who its members are, but rather members' teamwork skills"*. And these skills can be acquired through training. They do, however, give consideration to the group's diversity and feel that there are advantages to heterogeneous groups as well as homogeneous groups depending on what needs to be achieved. It has been found that when students group themselves, they usually form homogeneous groups – whereas if the lecturer forms the groups, it may be either.

Jaques highlights the influence that the size of the group has on the group function. He is of the opinion that as the size of a group increases, its characteristics change. He summarises this as depicted in *Table 1*.

More Cohesion

NUMBER OF MEMBERS	CHANGING CHARACTERISTICS
2-6	Little structure or organization required. Leadership fluid.
7-12	Structure and differentiation of roles begin. Face-to-face interaction less frequent.
12-25	Structure and role differentiation vital. Subgroups emerge. Face-to-face interaction difficult.
25- ?	Positive leadership vital to success. Subgroups form; greater anonymity. Stereotyping, projections and flight/fight occur.

More Tension

TABLE 1: Changing characteristics of groups with increase in membership [Jaques, 1991]

In his observations of groups and their group function Belbin also indicates that the size of the team does have an influence on its function. Belbin observed that the difference between a six-member and a four-member team revolved around the chairmanship. Four-member teams often became leaderless while five-member teams seemed to be well regulated. In a five-member team –

> *...the group is large enough to benefit from an organization, while the (chairman's) casting vote becomes decisive should uncertainty or disagreement threaten* [Belbin, 1981].

Our preference for the Belbin approach stems from the fact that team roles are assumed according to the team members' **intrinsic personality traits** rather than being allocated to the member. Although each member could be allocated any of the tasks, some tasks are simply done with less effort by a person who is inclined to assume that role naturally.

Belbin's validated and standardised questionnaires (a self-assessment as well as the minimum of four observers' assessment questionnaires) and the software Interplace IV were used in this study to determine each student's psychometric profile. These profiles (without any reference to either gender or cultural background) were then used to constitute academically diverse but "balanced" teams. Belbin, who developed the team-role concept, identified nine team roles, each with its associated strengths and weaknesses [Belbin, 1993].

The nine team roles are:

- Plant
- Resource Investigator
- Coordinator
- Shaper
- Monitor Evaluator
- Teamworker
- Implementer
- Completer Finisher
- Specialist

Belbin defines a team role as –

> *...a pattern of behaviour characteristic of the way in which one team member interacts with another where his performance serves to facilitate the progress of the team as a whole.*

He maintains that each team role has a distinctive contribution to make to successful team functioning. Each team role has a set of "allowable" weaknesses associated with it, and Belbin describes these allowable weaknesses as the *cost* of the positive contribution of the team role to the team.

Stoltz [Blignaut *et al.*, 1998] said (in the presentation "*Chalk-and-talk" versus Cooperative Learning: A Comparative Study,* presented at the IFIP'98 Conference) that Belbin's team roles can be grouped, amongst others, into four categories:

Ideas Roles

The Plant and Resource Investigator bring ideas to the team. The Plant tends to contribute self-generated ideas, while the Resource Investigator is a good scout and collects ideas externally to the team, thus avoiding an internal focus. The associated allowable weakness of the Plant is forgetfulness and that of the Resource Investigator is a tendency to be easily bored and somewhat erratic.

Leadership Roles

The Shaper, who can be aggressive, creates a sense of urgency in the team and focuses the team's activities on stated goals. The Coordinator is like the conductor of an orchestra and coordinates the activities of the team inconspicuously to achieve mutually formulated goals. The Coordinator can be manipulative and can be viewed as lazy.

Control Roles

The Monitor Evaluator is a very analytical individual and can evaluate alternative possible solutions without becoming emotionally involved. However, the cost of having this individual in the team could be a tendency to be overcritical. The Completer Finisher is conscious of detail but can get bogged down in unnecessary detail and become anxious, while the Implementer is a well-organised individual, able to prioritise tasks. The Implementer can become rigid.

Support Roles

The Teamworker is the individual who offers emotional support and alleviates conflict in the team, but can be indecisive, and the Specialist is the team member who provides "technical support" IF the team's area of concern is within his/her area of personal interest. The Specialist can be territorial.

Another grouping of roles mentioned by Belbin are:

Social Roles

The Resource Investigator is the person who is outgoing, enthusiastic and, most importantly, develops contacts. The Teamworker is the perceptive and diplomatic team member who averts friction and calms the waters. The Coordinator delegates well, is confident and a good chairperson.

Thinking Roles

The Plant is the creative and unorthodox thinker. The Monitor Evaluator sees all the options and judges accurately, and the Specialist provides knowledge in rare supply.

Acting Roles

> The Implementer is disciplined and turns ideas into practical actions. The Completer Finisher searches out omissions and, most importantly, delivers on time. Finally, the Shaper is dynamic, thrives on pressure and has the drive and courage to overcome obstacles.

To constitute an effective team, Belbin argues that team members should *collectively* display the personality traits associated with all the team roles. Each person's profile will be a combination of these roles; therefore a team need not consist of nine members to be balanced [Venter & Stoltz, 1995].

Barbara Senior [1997] found, in a study done on 11 management teams of between four and nine members, that there was a link between team performance and team-role balance.

Mind maps

The concept of cooperative learning within a team, combined with the concept of "mind mapping" [Buzan, 1995], was introduced to help students to get the "overall picture" and not to get bogged down by the technical detail of their study material. (A mind map is a clear and concise graphical representation of relevant, associated, categorized and hierarchically ordered information.)

Prof Roger Sperry of California found in the late 1960s that the two hemispheres of the cerebral cortex divided the major intellectual functions between them. Thus the two hemispheres of the brain use two different modes of knowing about the world, namely apprehension and comprehension. To come to this conclusion, Sperry and his colleagues studied the behaviour of split-brain patients, patients who had undergone an operation to surgically divide the *corpus callosum* (neural fibres that

connect the left and right neurocortex) to relieve the severity and frequency of epileptic seizures [Kolb, 1984: 46].

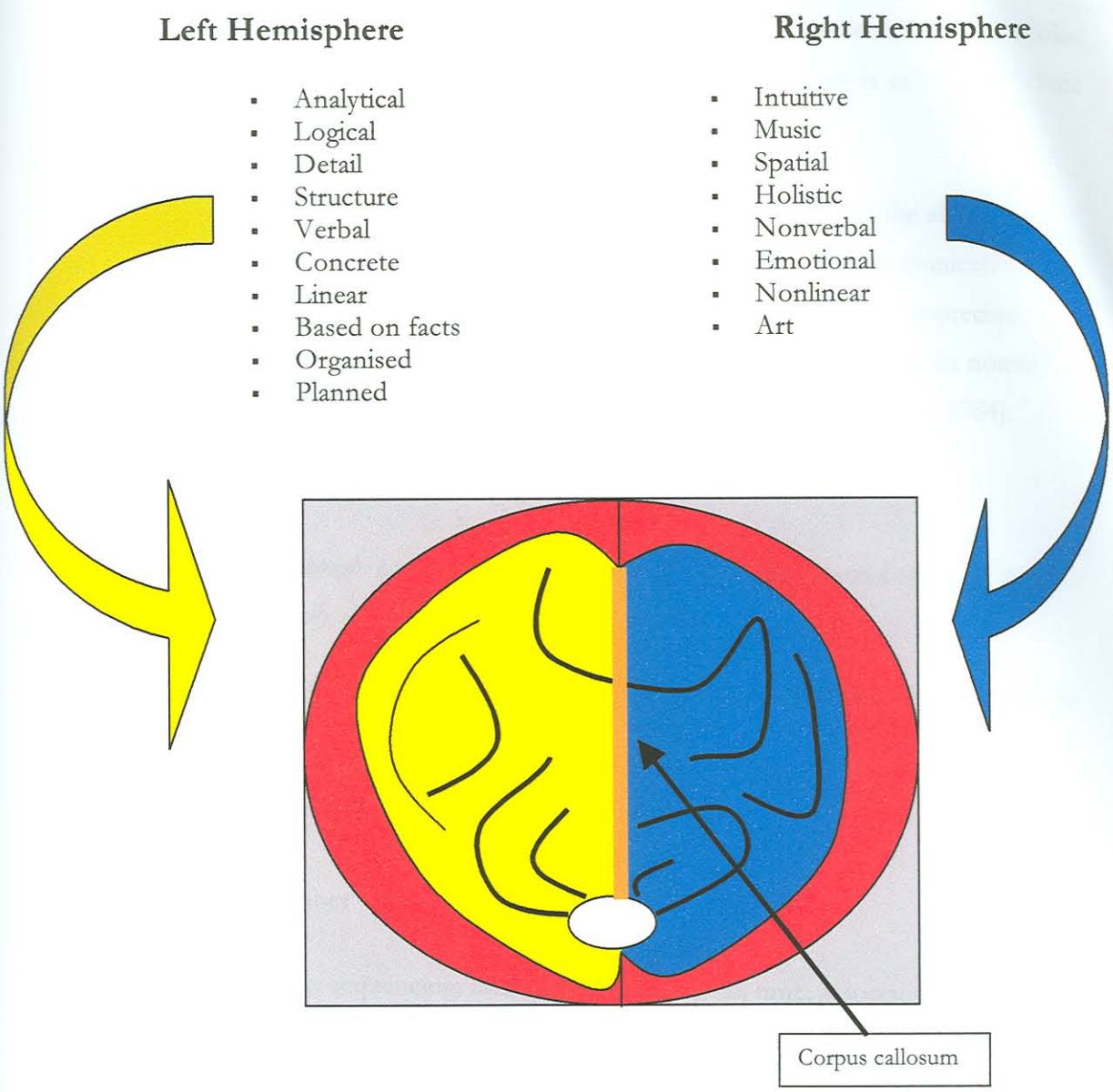


FIGURE 6: A schematic representation of the two hemispheres of the brain [Sketch adapted from Pretorius, 1994: 162]

According to Sperry's research, the left brain is responsible for the comprehension process whereas the right brain deals with the apprehension process. (The comprehension process is abstract, symbolic, analytical and verbal, whilst the apprehension process is concrete, holistic and spatial.)

To use music as an example: the left hemisphere governs the ability to read music as it is specialised for understanding language communication, but the right hemisphere controls the ability to recognise, appreciate and remember melodies. The right hemisphere is more specialised in nonverbal understanding such as emotion, pattern recognition, etc. [Kolb, 1984].

Buzan emphasizes in his book that:

> *...although each hemisphere is dominant in certain activities, they are both basically skilled in all areas* ... [Buzan, 1995: 33].

He lists the skills available to all people (which was previously attributed to either the left or right hemisphere) as:

- Language: words; symbols
- Number
- Logic: sequencing; listing; linearity; analysis; time; association
- Rhythm
- Colour
- Imagery: daydreaming; visualisation
- Spatial awareness: dimension; Gestalt (whole picture)

He says the theory of the way that the human brain remembers gave shape to his development of "mind mapping".

The human brain remembers:

- items from the beginning and the end of a learning period;
- items associated with patterns already stored;
- any outstanding items;
- items which appeal to any of the five senses; and
- items of particular interest.

De Bono [1992] coined the phrase "lateral thinking" which emphasizes the searching for different approaches and different ways of looking at things. According to him the brain forms patterns of thinking. The natural inclination is to follow these patterns of thinking to solve problems. Lateral thinking is moving "sideways" across these fixed perceptions to try to explore different concepts. Various methods can be used to get us out of the usual line of thought. Mind mapping is such a method.

> *Release from fears and inhibitions is an important part of creativity* [De Bono, 1992].

Mind mapping is able to do just this – release the designers of the mind map from their fears and inhibitions and thus create the opportunity for creativity. And it is this *creativity* that allows the designers of a mind map to move away from the traditional linear method of organising facts.

Mind mapping (in this study) gave learners an effective method of coming to grips with a large body of information. Students were expected to brainstorm a section of the work and to produce a mind map. It was felt

that this process of ordering facts non-linearly but hierarchically should help to bridge the gap between thinking and writing. All participating team members were allowed to make use of a (two A4-sized or one A3-sized) mind map (covering all the work they had done) during written examinations.

Learning styles

It may be said that mind mapping is suitable only for students with a particular learning style. Kolb [1984: 70] used the Learning Style Inventory (LSI) to investigate individual orientations to learning. The LSI measures a person's emphasis on the four learning **modes**, namely:

- An orientation to **concrete experience.**

  In this mode feeling is more important than thinking: emphasizing the uniqueness and complexity of present reality rather than theories and generalisations, it favours an artistic approach above a systematic, scientific approach to problems.

- An orientation to **reflective observation.**

  Impartial observation is the strength of this mode of learning – it emphasizes *how* things happen rather than *what will work.*

- An orientation to **abstract conceptualisation**.

  This mode of learning favours thinking above feeling and focuses on using logic, ideas and concepts. It favours a scientific approach to problems rather than an artistic one.

- An orientation to **active experimentation.**

  This mode is pragmatic about what works. It is unconcerned about understanding. Thus the emphasis is on doing rather than observing.

LSI also measures the extent to which a person emphasizes abstractness over concreteness and the extent to which the person emphasizes action over reflection.

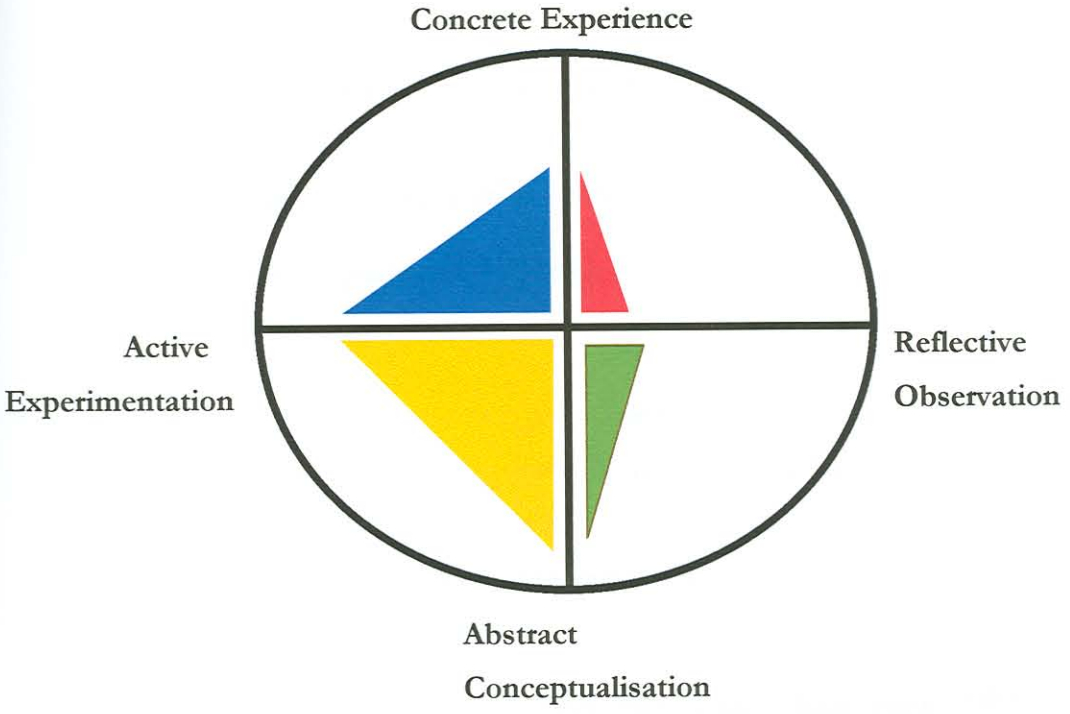


FIGURE 7: Example of a learning-style profile

Kolb's conclusions about learning styles fit in well with Jung's typology [Jung, 1977] of psychological types, namely:

1. mode of relation to the world via introversion or extroversion;

2. mode of decision-making via perception or judgement;

3. preferred way of perceiving via sensing or intuition; and

4. preferred way of judging via thinking or feeling [Kolb, 1984: 67-85].

Kolb states that –

> *...a major function of education is to shape students' attitudes and orientations toward learning - to instill positive attitudes towards learning and a thirst for knowledge, and to develop effective learning skills.*

He is of the opinion that learning is best conceived as a process, not in terms of outcomes.

> *It is the notion of constant, fixed elements of thought that has had such a profound effect on prevailing approaches to learning and education, resulting in a tendency to define learning in terms of its outcomes, whether these be knowledge in an accumulated storehouse of facts or habits representing behavioural responses to specific stimulus conditions.*

How do we then reconcile **Outcomes-Based Education** (OBE) with Kolb's opinion of "outcomes" as explained above? In the new South African Curriculum 2005: Lifelong learning for the 21st century, outcomes-based education is a term that is often used. According to Prof Sibusiso Bengu, the aim of the new curriculum is to shift from a curriculum that was content-based to one which is based on outcomes [Curriculum 2005, 1997]. It is perhaps best to consider the definition of "outcomes" as proposed by

the South African Qualifications Authority (SAQA) before simply discarding the thought of outcomes.

Eight learning areas have been defined for the new curriculum, namely:

1. Communication, Literacy and Language Learning
2. Numeracy and Mathematics
3. Human and Social Sciences
4. Natural Sciences
5. Arts and Culture
6. Economic and Management Sciences
7. Life Orientation
8. Technology

For these eight learning areas eight critical outcomes are proposed by SAQA. Thus learners in all the learning areas should be able successfully to demonstrate the following abilities:

- To communicate effectively using visual, mathematical and/or language skills in the modes of oral and/or written presentation;
- To identify and solve problems by using creative and critical thinking;
- To organise and manage themselves and their activities responsibly and effectively;
- To work effectively with others in a team, group, organisation and community;

- To collect, analyse, organise and critically evaluate information;
- To use science and technology effectively and critically, showing responsibility towards the environment and the health of others;
- To understand that the world is a set of related systems - this means that problem-solving contexts do not exist in isolation; and finally
- To show awareness of the importance of effective learning strategies, responsible citizenship, cultural sensitivity, education and career opportunities and entrepreneurial abilities.

These "outcomes", I believe, are not the same as those that Kolb referred to.

In his research Kolb found that the learning styles of people sharing a common occupation were not necessarily the same but that their learning styles were more strongly associated with their undergraduate educational experience. He finally concludes that –

> *...one's undergraduate education is a major factor in the development of his or her learning style* [Kolb, 1984: 88].

This is good news as it means that at undergraduate level the student's learning style is not yet a *fait accompli* and a new method such as the designing of mind maps can still be introduced very fruitfully.

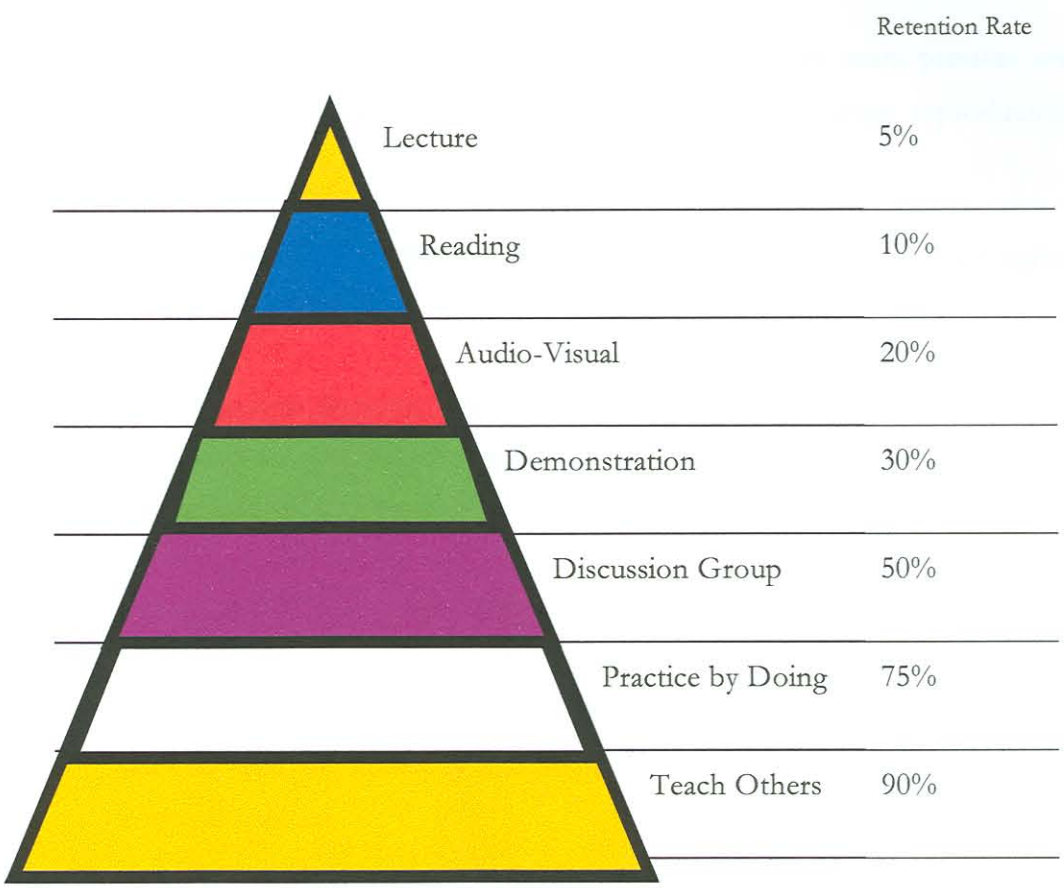


FIGURE 8: Learning pyramid developed by the National Training Laboratories in Bethel, Maine [http://cac.psu.edu/ets/presentations/CatalystTexts/pyramid.html]

Mix of formal (lectures) and informal sessions

The "Learning Pyramid", depicted in *Figure 8*, indicates that the average retention rate of students who attend a lecture (5%) is by far inferior to the retention rate of cooperative learning (90%) where students make use of their learning by sharing it with their team mates.

When considering the mixture of formal lectures, small group work and individual study Jaques [1991: 49] mentions the following working hypotheses:

- Courses with high student-contact hours and heavy exam pressure are likely to **inhibit** deep, holistic thinking and encourage reproductive learning.

- Students who prefer holistic and deep relativistic thinking are more likely to prefer small discussion groups.

And as holistic thinking is what we would like to cultivate in our students, we would seriously have to consider the mixture of formal and informal sessions.

The mix of formal and informal sessions would probably also reflect the role of the lecturer in the learning situation [Jaques, 1991: 24]. The more authoritative lecturer will probably be inclined to opt for more formal sessions and the more facilitative lecturer will probably opt for more informal sessions.

In formal sessions (and the authoritative mode) the lecturer can be:

- DIRECTING

  The lecturer takes charge of the discussion by re-routing it when he/she thinks that is necessary. The lecturer will also decide what further work needs to be done on the topic.

- INFORMING

  Here the lecturer will summarise the work and highlight how the work relates to work previously done.

- CONFRONTING

  By directing questions to specific students the lecturer will be challenging, and will agree or disagree with the answer given. Furthermore the lecturer will provide the students with direct feedback.

In the informal sessions and in the facilitative mode the lecturer could be:

- RELEASING TENSION

  By allowing a lighthearted approach to the subject matter, arousing laughter and dispelling any fears the students may have.

- ELICITING

  By drawing out student opinions, allowing independent problem-solving and promoting self-discovery and personal insight, if necessary, facilitating student interaction.

- SUPPORTING

  Affirming the value of the student's contribution by not being critical and by approving or agreeing with what the student says.

In this study it has been found that students enjoy the more informal format of lectures, in spite of their initial reluctance to accept a change [Venter & Blignaut, 1997].

Assessment

Assessment can be twofold:

- the assessment of the group (group function) and

- the assessment of the individual learning that has taken place.

When considering group function it is often the lecturer who feels responsible if group function is not what it is expected to be. However, the

success of group function does not depend only on the skills of the lecturer. As Jaques notes –

> *...evaluation works best if it is seen as a continuous process engaged in by all those who contribute to the setting up and participating in the group* [Jaques, 1991].

When it comes to the individual assessment, what instruments can be used to measure the dimensions of learning we wish to measure? If we acknowledge that there ARE several types of learning which we deem important, then written examinations cannot be the only method of assessment.

The objectives of present-day instruction are more than the mere memorisation of information; they include the acquisition of lifelong skills. These lifelong skills [Denning, 1993] include an awareness of the need to function in an internationally networked world, skills in communication both oral and written, ability to work productively in teams, and flexibility and adaptability in the job market. New types of instruments are required to allow the assessment of these qualities.

According to Dochy and Moerkerke the balance of power between teacher and student is changing. Thus assessment in the near future will probably be important throughout the learning process, focus on mastery of skills, appear in many different forms, use forms of communication technology and multimedia, and be administered by students, teachers, peers and external bodies [Dochy & Moerkerke, 1997].

Conclusion

The South African Department of Education embarked on a curriculum review in 1995 that culminated in the publishing of Curriculum 2005 in 1997. This new curriculum has brought concepts such as teamwork, group

work, lifelong learning and critical thinking to the fore. Furthermore, the transformation that is currently taking place in postapartheid South Africa has changed most universities' student population profiles from linguistically and culturally **homogeneous** student bodies to student bodies that are linguistically, culturally and even academically **diverse**. These changes, apart from providing a challenging education environment, has made the experience of the Historically Black Universities (HBUs) more relevant to tertiary education in general. This thesis with its emphasis on cooperative learning and teamwork in a multicultural environment where the students are from diverse backgrounds therefore could contribute to the discourse on the new approach to teaching in a transforming South Africa.

In the literature much has been said about cooperative learning [De Villliers, 1996a, 1996b], learning in small groups [Brodie, 1995], the effect of cooperative learning on intergroup relations in a multicultural setting in secondary schools [Malory John Du Plooy, 1993], and the teaching of Computer Science [Terry, 1995]. However, none, as far as I know, pulls together cooperative learning, group constitution and the teaching of Computer Science in a multicultural setting, as is done in this study.

In this chapter the literature on the different aspects of cooperative learning, team constitution, team function, as well as the literature on related topics such as methods of assessment, learning styles and methods of knowledge representation were discussed. In the next chapter various research methodologies will be discussed. It was felt that the problem should be viewed from several perspectives and therefore more than one methodology was used in the research effort. To manage these different methodologies, Soft Systems Methodology (SSM) was used.

Chapter 3

RESEARCH METHODOLOGY DISCUSSED

To learn is a natural pleasure, not confined to philosophers, but common to all men.

Aristotle, *Poetics* [4th C. BC]

Introduction

The research was done over a longer period of time, data was collected from the same population at more than one point in time and the design was non-experimental; it could therefore be described as being a longitudinal research effort. (In general a nonpositivist approach to the research was followed.) The approach, however, drew from several research methodologies and these methodologies, and their bearing on the research at hand, will be discussed in this chapter.

Objectivism versus Subjectivism and Order versus Conflict

Burrell and Morgan [1979] combined the assumptions about the nature of science (where there are two distinct schools of thought, namely OBJECTIVISM and SUBJECTIVISM) and the assumptions about the nature of society (with once again two models, namely that of ORDER/INTEGRATION and CONFLICT/COERCION) into a framework of four paradigms to aid in the analysis of social reality.

According to Burrell and Morgan, this framework (see *Figure 9*) defines four distinct sociological paradigms to be viewed as contiguous but separate. They are of the opinion that these paradigms define fundamentally different perspectives from opposing standpoints. Thus "*to be located in a particular*

paradigm is to view the world in a particular way". They emphasise that the four paradigms are mutually exclusive and that a synthesis of these perspectives is not possible. They do, however, concede that it is possible to operate in the different paradigms but only see that it can be done sequentially over time [Burrell & Morgan, 1979].

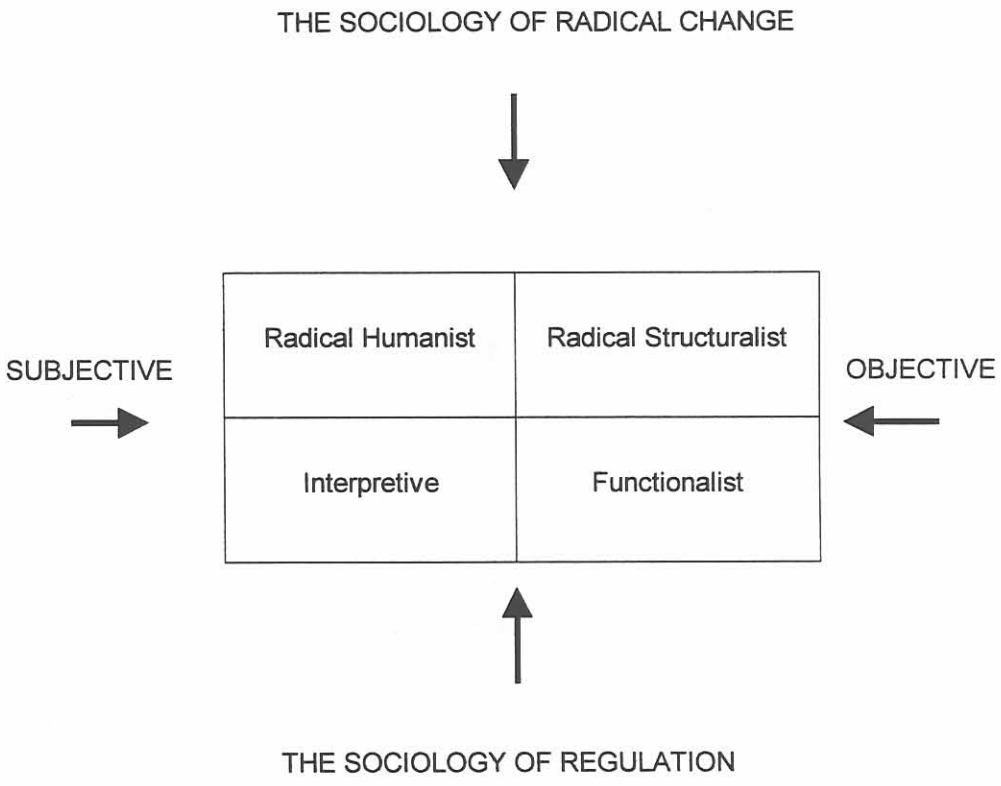


FIGURE 9: A framework of sociological paradigms

Combining the four paradigms

Du Plooy, Introna and Roode [Roode, 1993] propose that researchers should not be restricted by these mutually exclusive paradigms as defined by Burrell and Morgan but should rather use them in a creative way to view the research problem from various vantage points. Thus the researcher "*should deliberately pose questions to explore different aspects of the problem or situation at hand*". They suggest that the researcher use the following diagram to inquire about the different facets of the research problem, allowing him/her to obtain as much information about the problem as possible.

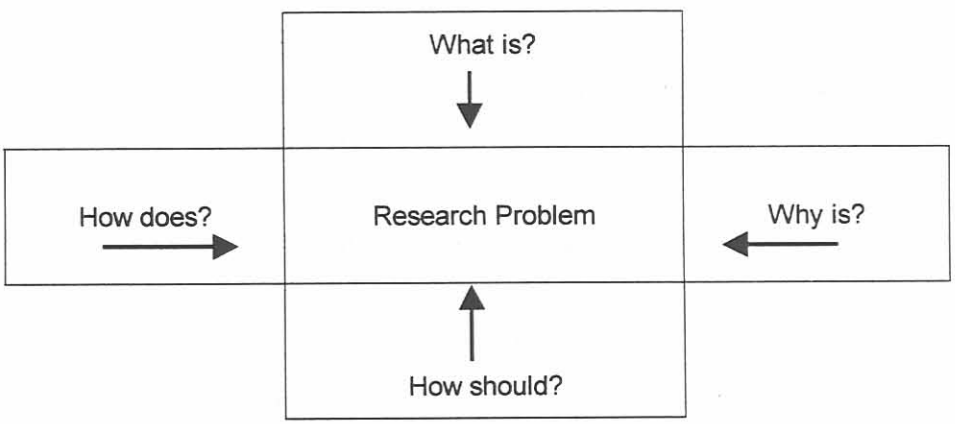


FIGURE 10: The Du Plooy, Introna and Roode research question framework

In the above diagram the **why is** relies on the Functionalist paradigm (of Burrell and Morgan), the **what is** on the Interpretive paradigm, the **how does** on the Radical Humanist paradigm and the **how should** on the Radical Structuralist paradigm. Thus the suggested framework allows the researcher to get a holistic view of the problem [Roode, 1993].

The framework, described by Roode, was used to generate the research questions of this study which were posed in Chapter 1. The questions that initiated this research are:

WHY IS?	WHY IS the "chalk-and-talk" lecturing method not a successful teaching method for second language learners?
	WHY IS verbatim studying the preferred study method for students from academically disadvantaged backgrounds?
	WHY IS teaching geared towards the individual when most working environments expect their employees to be able to work effectively in teams?
HOW SHOULD?	HOW SHOULD teams be constituted?
	HOW often SHOULD formal and informal lectures be alternated?
	HOW SHOULD students be assessed?
WHAT IS?	WHAT IS successful learning?
HOW DOES?	HOW DOES one measure success?

Sten Jönsson is of the opinion that action research will become more common as the interpretive and critical approaches in social research become more acceptable. He agrees with the action research definition of Argyris *et al.* [1985], namely, that scientists in collaboration use it in

conjunction with the participants of the study. According to Argyris *et al.* the main feature of action research is that it is –

> *...expressly designed to foster learning about one's practice and about alternative ways of constructing it* [*op.cit.*: 237].

According to Jönsson each of the three broad research approaches (found in the social sciences) has their specific strengths and limitations. The **critical** approach is close to action research in that it aims to uncover conflicts and contradictions in the organisational structures being studied. With the **interpretive** approach the researcher must be able to "place himself in the shoes of the actor". However, the **positivist** approach is still the dominating approach and assumes independence between researcher and research object. Action research definitely does not match the criteria of the positivist approach but can be both interpretive and critical, depending on the values of the researcher and the research objectives [Jönsson, 1991].

Soft Systems Methodology

The research approach of this study lends from the framework described in Roode [1993] in that it tries to see the problem holistically. In addition, the Soft Systems Methodology (SSM) was judged to be best suited to manage the research process [Checkland & Scholes, 1990].

Research in education can be described as an endless cycle of experience leading to purposeful action and SSM (as described by Checkland and Scholes) is:

> *... an organized way of tackling messy situations in the real world. It is based on systems thinking, which enables it to be highly defined and described, but is flexible in use and broad in scope.*

A graphical representation of basic SSM is given in *Figure 11*. This diagram shows the operation of a cyclical learning system where a situation which concerns the researcher exists; some relevant human activities are selected to remedy the situation; these models are compared to the real-world situation; and some action is initiated to improve the original problem situation.

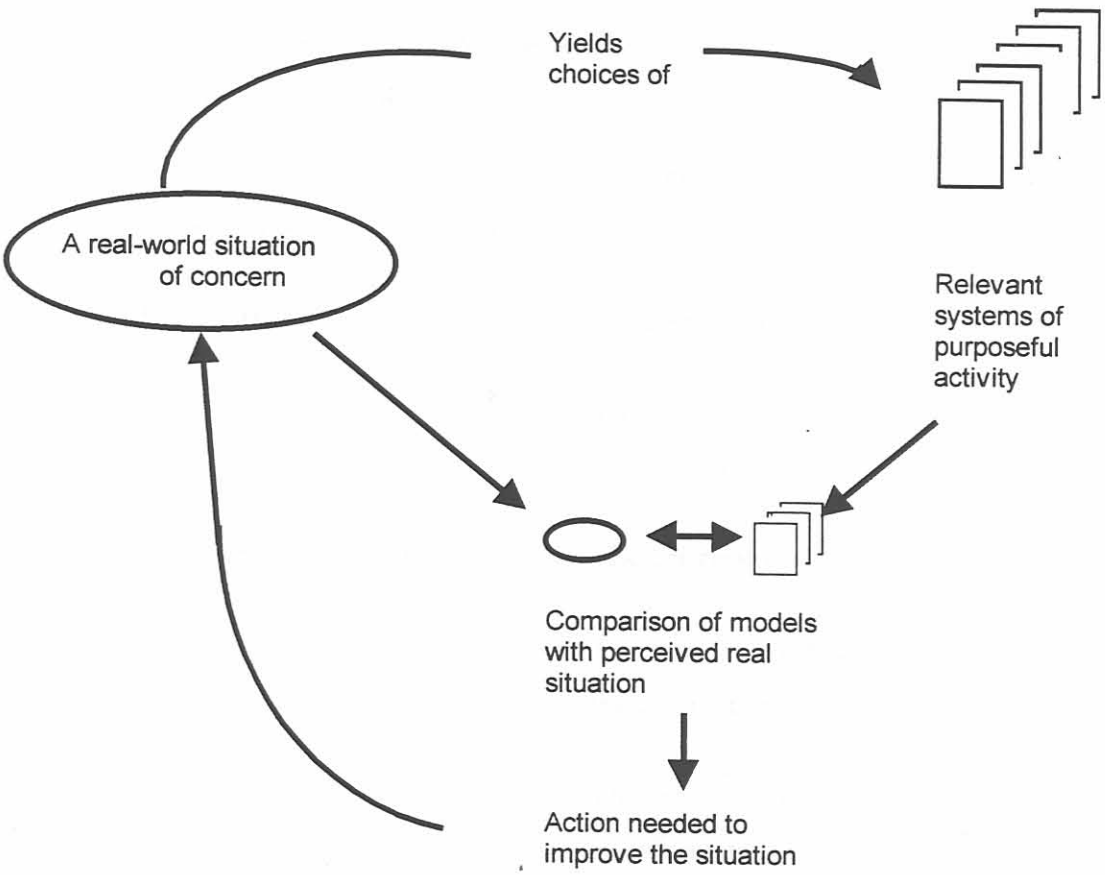


FIGURE 11: The basic shape of SSM [Checkland & Scholes, 1990: 7]

This diagram does not, however, do justice to the rich complexity of real-world problems. For instance the "world views" of the researchers, as well as the participants, are not depicted in the diagram. To put this in perspective: for any *purposeful action* a number of *relevant systems* are possible,

depending on the *particular interpretation* of the problem, which of course depends on the "world view" of the participants.

In order to articulate the purposeful action of a relevant system, a so-called "root definition" is formulated.

A root definition -

...expresses the core purpose of purposeful activity systems. That core purpose is always expressed as a transformation process in which some entity, the 'input', is changed, or transformed, into some new form of that same entity, the 'output'. [Checkland & Scholes, 1990].

To formulate a root definition the following elements should be considered (these elements spell the word CATWOE):

CUSTOMERS	Beneficiaries of the transformation
ACTORS	Those who would do the transformation
TRANSFORMATION PROCESS	The conversion of input to output
WORLD VIEW	The perspective that necessitates the transformation
OWNERS	Those who could stop transformation
ENVIRONMENTAL CONSTRAINTS	Constraining elements outside the system

CATWOE within the methodology of SSM thus:

> *...seeks to provide help in articulating and operating the learning cycle from meanings to intentions to purposeful action without imposing the rigidity of technique* [Checkland & Scholes, 1990].

The transformation, as described in CATWOE above, can be broken up into several transformations. However, to simplify this discussion, the transformation of this study is described only in the following broader (inclusive) terms.

The elements of CATWOE as applied to our problem:

C	"customers"	Beneficiaries of T (the transformation) are the students
A	"actors"	Lecturers and empowered students
T	"transformation process"	Conventional lectures (where learning equaled the ability to reproduce) to teamwork and cooperative learning (sharing of knowledge, expertise and acquiring lifelong learning skills)
W	"Weltanschauung" (World view)	The sharing of knowledge and information is necessary if we want to cope with an everchanging and growing knowledge base.
O	"owners"	Students, lecturers and university structures
E	"environmental constraints"	Scarce resources (laboratories and assistance, historically underprepared students from disadvantaged backgrounds)

Thus the root definition for the above transformation, with the world view of this project, is as follows:

Root Definition Lecturers can create lifelong learning opportunities for university students (from diverse backgrounds) by introducing teamwork and cooperative learning, so that they can cope with an ever-changing knowledge environment.

The core of CATWOE is the pairing of the transformation process (T) with the "Weltanschauung" or world view (W), which makes the transformation meaningful.

Argyris *et al.* in their description of the action research methodology say it is a methodology where

> *...the researchers engage with the participants in a collaborative process of critical inquiry into problems of a social practice in a learning context.*

The question can now be raised - what is the difference then between SSM and action research, as SSM is also described in very similar terms?

Perhaps SSM can be best described as a "multifaceted" version of action research in which:

a) Monitoring and control is done throughout the process against specific defined measures of performance.

b) Evaluation of the performance of the transformation process can be done by measuring its:

efficacy	checks whether the chosen approach is producing the required output
efficiency	checks if the method is economical on resources
effectiveness	checks if this procedure will withstand the passage of time and satisfy long-term aims

c) Furthermore controlled action can be taken throughout the process in order to achieve the set objectives.

Transforming SSM

In *Figure 11* the basic shape of SSM has been adapted to reflect the "endless cycle" of this research project. Initially teamwork (1 in *Figure 12*) was introduced to complete large tasks that required a broader expertise. Teams were constructed without adhering to specific criteria; students were allowed to form their own teams. Each team consisted of four to six members. These "self-constructed" teams were mostly homogeneous groups, culturally as well as academically. Experience signaled that the teams, where the members lived close to one another, were able to meet more regularly and could therefore complete tasks more effectively. In subsequent academic cycles geographic proximity of residence was taken into account, where possible, with the constitution of teams. However, team functioning was still not optimal as many groups experienced excessive conflict, which detracted from the advantages of teamwork. Team constitution thus needed further adaptation, as it is our belief that learning in teams at university enhances the acquisition of lifelong skills and allows internalizing concepts of the subject discipline in a more relaxed

atmosphere. This approach also exposes the students to group dynamics, thus developing abilities much needed in adult and work life.

Consequently, team constitution was refined by using Belbin's team-role methodology (2 in *Figure 12*) to construct so-called "balanced teams". Past experience in the management development arena signals the need for carefully constructed teams in the learning environment as the learning experience of many teams has been observed as ineffective, and often disrupted, by an imbalance of personality traits. In an effort to control this variable, it was decided to use Belbin's team-role methodology to construct the teams. Belbin argues that no one person possesses all the qualities needed for optimal problem solving, but that the members of a well-constructed and balanced team collectively should display all the needed qualities. Belbin further argues that the repetition of traits in the same team can lead to (amongst others) disruptive arguing, excessive conflict and "groupthink".

Originally teamwork was implemented to accomplish large tasks, such as the presentation of a literature survey or the completion of a project. Teams met in their own time to work on these tasks. Traditional "chalk-and-talk" lectures were given during formal lecture periods. The traditional method of lecturing provides little scope for the development of communication skills, both written and oral. Cooperative learning, where students work together in small groups (or teams) and draw on one another's strengths to complete tasks, was introduced. Cooperative learning allows students to share personal insights gained through individual learning in a group situation. This not only enhances conceptual insight but also fosters effective oral and written communication.

During the next phase of the study, both the concepts of team roles and teamwork were retained and cooperative learning (3 in *Figure 12*) was introduced. Our students are academically and culturally diverse. English is a second or third language for the majority of these students; therefore many find it difficult to verbalise their understanding of the work and thus resort to verbatim studying. Although the introduction of cooperative learning addressed the lack of communication skills, many students still resorted to verbatim studying. This learning behaviour signaled an inclination to concentrate on detail and a failure to see the overall picture. To remedy this inclination, mind maps (4 in *Figure 12*) were introduced.

A mind map is a clear and concise graphical representation of relevant, associated, categorized and hierarchically ordered information. The concept of mind mapping gave learners an effective method of coming to grips with a large body of information. Students were expected to brainstorm a section of the work and to produce a mind map. This process helps to bridge the gap between thinking and writing. All participating team members could use one A3-sized mind map or two A4-sized mind maps during written examinations.

To accommodate the introduction of these innovative approaches, the method of lecturing (5 in *Figure 12*) had to be reviewed. The cooperative learning approach meant that lectures deviated from the traditional presentation style. Students were expected to prepare prior to attending class. The teams discussed the prescribed section of work and identified problematic areas. If none of the team members could explain the problem satisfactorily, the team could call upon the lecturer to clarify. If more teams experienced the problem the lecturer would give a brief presentation-style lecture on that particular section of the work.

The success of these implemented systems is difficult to quantify. Examinations are usually the instrument with which a "successful" course is measured but they do not do justice to lifelong skills acquired using this method of lecturing. New assessment methods (6 in *Figure 12*) thus needed to be investigated. Team assignments, such as the drawing of mind maps, presentations or projects are assessed continuously. Tests and the final examination are written individually. Alternative methods of assessment are currently being considered within the constraints of university examination regulations.

Although student assistants help students during laboratory sessions, students have indicated that they find the assistance inadequate. The training of student assistants to provide informed assistance to students in the laboratories and the creation of an online helpdesk are being considered (7 in *Figure 12*).

Throughout this cyclical process, the various models were monitored. If they did not comply with the defined measures of performance - namely efficacy, efficiency or effectiveness - changes were made and action was taken to improve the situation.

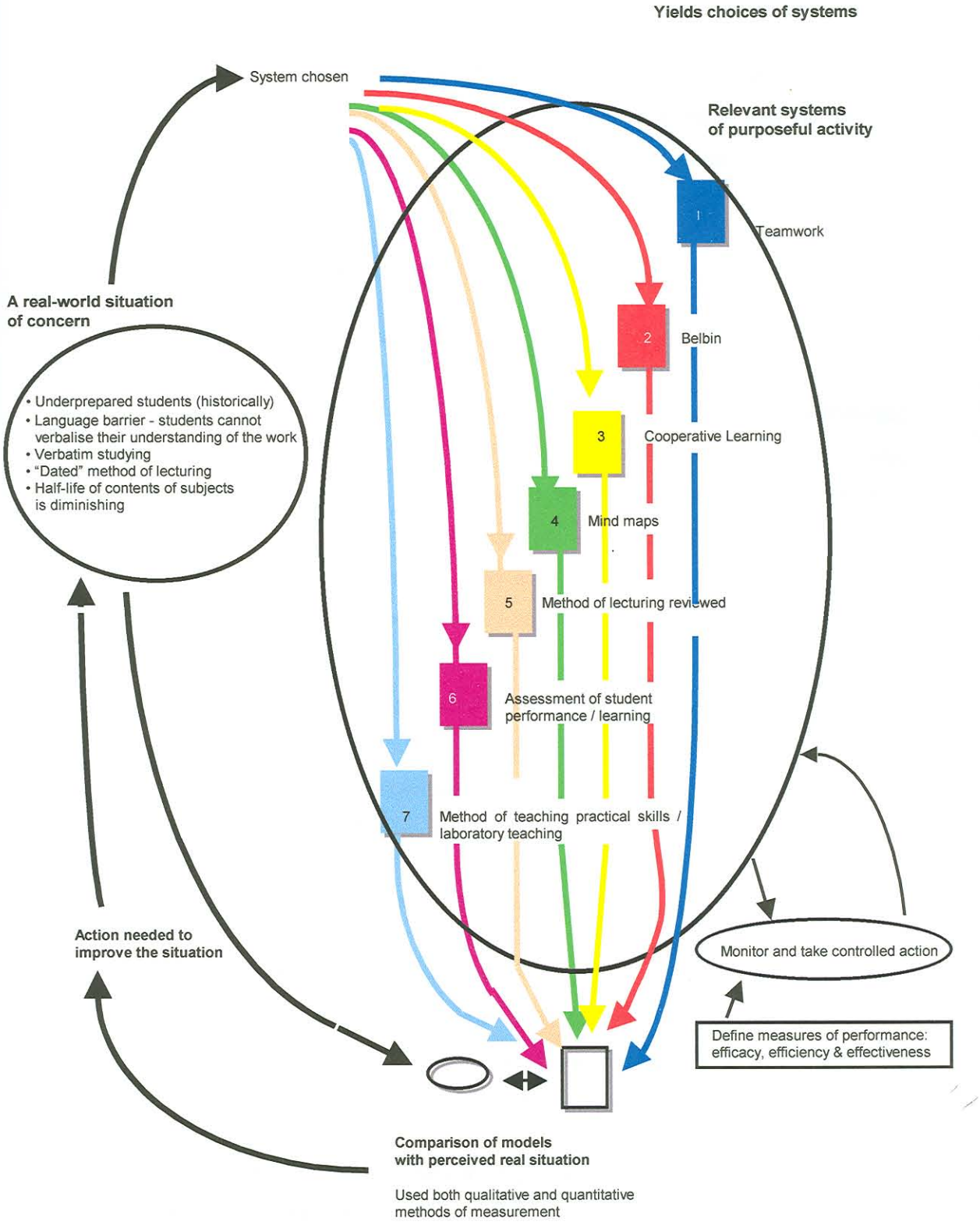


FIGURE 12: Basic shape of SSM applied to the problem of graduates who are not adequately equipped for the job market

The progressive execution of the relevant systems (1, 2, … , 7) as depicted in *Figure 12*, was collated and implemented back to back, in chronological order, as shown in *Figure 13*. It should be kept in mind that the relevant systems of each cycle are retained, refined and implemented in the next research cycle together with new relevant systems.

Discussion of research cycle as depicted in Figure 13

A *A real-world situation of concern*

UWC students typically come from varied academic and socioeconomic backgrounds. Most are first-generation university students and a large proportion come from educationally disadvantaged communities. The fact that English is not the home language for the majority of our students has a bearing on the difficulties students experience with verbalising their understanding and they resort to memorising instead of understanding the prescribed text. In a changing world, in particular a dynamic computer environment, it is counterproductive to memorise material that has no significant longevity. A paradigm shift from teaching to learning is therefore indicated. Teaching methods should create the opportunity for students to acquire lifelong skills.

B *Relevant systems of purposeful activity*

Research started in 1995 with teamwork. Teams were constituted in such a manner that students were able to work together after hours - that is, they lived close to one another. At the same time cooperative learning was introduced in tutorial sessions but "chalk-and-talk" lectures were still given.

It was felt that the constitution of groups needed some refinement as the geographical proximity of their homes mostly implied that groups were not culturally diverse. Furthermore, some groups fell apart because of personality clashes and ability imbalances. Therefore, in 1996, it was

decided to implement Belbin's methodology to constitute more "balanced" teams. Mind maps were introduced at the same time to allow students to see the larger picture and not to get bogged down with the detail of the study material.

In the 1997 cycle care was taken that students within a group were academically diverse. In order to get to know students quickly student names and photographs were collated within groups. "Chalk-and-talk" lectures were kept to a minimum and more time was allocated to group work.

Currently alternative methods of student assessment and laboratory teaching are being evaluated.

C *Monitoring and taking controlled action with predefined measures of performance*

The lecturer becomes a facilitator with this method of teaching and needs to be attuned to the needs of the students. Careful monitoring of group function is indicated and if necessary the lecturer must intervene to ensure that learning opportunities are used fruitfully (*efficacy and effectiveness*). Weekly reporting by the groups via e-mail can sensitise the lecturer to dysfunction within the group. *Efficiency* is ensured as working with groups is more economical on resources than addressing individual problems.

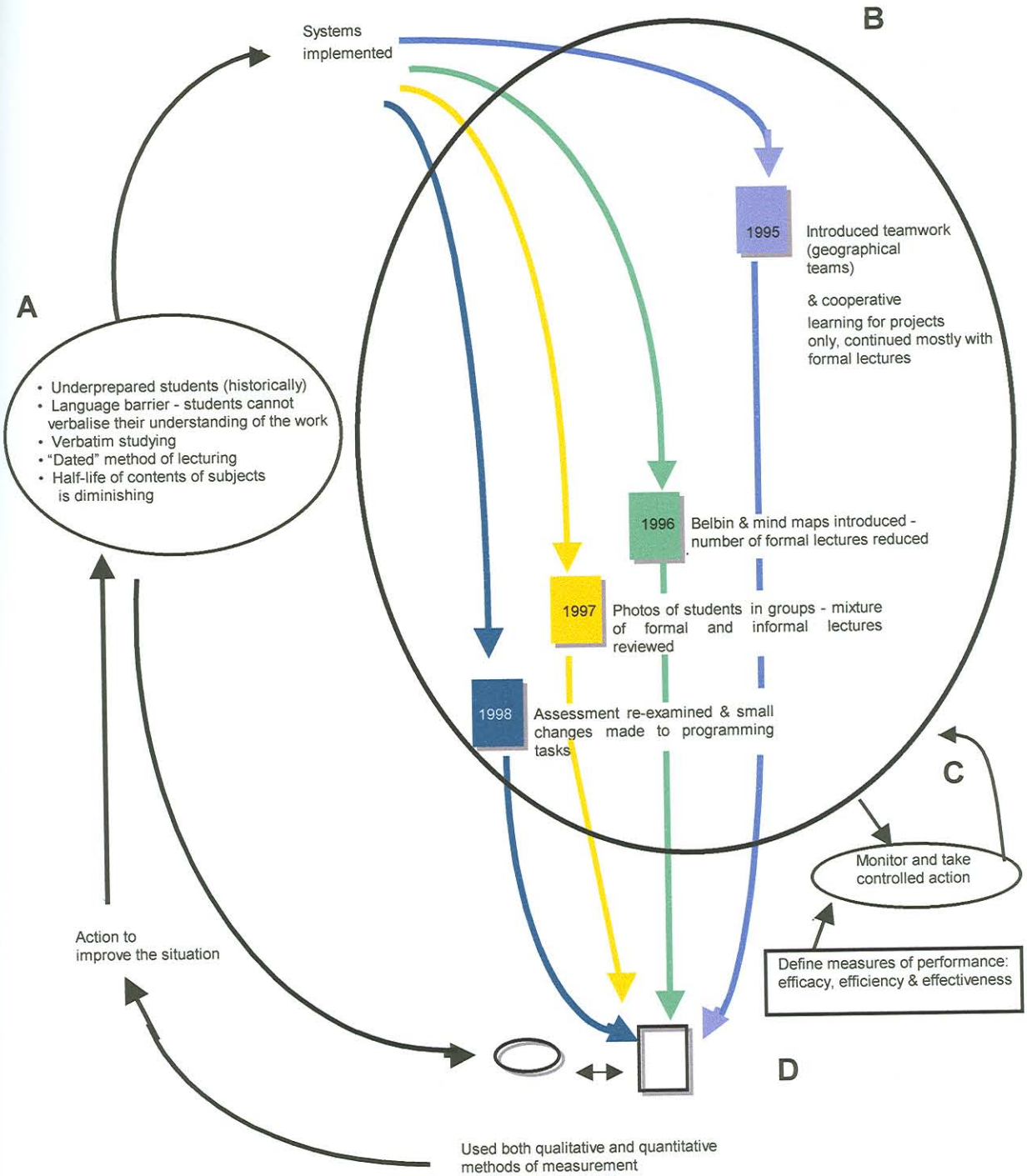


FIGURE 13: Annual cycles of the model of SSM [Checkland & Scholes, 1990] used

D *Comparison of models with perceived real situation*

Both qualitative and quantitative instruments of measurement were implemented. Why use both these instruments? It was felt that research in education could be compared to a naturalistic study where inquiry demands a human as instrument, adaptive to an indeterminate situation. Qualitative methods, such as interviewing [Schön, 1983], observing and taking note of nonverbal cues, come more easily to the human-as-instrument. However, the quantitative paradigm creates more opportunities for the naturalistic investigator [Lincoln & Guba, 1985] and by combining these methodologies it was felt that the research findings would be more comprehensive.

Integrating approaches

Lee [1991] has discussed the feasibility of integrating an interpretive approach with the traditional positivist approach, and showed that the two different approaches are mutually supportive, not mutually exclusive. Naturally, it would only make sense to add an additional layer of research if the results benefit the study - in other words, if the additional work leads to conclusions, which would not otherwise be drawn. In chapter 5 this point will be further discussed.

According to Strauss and Corbin [1990] grounded theory is not developed before research is done and then tested to confirm the theory. Rather it is an inductive process whereby data is collected, analysed and certain phenomena, relevant to the research, are allowed to "*emerge*". Pandit [1996] is of the opinion that a synergy is created if quantitative data is collected to corroborate the findings of qualitative data. And qualitative data allows the researcher to understand the "*rationale of the theory and the underlying relationships*".

By drawing some of the research methodologies together (the qualitative, quantitative, interpretive and SSM research methodologies) a clear picture of the research problem will emerge. If the results are furthermore interpreted from various perspectives the problem can be evaluated holistically.

Conclusion

Research in education is at best "fuzzy" and SSM was an effective encompassing method of dealing with the research process. SSM allowed the researcher to become part of the research process. The cyclical nature of SSM is well suited to the educational field in that small adaptations can be made with each new cycle. Both qualitative and quantitative research methodologies were used to collect data and to measure the effectiveness of interventions implemented. Careful monitoring was implemented throughout the research process and controlled action was taken to achieve set objectives.

In the next chapter the research problem of underprepared students, the language barrier, the "dated" method of lecturing and verbatim studying will be revisited. Each period of the study will be discussed as a separate case study. In chapter 5, the research will be viewed from different perspectives. These perspectives include a perspective using Knowledge Interests as defined by Habermas, a perspective using hermeneutics, a perspective using Interpretative Research and Giddens' *consequences of contemporary modernity* as a perspective.

By viewing the problem from various vantage points, emergent themes will come to light and in the tradition of the grounded theory approach "*what is relevant to the area of study will be allowed to emerge*" [Strauss & Corbin, 1990]. These emergent themes will allow the development of a framework for group constitution for small group learning in the field of information technology. This framework will be discussed in Chapter 6.

Chapter 4

THE PROBLEM REVISITED

An honest tale speeds best being plainly told.

Shakespeare, *Richard III* [1592-93]

Introduction

The "tale" of the so-called longitudinal research, told in the first chapter of this thesis, is now revisited as five distinct periods. Each of these distinct periods will be described as a case study. These case studies have been documented as technical reports and contain all the qualitative and quantitative data collected during the particular study. The qualitative data includes results of unstructured interviews, field notes, e-mail messages and photographs.

The scope of a case study, according to Yin [1994: 13], is the investigation of a contemporary phenomenon within its real-life context. The periods that will be described fall within this definition in that they describe a contemporary phenomenon and are seen within a real-life context. Myers [http://www.misq.org/misqd961/isworld/index.html] argues that the case study is the most common **qualitative** method used in information systems research. According to Du Plooy [1998] a case study can be seen as –

> *...an experiment, similar in some ways to the typical experiment common in natural science research, conducted in a setting where the phenomenon of interest occurs naturally.*

He suggests that the researcher can, after collecting the data and interpreting the results, deductively or inductively find causal links and thus

arrive at some explanations of the phenomena being investigated. In this thesis both the deductive and inductive approaches are used, and in this chapter, where the different case studies will be discussed, deduction is used to draw conclusions from quantitative and qualitative data collected. In Chapter 6 we will use induction to arrive at a framework for group constitution for small group learning in the field of information technology. Therefore, naming these periods "case studies", although originally not conducted as case studies, is in line with the above description of case studies and allows each period to be demarcated into a separate unique study.

During the period 1995 to 1998, when the case studies were executed, the research approach followed was that of an adaptation of Checkland and Scholes' [1990] methodology as described in Chapter 3. The grounded theory approach (discussed in Chapter 3) was followed to draw inductive conclusions and formulate a framework for group constitution for small group learning in the field of information technology. The five case studies, previously published as technical reports, will now be reviewed – starting with the 1995 period. It must be noted, however, that although these case studies are discussed as separate entities, they are closely related, in a cumulative sense, in that each presents a further intervention. The third case study is the exception, as it compares the "chalk-and-talk" method with teamwork in a different group of students.

CASE STUDY 1 – TEAMWORK AND COOPERATIVE LEARNING IN COMPUTER SCIENCE. THE FIRST SEMESTER OF 1995.

[Venter & Stoltz, 1995]

Study objectives

Students were placed in groups/teams at the onset of the course. Students who lived in close proximity were put into a group to enable them to work after hours, that is, off-campus if they wished to do so. Unbalanced or malfunctioning groups could have a negative effect on the group members' learning experience and it was therefore important to look at the way that groups were constituted. This was done to minimize the exclusion of students, but also to motivate them to study cooperatively – that is, to work independently yet share their insights with their team members.

The definition of group work or teamwork, in this study, is the working together of a team to achieve a common goal such as the presentation of a paper in this particular instance. The task set for the team was almost impossible to attain individually; thus the team had to decide amongst themselves how to share the task load. Each individual was expected to bring his or her share of work back to the group forum, where it could be reworked before inclusion in the final product. The final product was thus a team effort.

Cooperative learning, on the other hand, is defined as the sharing and discussing of personal insights, gained through individual learning, in a group situation for the purpose of conceptual insight, but also to foster effective oral and written communication. A prerequisite for a successful team is that students are committed to the team effort which compels them to develop communication and interpersonal skills.

Course curriculum

The module in which this teaching style was adopted was a third-year Operating Systems module. In this module the students learnt about the concepts that underlie operating systems, concepts such as concurrency, deadlock, secondary storage systems, etc. Furthermore it was expected of the students to be reasonably acquainted with the operating system UNIX. A week after the completion of the course, each team was expected to present a paper on a set topic on new developments in the computer environment.

Two lecture periods were appropriated to explain how to read effectively, how to write up what had been researched and then how to present it. This task was undertaken by the Academic Development's Writing Centre.

The Computer Science major at that time consisted of four blocked modules. Thus approximately six-and–a-half weeks of the academic year (26 weeks) was used for each module. All the lecture periods and practical times in the six-and–a-half-week period were then used for the one module. Five lecture periods of 40 minutes each and a practical period of six hours were scheduled per week.

Students were expected to come prepared to class. The teams or groups sat together and discussed problem areas. The lecturer was called upon to help whenever help was needed. The role of the lecturer was thus just the role of a facilitator. If various groups experienced the same problem, the lecturer would then interrupt the group discussions and a lecture would be given on only that topic.

Design

It was decided to formulate a model of team-based cooperative and action learning based on the insights of Johnson *et al.* [1994], Belbin [1993] and Revans [1980].

Cooperative learning

As described by Johnson *et al.* cooperative learning, in contrast to competitive learning, is the working together -- in a group -- to maximize own and the group's learning. According to them five basic elements form the essential elements of cooperative learning as described before.

Team roles

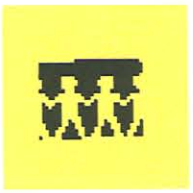
For a team to function successfully, it is important that each individual team member acknowledges his/her own strengths and weaknesses, as well as those of the other team members. R. Meredith Belbin [1993] maintains that optimal team functioning is only possible once team members delegate tasks related to their personal weaknesses to other team members who have these skills as strengths, and when team members accept responsibility for those tasks related to their personal strengths.

These personal strengths and weaknesses are identified through validated and standardised questionnaires measuring stated as well as observed behaviours, and roles in the team are then allocated in accordance with the individual team member's psychometric profile.

Belbin identified these strengths and their associated weaknesses as team roles (depicted in *Figure 14*) and he maintains that each of the nine team roles has a distinctive contribution to make to successful team functioning.

Johnson *et al.* [1994] *allocate* roles to team members arbitrarily. The categories of roles are:

- Forming
- Formulating
- Functioning and
- Fermenting roles.

	Belbin Roles & descriptions	Allowable weakness
	**Resource Investigator**: Extrovert, enthusiastic, communicative. Explores opportunities. Develops contacts.	Overoptimistic. Loses interest once initial enthusiasm has passed.
	**Co-ordinator**: Mature,confident, a good chair-person. Clarifies goals,promotes decision-making, delegates well.	Can be seen as manipulative. Delegates personal work.
	**Shaper**: Challenging, dynamic, thrives on pressure. Has the drive & courage to overcome obstacles.	Can provoke others. Hurts people's feelings.
	**Monitor Evaluator**: Sober, strategic and discerning. Sees all options. Judges accurately.	Lacks drive and ability to inspire others. Overly critical.
	**Teamworker** : Co-operative, mild, perceptive and diplomatic. Listens, builds, averts friction, calms the waters.	Indecisive in crunch situations. Can be easily influenced.

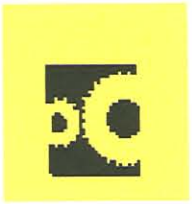
	Roles & descriptions	Allowable weakness
	**Implementer**: Disciplined, reliable, conservative and efficient. Turns ideas into practical actions.	Somewhat inflexible. Slow to respond to new possibilities.
	**Completer** : Painstaking, conscientious, anxious. Searches out errors and omissions. Delivers on time.	Inclined to worry unduly. Reluctant to delegate. Can be a nit-picker.
	**Specialist** : Single-minded, self-starting, dedicated. Provides knowledge and skills in rare supply.	Contributes on only narrow front. Dwells on technicalities. Overlooks the 'big picture'.
	**Plant** : Creative, imaginative, unorthodox. Solves difficult problems.	Ignores details. Too pre-occupied to communicate effectively.

FIGURE 14: A brief description of the Belbin team roles [Belbin, R. Meredith, 1993: 23]

In the Belbin approach team roles (which were identified by the psychometric tests) are allocated to each team member in line with his/her natural inclinations or intrinsic personality traits.

Why the integration of team/group work and cooperative learning?

SYNERGISTIC REASONS

Our experience indicated that many groups fall apart because the members never gelled into a synergistic team. (In a synergistic team, the team achieves collective insights which are superior to any insight that an individual team member can generate.) Senge [1990] sets preconditions for synergistic team functioning (i.e. generative learning):

Systems Thinking: helps the team to see patterns and learn to reinforce or change them effectively.

Personal Mastery. In seeking personal mastery, the team members clarify and deepen their vision, focus their energy, develop patience, and, in general, approach life as an artist approaches the creation of a work of art.

Shared Mental Models. We understand the world and take action in it based on notions and assumptions that may reside deep in the psyche. Once team members suspend these notions and assumptions in front of others to be scrutinized, deeper understanding and new insights may result.

Team Learning. True learning begins with dialogue, in which members suspend assumptions and think together to solve problems.

EDUCATIONAL REASONS

The classical approach of lectures with little contribution from the class, i.e., learning without interaction with peers or the lecturer, was found to be inappropriate as students focused on reproduction of information and rote

learning instead of inquiry and understanding. This resulted in a lack of interest, boredom and perfunctory work.

Although teamwork was used in this course for seven years prior to 1995, it was implemented only for the preparation of an oral presentation. The classical lecture method/style was previously used in class.

The approach of cooperative learning was decided upon for the 1995 academic year, to remedy the above shortcomings and to create a sense of shared responsibility and mutual commitment to each team member's learning experience.

Method

Teams were constituted to allow students in geographical proximity to work together even when not on campus. Care was taken that students within a group were not homogeneous but academically diverse. The number of students per group was governed by the number of groups, namely eight, which was in turn determined by the number of available resources such as computers. (The total number of students in the class of 1995 was 41.)

A consultative session was used to explain to students why they were grouped in this particular way. It was made clear to them that in their work environment they would not necessarily have a choice with whom they wanted to work. Time was appropriated for the explanation of the underlying concepts of teamwork as well as cooperative learning. An undertaking was also given to share with them the results of the respective questionnaires and the study. It was emphasized that the students would gain self-insight and personal growth through this exercise.

Two lecture sessions were appropriated to communicate effective written and oral communication skills to the class. Groups were invited to consult

the Writing Centre should they require assistance with the compilation of their presentation.

After an intensive 7-week Operating Systems course, Belbin's team-role test (Interplace) was applied. No feedback was given at the time, as this information was to be used for team constitution for the second semester at which time feedback and guidance was given to the individuals and newly constituted groups.

Questionnaires were administered after completion of the course to measure the student's impressions of the contents and presentation of the course. Interviews were conducted with individuals and groups using the "reflective conversation protocol" [Schön, 1983].

Main results, findings and discussion

Team functioning

In general the groups reported positively on their team functioning. However, one group (Group 3) expressed their dismay at their group's functioning. Another (Group 6) reported no cohesion; they ascribed it to the fact that they lived close to one another and knew each other too well, resulting in disrespect. Group 7 reported mutual cooperation and satisfaction after excluding a member.

A closer look at the individual team roles of Group 3 revealed an imbalance which can explain the dysfunctional team. Four of the five members had the team role of Plant as one of their dominant roles, three had Specialist as a dominant role, three had the role of Shaper and two that of Monitor Evaluator as dominant roles. Research [Belbin, 1993] found that too many Plants (Innovators) are disruptive to team functioning, as these individuals tend to be unable to listen actively to one another and prefer to do his/her own thing. Belbin also reports that Specialists are no team players, as they

prefer solo performance. Two Monitor Evaluators in a team can lead to excessive analysis and three Shapers can lead to too much argumentation.

Group 6 should have been a well-functioning team, but failed to achieve this, probably due to unknown variances.

After excluding a noncommitted member, Group 7 performed well - they excluded an Implementer-Monitor Evaluator-Shaper. The team roles of the excluded member were dominant roles in the other members' team-role profiles and thus were superfluous. As mentioned in the analysis of Group 3, three Shapers in a team cannot be conducive to a harmonious team. The combination of preferred team roles of the excluded member also indicated a rather egocentric and absolutist frame of reference.

Group-task presentation

In spite of the problems experienced by Groups 3, 6 and 7, all groups were able to accomplish relatively high scores for their group presentations. This confirms the positive effect of cooperative learning as reported by various researchers such as De Villiers and Roode [1995] and Johnson *et al.* [1994]. However, it was our conviction that Belbin's research on teamwork could enhance cooperative learning when balanced teams are constituted and team members acknowledge their own and others' individual strengths and weaknesses, and the contribution each member can make to the successful team.

Course evaluation

An analysis of the individual answers to the course evaluation questionnaire indicated that eighteen members of the class felt positive about the group work and cooperative learning approach. Fourteen class members had some reservations, either on the constitution of teams or cooperative learning, and only five members were completely against both approaches.

The comments of the members who offered positive responses highlight the following aspects as contributing to a successful learning experience [Venter & Stoltz, 1995: Appendix B, 1 -74]:

- active and informal involvement in dealing with new and often complex concepts;
- the sharing of the work alleviates workload;
- gained insight from the inputs of others;
- interdependence requires mutual responsibility and therefore thorough initial preparation;
- exposure to different individual study methods;
- acquisition of tolerance for others' shortcomings;
- makes learning fun and reduces boredom;
- insight into and understanding of the behaviour of other people;
- motivation to read beyond what was expected and to study at own pace;
- learn how to be cooperative;
- initial discussions in class provide a basic understanding of complex new topics;
- broadens own thinking models;
- teaches to deal with conflict/ conflict resolution; and
- bridges classroom experience with the real world.

Even though the following students still felt positive about the new approach, they raised the following points of criticism [Venter & Stoltz, 1995: Appendix B, 1 - 74]:

- due to the fact that the lecturer interacts with individual groups, questions to and answers by the lecturer cannot be shared by the whole class;
- too much time spent on a single topic;
- approach is time-consuming;
- would like more guidance on importance of various sections of work for examination purposes;
- preference for formal lectures;
- time is needed to become accustomed to this approach;
- lack of preparation as well as noncommitted members;
- too little attention to each group by lecturer;
- dominant members highjack group discussions and nonassertive members allowed only low contribution; and
- too much work, for too short a period of time.

Those who indicated no preference for this approach supplied the following reasons:

- lack of co-operation by students;
- inability to understand prerequisite work without the lecturer's input;
- preference for solo study and find group interaction difficult;

- inability to concentrate for an extended period of time on a given topic in an interpersonal setting; and
- unstructured approach makes agenda management difficult.

Interviews

An analysis of the interviews confirmed the findings reported above. However, the following was highlighted [Venter & Stoltz, 1995: Appendix E, 1 - 27]:

> *...it takes the strain out of learning.*
>
> *...it has become more spontaneous, if you are given a topic to attend to, and somebody has read the topic, it is not a question of asking who has read the topic. The person that knows just starts to explain. Then you go home, you read again to verify the explanation, it now becomes part of your knowledge.*
>
> *...if you have a problem, you know that your colleague will probably be able to help you. You know the student-lecturer ratio is very high. It is difficult to get individual attention. It is difficult for the lecturer to solve individual problems, even for 40 students it is very boring.*
>
> *Group work has a responsibility that is associated with it, so once you have a responsibility, there is a certain amount of work you must do in order to make conflict resolution cheaper in business economical terms. So to make that, it forces you to do something.*

Conclusion

The majority of the students in this case study indicated that they did not only gain academically but also on the personal and social levels, by using this method of study. Cohen [1994] is of the opinion that it is necessary to distinguish among different meanings of the effectiveness of cooperative learning.

The following table summarises the intervention and its results.

RESEARCH QUESTION	INTERVENTION	RESULTS OF CASE STUDY 1
TEAM CONSTITUTION How should teams be constituted?	Teams were constituted to allow students in geographical proximity to work together even when not on campus. Teams were academically diverse.	Two groups experienced problems, a third group reported mutual cooperation after excluding a member.
FORMAL/INFORMAL LECTURE RATIO How often should small group learning be alternated with plenary sessions and formal lectures?	No specific decision made on ratio of lectures versus small group learning sessions. Continued mostly with formal lectures.	
SUCCESSFUL LEARNING What could be considered a successful learning experience?	Cooperative learning was introduced.	Students indicated that they: gained insight from the input of others; found this type of learning fun; etc.
MEASURING SUCCESS How is success measured?	▪ Academic achievement ▪ Conceptual learning ▪ Equity ▪ Prosocial behaviour	Could not be determined conclusively. Learnt tolerance Sharing of work
ASSESSMENT How should students be assessed?	Formal examinations	Not changed

TABLE 2: Summary of the results of CASE STUDY 1 in terms of the research questions

According to Cohen it is essential to decide what will constitute effectiveness, namely academic achievement, conceptual learning, equity or prosocial behaviour. At this stage of the research the indication was that the intentions of the study, *to help Computer Science students acquire the necessary skills in communication, written and oral, and to be able to work productively in teams*, were being achieved.

In the next case study the method of team constitution was changed and cooperative learning was introduced.

CASE STUDY 2 – COMPUTER SCIENCE A TEAM EFFORT? USING PSYCHOMETRIC PROFILES IN TEAM CONSTRUCTION. THE SECOND SEMESTER OF 1995 AND FIRST SEMESTER OF 1996.

[Venter & Blignaut, 1997]

Principal objectives

It was noted with concern that third-year Computer Science students (at UWC) often answered examination questions in the exact wording found in the textbook which may suggest that they memorised their study material without the necessary understanding of important underlying concepts. For most of the students (58%) in this case study, the language of instruction is a second or third language. Discussion groups allow students to explore their understanding of the work. This could probably render verbatim studying unnecessary.

It is important to create an environment where students can acquire lifelong skills. A few of these (from a list by Denning [1993: 102]) are:

- Awareness of need to function in international, networked world
- Skills in communication, oral and written
- Ability to work productively in teams
- Flexibility and adaptability in job and career

This study was twofold in that it was directed at understanding the influence of group constitution on group function as well as the influence of teamwork and cooperative learning on the individual's understanding of the subject.

Cohen [1994] suggests that the effectiveness of teamwork and cooperative learning can be measured using the following criteria:

- academic achievement;
- conceptual learning and higher-order thinking;
- equity or equal status interaction within the group;
- positive intergroup relations; and
- desirable prosocial behaviours.

These criteria will be used when measuring the effectiveness of this intervention.

Materials and methods

Design

A different teaching style, incorporating cooperative learning, was adopted for two Computer Science third-year modules, namely Operating Systems (CS314 in the first semester of 1996) and Data Communication & Computer Networks (CS324 in the second semester of 1995). In the Operating Systems module the student learnt about the concepts that underlie operating systems, such as concurrency, deadlock, secondary storage systems, etc. In the Networks module the student learnt about networking protocols, local area networks, wide area networks, etc.

The module on Operating Systems was lectured in the first part of the first semester of 1996 and each team had to present a paper on new developments in the computer environment after the short midsemester recess. For the module on Data Communication & Computer Networks (lectured in the first term of the second semester of 1995) the teams were expected to set up a small network as a practical, but also to write a project on the acquisition of a small network for a fictional (or real) company. Finally each team gave a short (10-minute) presentation on how they

tackled the project, difficulties experienced, and why they decided on certain products.

Two lecture periods were appropriated to explain how to read effectively, how to write up what has been researched and then how to present it. This task was undertaken by the Academic Development's Writing Centre.

In the second semester of 1995 and first semester of 1996, Belbin's [1993] validated and standardised questionnaires (a self-assessment as well as a minimum of four observers' assessment questionnaires) and the software Interplace IV were used to determine each student's psychometric profile. These profiles (without any reference to either gender or academic achievement) were then used to constitute so-called "balanced teams" based on Belbin's team-role theory. Belbin argues that to constitute an effective team, team members should *collectively* have certain intrinsic personality traits. In general teams had five members, with the odd exception where the team had six members. Although the size of the group was not intentional, a group size of six is considered to be the largest group where leadership can be fluid and where it can be democratically shared among the members of the group. Democratically-led groups, compared to authoritarian-led and *laissez-faire* groups, although slower in getting into production, are believed to be more motivated and productive with time and learning [Jaques, 1991]. (In the first semester of 1995, Belbin's method of team constitution was not used but students were grouped according to where they lived to allow them to meet and work after hours. Furthermore care was taken that students within a group were academically diverse.)

A consultative session was used to explain to students why they were grouped in a particular way, at the same time feedback was given to each student on the psychometric tests conducted. It was made clear to them that in their work environment they would not necessarily have a choice

with whom they wanted to work. Time was appropriated for the explanation of the underlying concepts of teamwork as defined by Belbin [1993] as well as cooperative learning as defined by Johnson *et al.* [1994]. Each student received a summarised report of his/her rating of himself/herself compared to the ratings of his/her four observers and a final weighted rating indicating his/her dominant team roles. They received a further personalised report, which highlighted the student's positive contribution to a team as well as his/her allowable weaknesses within the team.

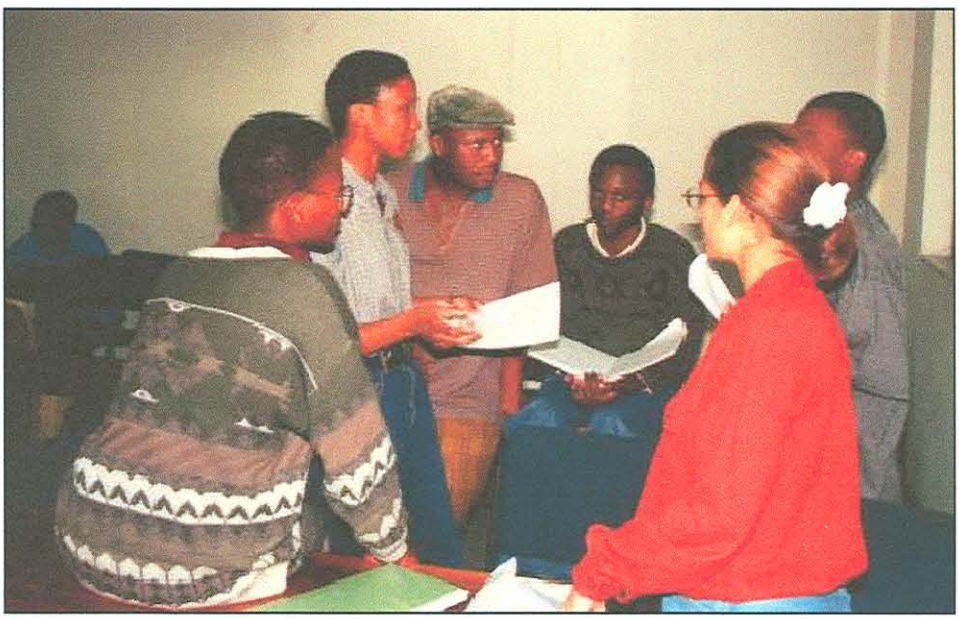


FIGURE 15: Team in session

The cooperative learning approach meant that lectures deviated from the traditional presentation style. Students were expected to come prepared to class and be seated in their respective teams/groups. The groups had to discuss areas that they found problematic. If none of the team members could explain the problem satisfactorily, the team could call upon the lecturer who would then give a brief presentation-style lecture on that particular section of the work.

Cooperative learning was used to share personal insights gained through individual learning in a group situation, for the purpose of conceptual insight but also to foster effective oral and written communication.

The concept of cooperative learning within a team combined with the concept of mind mapping was introduced to help students to get the "overall picture" and not to get bogged down by all the technical detail. (A mind map is a clear and concise graphical representation of relevant, associated, categorized and hierarchically ordered information.) Students were expected to brainstorm a section of the work and to produce a mind map.

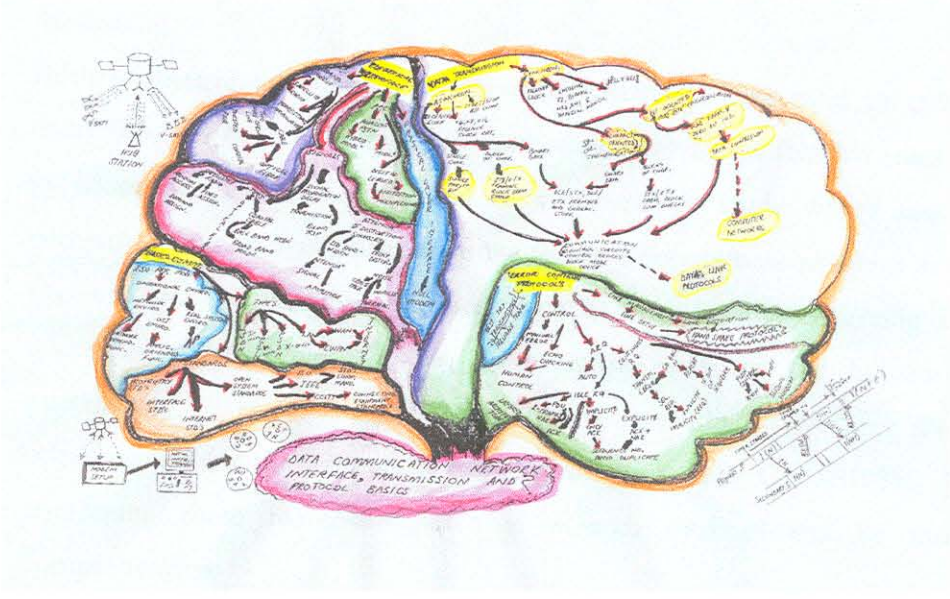


FIGURE 16: Mind map

During the class any member of a team could be called upon to explain his/her understanding of the section of work to the whole class, using the group mind map. The team had to come to class prepared with a transparency of the mind map, in order to present it.

The group mind map could be used during the writing of tests and even in the final examination. Each group/team member was allowed to use a copy of their group's mind map, drawn on both sides of an A4-sized paper (or one side of an A3-sized paper) and covering all the work, in the examination room.

The working together of a team to achieve a combined goal such as the presentation of a paper or the completion of a project is almost impossible to attain individually, thus making the team effort imperative. The progress of each team was carefully monitored. Teams had to report weekly on their progress. This was done via e-mail.

Method

Both qualitative and quantitative research methods were used to collect data. Why use both these research methodologies? It was felt that research in education could be compared to a naturalistic study where inquiry demands a human instrument adaptive to the indeterminate situation he or she will find. Qualitative methods, such as interviewing, observing and taking note of nonverbal cues, come more easily to the human-as-instrument. However, the quantitative paradigm creates many opportunities for the naturalistic investigator [Lincoln & Guba, 1985]. By combining these methodologies the research findings will be more comprehensive.

The quantitative method used entailed the use of a self-administered questionnaire that covered background information such as gender, home language, age, as well as questions on group behaviour, usefulness of the Belbin's team-role classification and preferences for different lecture styles. The data was analysed using the SAS statistical package [SAS, 1989]. Chi-square (χ^2) tests [Zar, 1984] were used to analyse frequency tables. Mann-Whitney and Kruskal-Wallis tests [Zar, 1984] were implemented to test for differences in continuous variables among the various groups.

Semi-structured interviews (where students were asked to reflect on their learning using Schön's "Reflective Conversation" protocol [Schön, 1983]), minutes of team meetings and field notes were used to collect the qualitative data.

Results

Quantitative research findings

Descriptive statistics

A total of 84 students (41 in 1995 and 43 in 1996) completed the questionnaires. All questionnaires could be used for analysis purposes. (Students were asked their matriculation mathematics marks. These marks were correlated with the marks received from the university records. This was done to check the integrity of the data. Data was found to be trustworthy and therefore all the questionnaires could be used for analysis purposes.)

A third of the class (33%) were female. The majority of the students (63%) were between 21 and 23 years old, and 29% were older than 23. Most of the students (74%) were enrolled for a B.Sc. degree, the rest for a B.Com. degree.

It was felt by most students (69.6%) that mind maps gave them a broader perspective of the work, that they learnt new ways of ordering facts and information (68.3%) and that the presentation of the mind map enhanced their understanding of the work (61.6%).

The different home languages of the students (See *Figure 17*) were Xhosa, English, Afrikaans, and languages such as Zulu, Shangaan, Tswana, Ndonga, South Sotho, Siswati, etc.

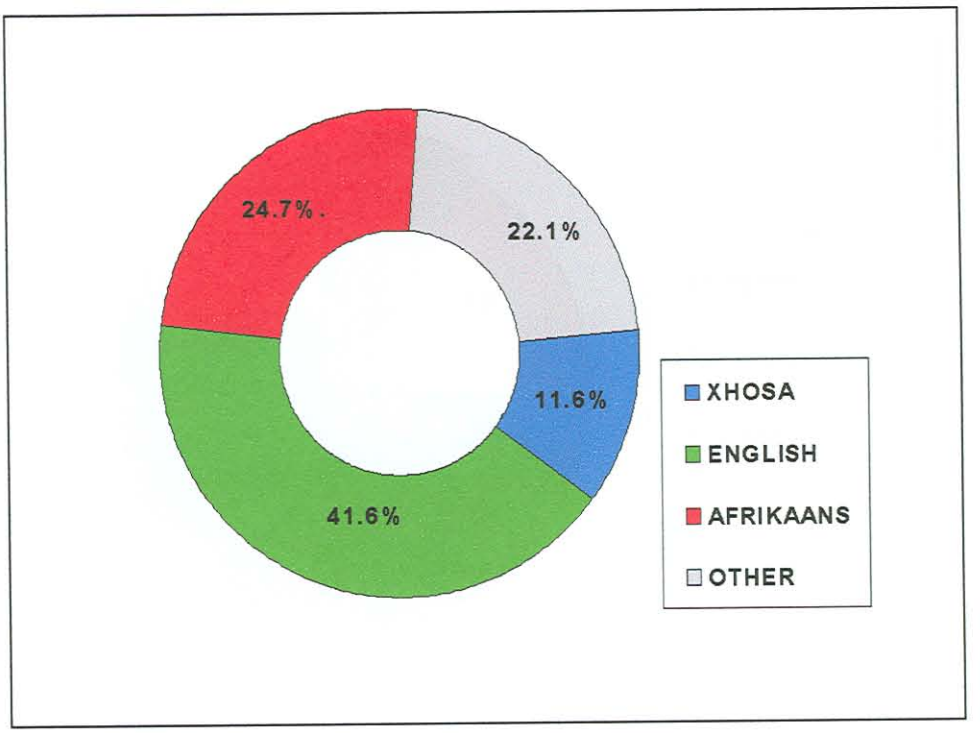


FIGURE 17: Different home languages of the students

The frequency analysis of the questionnaire indicated that most students were positive about their group participation. For example, 83% expressed their willingness to cooperate with their group members but they also expected cooperation from their group members (89.9%). They felt accepted as a group member and felt that their group was cohesive.

The majority (62.5%) enjoyed working in a group, 73.4% indicated that the group motivated them to do their share of the work and 68.4% felt that more work was done faster.

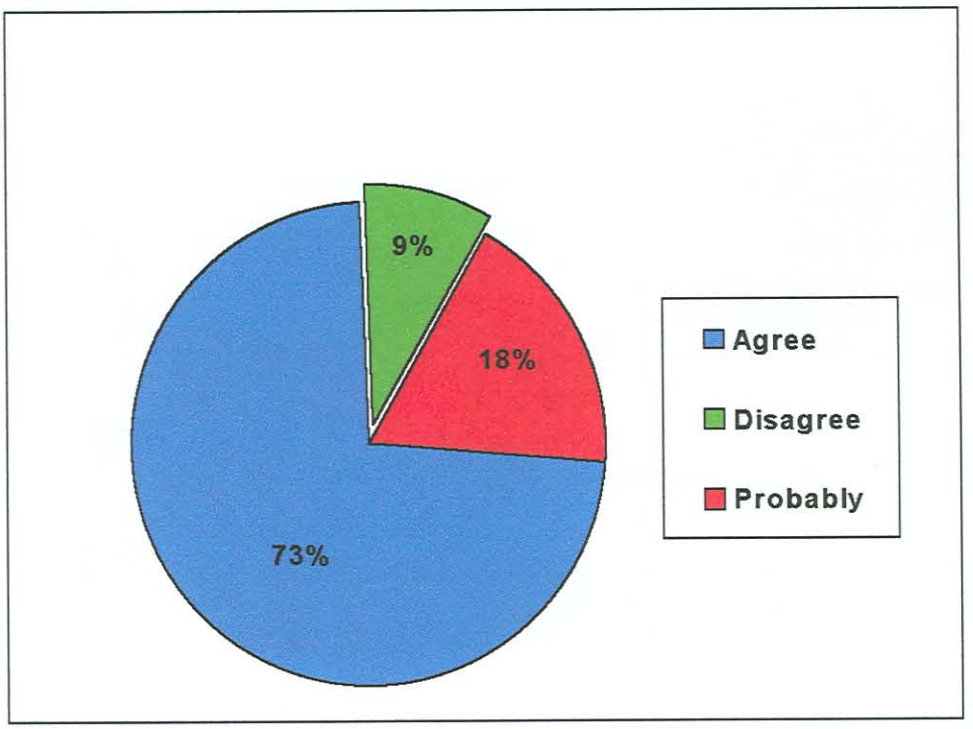


FIGURE 18: Group motivated me to do my share

Most students accepted the Belbin team-role concept. They indicated that they gained insight (68.8%) into the role that they could play within a team. Only 46.8% felt that the team profile was a good reflection of them but most (79.8%) found it interesting to see how their family and friends rated them. The majority (78.2%) felt that they gained insight into their strengths and weaknesses within a team.

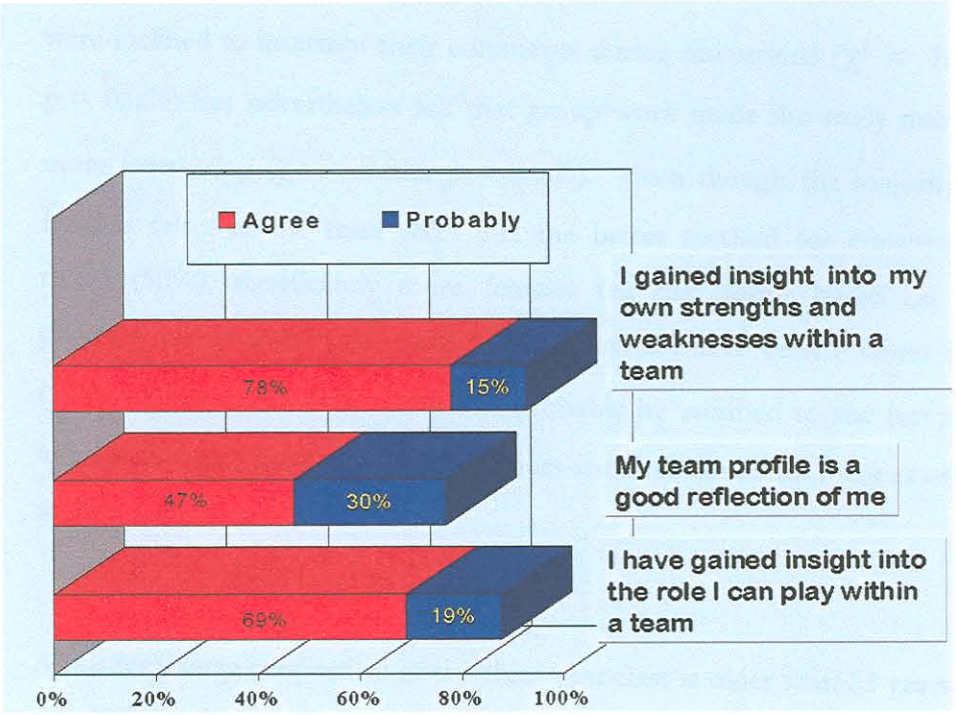


FIGURE 19: Belbin team-role concepts

Students (54.3%) liked the more informal format of the lectures and enjoyed doing the presentation in the Operating Systems course (75%).

Inferential statistics

GENDER

In a recent study by Durndell and Thomson [1997] it was found that over the last decade very little had changed in the relative interest in and involvement with computing of females as opposed to males (in Britain). The fact that two thirds of the study group are male corresponds to the British finding, but in both attitude and achievement we found very few differences between the genders. A few differences were, however, significant.

It is interesting to note that men have the perception that team members do not value their opinion: significantly more males felt that team members

were inclined to interrupt their comments during discussions (χ^2 = 7.452, p = 0.024) but nevertheless felt that group work made the study material more interesting (χ^2 = 9.522, p = 0.009). Even though the majority of females felt that the team roles was the better method for constituting teams (56%), significantly more females felt that teams based on the geographical proximity of students' homes would have been a better idea (χ^2 = 6.354, p = 0.042). This can probably be ascribed to the fact that women feel unsafe on campus after hours and thus could not meet as often as they wished to.

AGE

A relatively large proportion of the third-year class is older than 23 years of age (29%). It may be an indication that students start their university careers at a later stage, which would underwrite the finding that many students are from a disadvantaged background. Or it may be that these students need more than the required three years to complete their bachelor degrees and are thus spending an extra year or two at university because their schooling did not prepare them sufficiently for tertiary education. The language of instruction could probably be a factor too.

Significantly more males are in the age group > 23 (χ^2 = 7.948. p = 0.005). The younger students (23 and younger) scored significantly better in their final matriculation examination (χ^2 = 8.175, p = 0.004) and are mostly English or Afrikaans-speaking (χ^2 = 9.295, p = 0.002).

LANGUAGE

For the majority of students (58.4%) the language of instruction, English, is not their mother tongue. When students whose home language is English, Afrikaans or an African language are considered separately, the students whose mother tongue is a language other than English (χ^2 = 10.100, p =

0.039) need to paraphrase what team members have said before commenting, indicating that students whose home language is not the language of instruction (English) find it difficult to express themselves well in English.

MARK COMPARISONS

Significantly more students who obtained a matric mathematics symbol less than a C indicated a willingness to work in a group ($\chi^2 = 7.942$, $p = 0.019$). A higher proportion of students who obtained an A, B or C for matric mathematics study for the B.Sc. degree ($\chi^2 = 8.737$, $p = 0.003$). A smaller proportion of the students who speak an African language obtained an A, B or C aggregate for their matric mathematics ($\chi^2 = 7.868$, $p = 0.020$). Practically all the students who obtained an A, B or C for matric English feel that the group accepts them as they are ($\chi^2 = 7.264$, $p = 0.026$). The only Computer Science module that significantly correlated with the matric final results is the software engineering course ($p = 0.0169$, $r = 0.2889$). No significant correlation was found between Computer Science marks and matric English or matric mathematics results.

To ascertain whether matric English or mathematics results could be used to predict the aptitude of students in Computer Science, various regression analyses were calculated. It was suggested that the formula ($maths^2$ x eng) could be used to predict Computer Science ability. When calculated, none of these regression equations proved to be useful or statistically significant.

Principal component analysis indicated that the dominant team role according to Belbin did not have any bearing on the achievement of the students.

No significant mark differences were found between the genders.

Students whose mother tongue is an African language achieved a higher year mark for CS324 (Mann-Whitney = 4.8601, p = 0.0275).

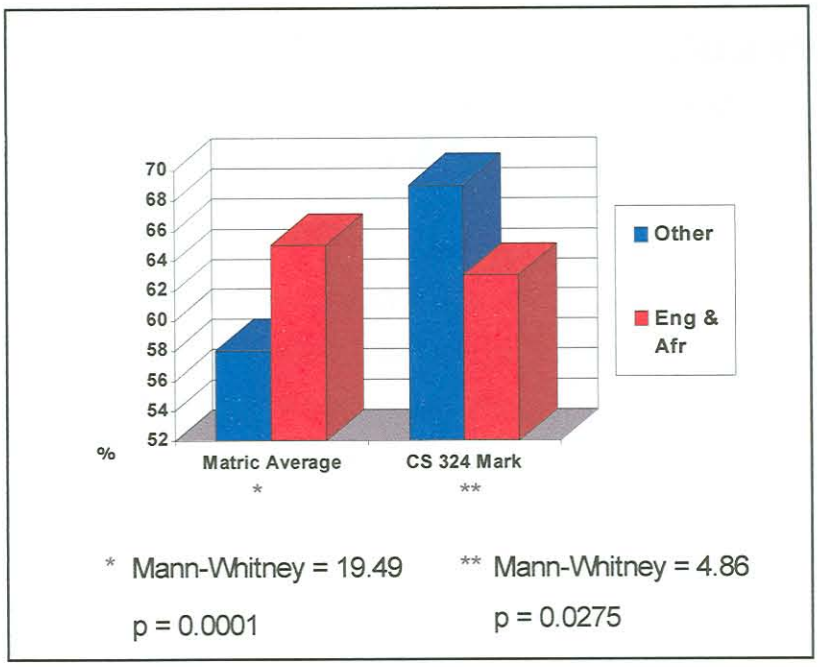


FIGURE 20: Matric average compared with third-year results

As can be seen from *Figure 20*, matric average is no indication of success rate at third-year level. The backlog that African language speakers experience in their first year is eradicated by the time they reach their third year.

The results for both matric average and matric mathematics were higher for English and Afrikaans-speaking students (Mann-Whitney = 19.491, p = 0.0001; Mann-Whitney = 8.5802, p = 0.0034). English-speaking students did significantly better in the CS314 exam; they also obtained a significantly higher CS313 final mark compared to the other students (Mann-Whitney = 8.3992, p = 0.015; Mann-Whitney = 6.1139, p = 0.047).

Younger students (<23) did significantly better than the older students (>=23) in matric average, matric English, CS313 (Software Engineering) year and final mark (Mann-Whitney = 8.0944, p = 0.0044; Mann-Whitney = 4.9727, p = 0.0258; Mann-Whitney = 4.3941, p = 0.0361; Mann-Whitney = 4.7295, p = 0.0296). B.Sc. students achieved higher marks for matric mathematics (Mann-Whitney = 6.0607, p = 0.0138) compared to the B.Com. students.

Students who obtained an A, B or C for their matric average did well in matric mathematics and matric English (Mann-Whitney = 11.036, p = 0.0009; Mann-Whitney = 4.4179, p = 0.0356). These students also scored high marks in the final mark for CS313 (Mann-Whitney = 8.8782, p = 0.0029).

Qualitative research findings

Interviews

To obtain additional information, interviews (using the "Reflective Conversation" protocol [Schön, 1983]) were conducted with the 16 teams and with eight individual members of the teams. Students indicated that they now **reflected more on their learning** [Venter & Blignaut, 1997: Appendix I: 1 – 70]:

> *It helped to get a better overview. Last semester you just try and study one section because we didn't have to do the mind map, we had to cover everything.*
>
> *It is now easier to associate certain things with each other to see where everything meets.*
>
> *When I do it myself I tend to focus too much on the detail.*

The students **preferred active learning:**

> *Oh mind maps, it is a new thing for us and we are not knowing what to do and how to construct the things, how to go about doing it – but later on as we went through the course it became better and you saw the value of it and I think it is actually good.*
>
> *While doing the mind map actually you are discussing it and if I don't know something they (the group) will explain it to me. We actually learnt more in class.*

The students **felt more stimulated**, challenged and satisfied:

> *So I actually like the approach. -- So you learn to stand on your own two feet.*
>
> *We at least came prepared to class.*
>
> *...the lecturer will say something and just go and go on, but while doing the mind map actually you are discussing it and if I don't know something they will explain it to me. We actually learnt more in class.*

Positive interdependence (where the group positively encourages members to work) was highlighted:

> *...nobody in our group is technically orientated. No geniuses that way in our group and I'm so amazed that we actually – did it.*

Some had their reservations about the team roles but the majority indicated that they had gained new insights into themselves and it had made them realise their strengths and weaknesses. As one student said:

> *Well, I thought -- subconsciously I thought, maybe I was like that. It's just that I could look at myself in that light, and the part that I see I should work on. I do have, not inadequacies, but I do have like maybe a fear of pain, something like that. I do have that or try to finish everything fast or make sure that everything is right, and they told me that is the part that I should work on. I do think that I should work on it as well.*

And another:

> *You think you have these strong points, because you don't realise your weaknesses. So if at least anybody else sees a weakness in you, you can work on it. ... you always think you're perfect...*

Team functioning

In general the groups reported positively on their team functioning. Initial problems usually arise from the different interpretations of commitment of team members. However, this is easily resolved by a discussion session between lecturer and team. Minutes of meetings, e-mailed once a week to the lecturer, are also an indication of how well the team functions.

This case study covered the second semester of 1995 (when Belbin was first introduced) and the first semester of 1996. Team functioning in these periods will now be discussed.

THE 1995 STUDY GROUP:

Two teams experienced more than the expected problems. Surprisingly the team which did best in their project, and its presentation, and which functioned exceptionally well as a team (Group 2), eventually excluded two of their members from using the final examination mind map. Even though one member felt that the group was too "strict" with the two expelled members, the majority felt that these two had not contributed their share. After consultation and intervention, one team member was allowed to use the final mind map and the other only half of it. At a meeting with the other (problematic) team (Group 3), the group's problems were not discussed. The intervention was just aimed at salvaging the project by allocating and coordinating the remaining tasks. This was successful.

THE 1996 STUDY GROUP:

Only one team (Group 4) did not seem to form a cohesive group. The groups were finalised in the second week and even at that early stage, this specific group had problems in getting organised. Throughout the course this group experienced difficulties. It is interesting to note that the student who was partly excluded from using the final examination mind map of a group in 1995, was a member of this specific team in 1996. Two teams (Groups 5 and 8) reported that they felt very positive about teamwork.

Discussion and conclusion

UWC students typically come from varied academic and socioeconomic backgrounds, most are first-generation university students and a large proportion come from educationally disadvantaged communities. This is reflected by the large proportion (30%) of the study group that are above 23 years of age. (Interestingly, the majority of these students are men.)

The official language of instruction at UWC is English but for a large proportion (58%) of our students, English is not their home language (see *Figure 17*). It is therefore not surprising that language was again highlighted as one of the factors influencing achievement at university. This has been our finding in an earlier study where language ability was identified as contributing to the success rate of students in computer literacy [Venter & Blignaut, 1996]. The fact that English is a foreign language for most students may have a bearing on the difficulties students experience with verbalising their understanding and why they resort to memorising instead of understanding the prescribed text.

Although no significant mark differences were found between the genders, it is interesting to note that significantly more males felt that the team members interrupted their comments during the discussions. Significantly more students who obtained a matric mathematics symbol lower than a C

indicated their willingness to work in a group. Furthermore, it was established that a larger proportion of students who speak an African language obtained a matric mathematics symbol lower than a C.

No significant correlation was found between third-year Computer Science marks and matric English or matric mathematics results. Thus matric English and/or matric mathematics results cannot be used to predict which students would be successful in their third-year Computer Science.

When using Cohen's [1994] criteria for measuring the effectiveness of teamwork and cooperative learning, the following can be concluded:

- Academic achievement: It could not be determined conclusively that students achieved better when working in groups. However, the majority of students indicated that working in teams contributed to their understanding of the subject, that they gained on a personal and social level and that they had learnt more in the group than they would have had by learning individually. Most (78.2%) felt that the Belbin team profile provided them with insight into the contribution that they could make to a team.
- Conceptual learning: The more informal format of the lectures, and the preparation and presentation of mind maps were positively experienced by most students; they learnt new ways of ordering facts and information which enhanced their understanding of the work.

Apart from academic achievement, some of the other criteria mentioned by Cohen that could be used to measure the effectiveness of this teaching method are:

- positive intergroup relations and
- desirable prosocial behaviours.

If the following remark of a student from the 1995 cycle (Case Study 1) is a measure of this, then the group work has indeed succeeded in respect of these two criteria [Venter & Stoltz, 1995: Appendix E, 1-4].

> *And also the other problems within our institution, students become like strangers. Like, oh, there is the coloured boy, there is a black student. We are all people from a different world. But in cooperating, that is happening in our class, but suddenly we communicate and in one group we have commonalities.*
>
> *The people I have met this year have been in the same computer class since 1992, but we have not even bothered to speak to one another. ... I know the students since 1992, but I don't know their names. The tension is gone -- now that we know each other.*
>
> *...without it being necessary to control your conversation, you know it will be accepted. It has brought one (collective) personality into the class.*

De Villiers and Roode [1995] are of the opinion that the social structure used in tertiary education is out of synchrony with the social skills needed in a technological-based economy. Cooperative learning and teamwork, with the development of positive intergroup relations and desirable prosocial behaviours, can possibly bridge the gap.

Even if the only positive aspect of group work turns out to be that students enjoy learning, which they seemed to do, then this more mature approach to learning is worth pursuing. On the other hand such a conclusion possibly indicates that the present structures of our examinations are failing to adequately test the dimensions of learning we wish them to.

The following table summarises the findings of this case study.

RESEARCH QUESTION	INTERVENTION	RESULTS OF CASE STUDY 2
TEAM CONSTITUTION How should teams be constituted?	Belbin team-role theory used to constitute balanced teams.	In 1995 two teams experienced problems, one of these functioned well until the final mind map had to be prepared. In 1996 only one group experienced problems.
FORMAL/INFORMAL LECTURE RATIO How often should small group learning be alternated with plenary sessions and formal lectures?	Group mind map presented by groups once a week. Formal lectures reduced – given approximately once a week plus *ad hoc* lectures (when students found material difficult).	The majority of students (54%) liked the more informal format of the lectures. *…we at least came prepared to the class…*
SUCCESSFUL LEARNING What could be considered a successful learning experience?	Cooperative learning with mind mapping was used.	Most students (70%) found that mind maps gave them a broader perspective of the work. *…later on as we went through the course it became better and you saw the value of it…*
MEASURING SUCCESS How is success measured?	▪ Academic achievement ▪ Conceptual learning ▪ Equity ▪ Prosocial behaviour	Could still not be determined conclusively. Mind maps improved conceptual learning. *…people from a different world … communicate …*
ASSESSMENT How should students be assessed?	Some peer evaluations introduced but mostly formal examinations.	Largest proportion of marks still individual examination mark.

TABLE 3: Summary of the results of CASE STUDY 2 in terms of the research questions

In the next case study the "chalk-and-talk" method is compared with small group learning. The only variable in this case study was the lecturing method. The class, the subject that was taught (Statistics) and the lecturer in this case study, remained the same.

CASE STUDY 3 – COMPARING "CHALK-AND-TALK" WITH TEAMWORK IN 1997.

[Blignaut & Venter, 1998b]

Introduction

The concept of "lifelong learning" can be interpreted in many ways. We would like to consider lifelong learning as the ability to adapt to and be prepared for an ever-changing world. This would necessarily include the basic skills of using technology effectively to access large repositories of information.

The philosophy of lifelong learning must impact on the way classes are conducted in educational institutions. The effectiveness of the "chalk-and-talk" method is thus becoming questionable. In this study a different teaching style, incorporating teamwork and cooperative learning, was adopted to promote lifelong learning skills: empowering the student to have an active role in his/her education.

The use of computers is an integral part of statistics and therefore students need to be computer literate. The majority of our students come from disadvantaged backgrounds. In a South African context this *inter alia* means that:

- Many schools (38%) have no access to a telephone;
- 43% of all schools do not have electricity; and
- Only 41% have water on the premises.

(Quoted from a survey published in 1997 [Bot, 1997]).

For many of our second-year Statistics students, this course would have been their first encounter with computers. Due to the diversity of students'

backgrounds it was felt that this teaching strategy could be beneficial to educate our students.

Design and method

Students doing a second-year course in Statistics (in the second semester 1997, STA225) were placed in groups (or teams) at the onset of the course using Belbin's team-role test. (The Belbin test [Belbin, 1993] is used by industrial psychologists internationally to constitute teams.) In order to discuss their understanding of a particular section of the work in a group situation, students had to prepare prior to the lecture. A formal lecture was presented on the first double period of each week. All other periods (six) and tutorials were used for teamwork activities. Each group had to hand in a weekly assignment and a computer practical was handed in fortnightly. Teams needed to construct mind maps [Buzan, 1995] of each chapter. Finally both sides of an A4-sized paper (or one side of an A3-sized paper) could be used to construct a team mind map, summarizing all the work done during the semester. All participating team members could use this team mind map in the examination.

Both qualitative and quantitative research methods were used to collect data. The quantitative method used, entailed the use of a self-administered questionnaire. Unstructured interviews using Schön's reflective converstation protocol [Schön, 1983], lecturer's notes and students' e-mail messages were used to collect the qualitative data. (Photographs of students were used to allow the lecturer to become familiar with the students in a shorter period of time.)

The results of some of the more general questions

The 52 students attending this course came from varied cultural and socioeconomic backgrounds. The home languages of these students were as follows: 26.7% spoke Xhosa, 36.5% spoke English, 9.6% spoke Afrikaans and 26.9% spoke other African languages, such as Zulu, Sotho, Siswati, etc.

Forty-seven percent was enrolled for a B.Sc. degree. The females were slightly more than the males (57.7%). Twenty-three percent of the students were older than 23 years of age. Most of the students had attended public schools (81%), and 8% had obtained tertiary qualifications prior to university enrolment.

Sixty-eight percent of the students said that working in a group improved their self-esteem. Only 14% said they preferred conventional lectures above this method of lecturing. Twenty-three percent of the students did not enjoy doing weekly assignments. Computer practical assignments were difficult for 23% of the students. The majority of students felt that not enough assistance was given whilst doing computer practical assignments.

Fifteen percent found it difficult to express themselves in English and to understand concepts due to language difficulties. The textbook was always easy to read for 72% of the students. Nineteen percent used their own computers at home. Fifty percent said they used e-mail. The Internet was accessed regularly by 27% of the students.

The course was enjoyed by 73% of the class, whilst 27% said they were not so sure. Seventy-eight percent said they liked the way that the class was conducted. Eighty-two percent said they almost always attended lectures. Ten percent said they read the relevant sections before attending class whilst 57% said they only prepared occasionally.

Ninety-eight percent said the lecturer's attitude was positive when approached. Eighty-eight percent said they were always well informed of what was expected of them. Ninety percent felt that enough opportunity was given to discuss problem areas with the lecturer.

Eighty-six percent of students indicated that they enjoyed this more mature approach to learning. Eighty-two percent said that they almost always

attended lectures - we found this quite remarkable. Team functioning requires students to be prepared and especially to be present.

It was found that matriculation results could not be used to predict success rate in Statistics courses at our university.

Language group comparisons

English is the medium of instruction but is the second, or even third, language for 64.5% of the students. It is thus not surprising that most significant differences were found when the different language groups were compared.

Due to the small numbers per language group, the language groups with similar profiles were combined to form groups large enough for statistical comparison purposes. The Afrikaans and English students' data (24) were compared with all the African language students' (27).

When comparing the African home language students with the other students, it was found that they obtained significantly lower marks in the second semester Statistics module, matric mathematics and matric average. During interviews it was mentioned that the African language students received most tuition in school in their home languages and thus at university found it difficult to express themselves in English.

The African language students kept their thoughts, feelings and reactions to themselves during group discussions (Fisher's exact test $p=0.002$), they also tended to summarize or paraphrase what other members had said before responding or commenting (Fisher's exact test $p=0.011$). More of the students with English or Afrikaans as home language felt that their comments were interrupted during group discussions (Fisher's exact test $p=0.0048$). Significantly more of the African language speakers felt they

had learnt more in a group than they would have done individually (Fisher's exact test p=0.038).

Although the entire group felt positive about mind maps, more of the African language students felt that mind maps increased their understanding of the subject (Fisher's exact test p=0.045); the creation of these mind maps were also more enjoyed by the African language students (Fisher's exact test p=0.021). The non-African language students access the Internet on a more regular basis (Fisher's exact test p=0.0058).

No difference was found in the matric English marks between the two groups. The Afrikaans and English-speaking students obtained higher marks for matric mathematics and matric average compared to the African language students (Mann-Whitney test, p =0.0001; p=0.0017). English and Afrikaans speakers did significantly better in the first semester (STA215) computer test. Even though all the students generally do better in the second semester of this course, the English and Afrikaans speakers did significantly better in the (STA225) test, computer, group work, semester, exam and final marks compared to the African language speakers.

Comparisons between B.Sc. and B.Com. students

The B.Com. students kept their thoughts, feelings and reactions to themselves during group discussions (Fisher's exact test p=0.005). More of the B.Sc. students found the group's mind map interesting (Fisher's exact test p=0.0072) and they found it interesting to see how others rated them (Fisher's exact test p=0.034). More of the African language students are enrolled for a B.Com. degree, whereas more B.Sc. students are English or Afrikaans-speaking (Fisher's exact test p=0.0005).

The B.Sc. students did significantly better in the matric average mark. They obtained significantly higher marks in the computer, semester, exam and final marks of the STA225 course.

Gender comparisons

Even though significantly more females felt that their comments were interrupted during group work discussions (Fisher's exact test p=0.031), they felt that group work helped them to understand the work better (Fisher's exact test p=0.0078). More females felt that mind maps gave them a broader perspective of the work (Fisher's exact test p=0.0057). The females were more inclined to prepare before attending class (Fisher's exact test p=0.036) and it is thus not surprising that they enjoyed the weekly discussions more than their male counterparts (Fisher's exact test p=0.012).

During both semesters the male students outperformed the female students in the computer test; this difference was only statistically significant during the first semester (Mann-Whitney test=7.1592, p=0.0075).

Age group comparisons (≤ 23; > 23)

It is interesting to note that the majority of students are older than 21 years of age. Less than 20% of the students who are academically in their second year have spent only two years at university.

More than 70% had been at university for a longer period. The younger students felt that group work helped them with the understanding of their work (Fisher's exact test p=0.0044) and they enjoyed discussing the study material (Fisher's exact test p=0.011), but they were forced to become more dependable (Fisher's exact test p=0.019). The lecturing format was enjoyed more by the younger students (Fisher's exact test p=0.0013). The older students found that they often did not have the extra time needed for the discussion groups as they had families and other responsibilities to tend to.

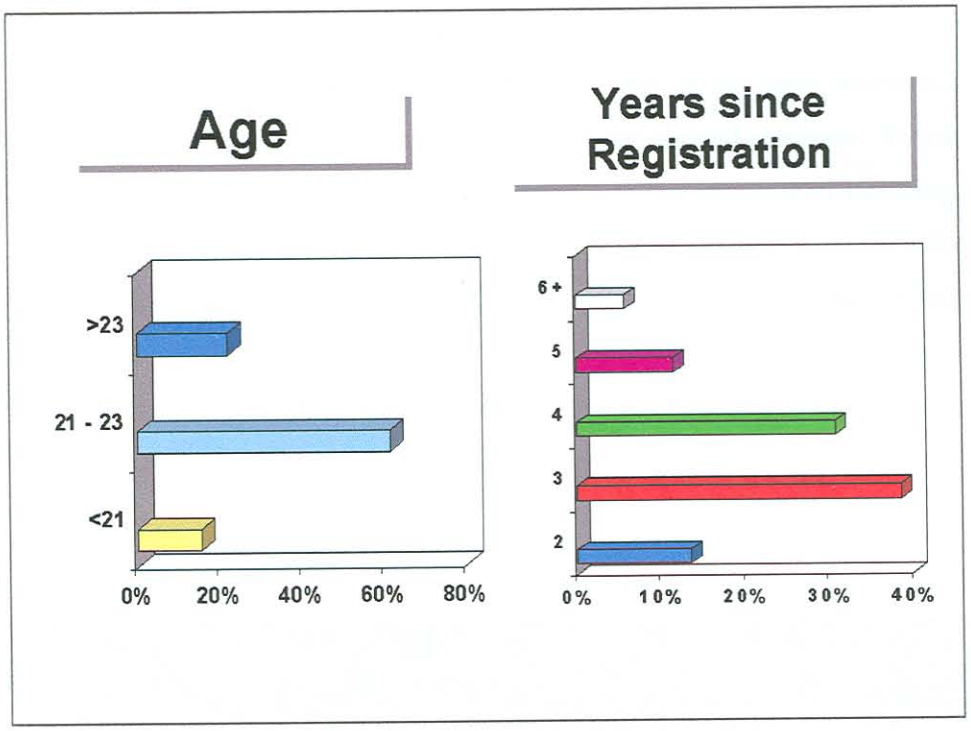


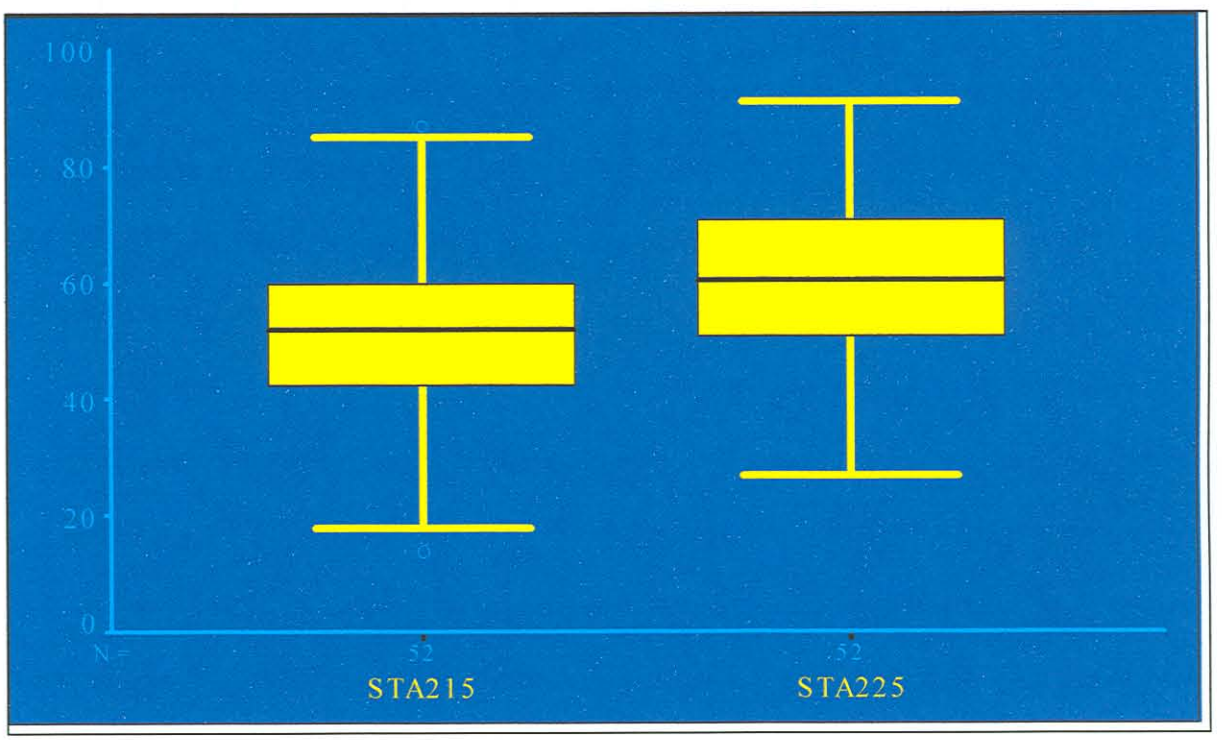
FIGURE 21: Age and throughput of second-year students

None of the older students obtained a percentage greater than 59% for their matriculation average (Mann-Whitney = 7.499, p=0.0062). More of the older students had a tertiary qualification before entering university (Fisher's exact test p=0.022).

Even though the correlation of the various marks was calculated, no significant correlation could be found between the Statistics and matric marks. Thus the matriculation results could not be used to predict success rate in statistics courses in this group of students. The first semester final mark and computer mark (STA215) could be used to predict the second semester final mark (STA225) with reasonable accuracy.

Paired comparisons of final (STA215 and STA225) marks

In this section course comparisons were done only in the cases where the same lecturer presented the first semester and the second semester. It was felt that the only variable to be investigated was the method of lecturing. Students who enrolled for both the first and second semester courses were included for comparison of the final results of the two semesters. (Only the marks of 1994, 1995 and 1997 were used for comparison purposes, as the variable "the lecturer" was the same in both semesters of those years. The data of 1996 could not be used, as the same lecturer did not teach both courses.)



Paired T-test = 5.647, p = 0.0001

FIGURE 22: Significant difference found between the teamwork, cooperative learning method and the "chalk-and-talk" method

A statistically significant difference was found between the final mark of STA215 ("chalk-and-talk" method) and STA225 (team, cooperative learning method) in 1997 (Paired T-test = 5.647, p = 0.0001). The Statistics marks obtained in 1994, 1995 and 1997 showed that in general (in all years) students, compared to the first semester, achieved higher final marks during the second semester.

We would like to believe that the significant increase in achievement in 1997 could be ascribed to teamwork and cooperative learning.

YEAR	VARIABLE	N	MEAN	STD.DEV	MIN	MAX
1994	STA215	19	50.05	16.01	14	85
	STA225	19	59.68	20.76	6	81
1995	STA215	34	52.15	10.50	29	75
	STA225	34	64.65	16.14	8	85
1997	STA215	52	51.98	17.12	12	87
	STA225	52	60.75	14.24	27	91

TABLE 4: Descriptive Statistics 1994, 1995 & 1997

Summary of paired test results

VARIABLE	YEAR	NORMALITY	TEST	TEST STATISTIC	PROB-ABILITY	SIGNIFICANT DIFFERENCE
STA225-STA215	1994	NO	Wilcoxon signed rank	0	1.0	NO
STA225-STA215	1995	NO	Wilcoxon signed rank	0	1.0	NO
STA225-STA215	1997	YES	Paired T-Test	5.647	**0.0001**	**YES**

TABLE 5: Summary of Paired Test results

The decrease in the computer mark between the two semesters could be due to many factors:

- The first semester computer work entailed using a Spreadsheet package (Quattro Pro) with no complicated statistical interpretation of data, whereas in the second semester the students were expected to interpret results, using theoretical principles covered in the course. The package used in the second semester was SPSS - a statistical package.

- During the first semester students were expected to complete all assignments individually. In the second semester each group completed a fortnightly assignment. The output and interpretation of the results were then e-mailed to the lecturer.

- From interviews it transpired that during the second semester some group members did not participate in the computer assignments.

- No time was appropriated on the official timetable for computer assignments. Students were expected to complete computer work in their own time. Some groups had difficulty finding suitable time slots to work together in order to complete the assignments.

The descriptive statistics (*Table 4*) show that in general (in all years) students achieved higher final marks during the second semester compared to the first semester. In *Table 5* a significant difference was found between the final mark of STA215 and STA225 in 1997. We would like to believe that the significant increase in achievement in 1997 could be ascribed to teamwork and cooperative learning.

Qualitative research findings

Interviews

To obtain additional information, interviews (using the "Reflective Conversation" protocol) were conducted with two members of each team [Blignaut & Venter, 1998b: Appendix I, 1 - 23].

It transpired that **language** was definitely a hurdle:

> *I had a problem when it comes to submitting it in English*
>
> *We think it is better if we explain the work in Nguni. I am not Nguni, I'm Sotho.* (another student says that he/she is Xhosa) *which is Nguni related. – I however, managed to adjust to Nguni. So whenever we work together as a group we speak Nguni. That would accommodate all the students, but I can't ignore the fact that we've come from different backgrounds.*

Students indicated that they now **reflected more** on their learning:

> *...you develop your own understanding.*
>
> *Group work as a re-enforcement for understanding the study material was a good idea.* [Blignaut & Venter, 1998b: Appendix H(i), 1]

They preferred **active learning** and creating **mind maps** [Blignaut & Venter, 1998b: Appendix I, 1 - 23]:

...group work, compared to last semester, it is easier doing it this way;

...when you see it on the mind map - you actually see that the work is not so much and that it is linked together.

Students felt **empowered:**

Group work, yes compared to last semester - it is easier doing it this way;

I did the course last year but it is much better this year;

...my mark - shot up by like 40% - so I can go to the exams with a 70% DP (semester average) - because I was working in a group it went up.

They acquired **lifelong skills** such as **social, conflict resolution, management and leadership skills:**

The class became more close;

It is actually better, a bit more personal;

...there is problems but I learnt to work with them - and understand them;

...we became friends - we socialised;

I personally prefer to work individually but it was a good exercise - it was scary - but of course we had good times;

...we learnt more about other people;

...we have some mixed feelings, of course, but on the whole it was a group effort from all the individuals.

Some had their reservations about the **Belbin team roles** but the majority indicated that they had gained new insights into themselves and it had made them realise their strengths and weaknesses.

Field notes

In order to monitor the various relevant systems implemented, the researchers kept field notes (daily observational reports). If it was deemed necessary, controlled action was taken. In general the groups reported positively on their team functioning. Initial problems arose from the different interpretation of team members' commitment. However, this was easily resolved by a discussion session between the lecturer and the team. Minutes of meetings, e-mailed once a week to the lecturer, were also an indication of how well the team was functioning.

Discussion and conclusion

UWC is committed to the concept of lifelong learning. It implies a fresh approach to knowledge, a holistic view of education, the integration of formal and informal types of learning and an appreciation for learning, which should be a lifelong endeavour. As resources are not likely to increase, innovative learning and teaching strategies will have to be developed to meet increasing needs.

English is a second or third language for most of our students and therefore they find it difficult to verbalise their understanding of the prescribed text. It is not surprising then that they resort to the memorisation of the text. With the introduction of cooperative learning students were expected to converse with peers, allowing them to learn to express themselves in English. It is a more desirable teaching method for these students who typically come from different academic and socioeconomic backgrounds.

RESEARCH QUESTION	INTERVENTION	RESULTS OF CASE STUDY 3
TEAM CONSTITUTION How should teams be constituted?	In the first semester of 1997 the "chalk-and-talk" method of teaching was used and in the second semester small group learning. Belbin team-role theory was used to constitute balanced teams in the second semester.	Students felt in general positive about their teams: *...I learnt to work with them, and understand them* *...we became friends and socialised*
FORMAL/INFORMAL LECTURE RATIO How often should small group learning be alternated with plenary sessions and formal lectures?	Formal lectures were given once a week plus *ad hoc* lectures – when students found material difficult. Photos of students allowed lecturer to get to know students in a shorter period of time.	Only 14% indicated that they would have preferred formal teaching. And in comparison to previous semesters a surprising 82% said they almost always attended class.
SUCCESSFUL LEARNING What could be considered a successful learning experience?	Cooperative learning with mind mapping was used for the first time with this group in the second semester.	Students were satisfied: *...my mark... shot up like 40%...*
MEASURING SUCCESS How is success measured?	▪ Academic achievement ▪ Conceptual learning ▪ Equity ▪ Prosocial behaviour	Students achieved SIGNIFICANTLY better with this method. Mind maps improved conceptual learning: *When you see it on the mind map – you actually see ... that it is linked together...* - -
ASSESSMENT How should students be assessed?	Some peer evaluations introduced but mostly formal examinations	Largest proportion of mark still individual examination mark. (The group mark forms a small proportion of the final mark)

TABLE 6: Summary of the results of CASE STUDY 3 in terms of the research questions

The majority of students indicated that working in teams contributed to their understanding of the subject. They gained on personal and social levels and learnt more in the group than they would have by learning individually, confirming that whilst most people find it easy to learn, many find it difficult to be taught [Ross, 1997]. Most felt that the Belbin team profile provided them with insight into the contribution that they could make in a team situation. The more informal format of the lectures, and the preparation and presentation of mind maps were positively experienced by most students; they learnt new ways of ordering facts and information which enhanced their understanding of the work. Students with a language disadvantage seemed to enjoy the creation of mind maps more and felt that it increased their understanding of the subject.

The successful implementation of cooperative learning requires students to prepare prior to attending class. Although an unusually (for UWC) high attendance rate was monitored, students came unprepared to class. Students achieved significantly higher marks in the second semester, proving that this teaching strategy has merit.

Only a small proportion of our students have access to a computer at home. The Internet was accessed on a regular basis by a small percentage of our students. One would expect that students would be interested and excited to become acquainted with modern technology such as the Internet and the use of e-mail. During both semesters the male students outperformed the female students in the computer test. To address this gender imbalance, new methods need to be explored to empower females in the use of technology.

The incredible growth of access to the Worldwide Web necessitates the creative use of computers. Communication, through electronic media, is becoming an important lifelong skill needed to function in a modern society. Cooperative learning within a team can therefore be considered a

bridging methodology for students from a disadvantaged background. The development of life skills such as positive intergroup relations and the ability to work productively in teams could help to bridge the gap between tertiary education and the job market. With this approach students seem to enjoy learning more, making it a worthy pursuit.

Teamwork, the use of mind maps and Belbin's group constitution were all implemented in the second semester of 1997 (Computer Science group) and data collection was continued. This period will now be discussed as Case Study 4.

CASE STUDY 4 – A CHANGING WORLD NECESSITATES NEW TEACHING METHODOLOGIES. THE SECOND SEMESTER OF 1997.

[Venter & Blignaut, 1998]

Introduction

This report focuses on new methods used in tertiary teaching and learning. Although this study deals with students majoring in Computer Science, it is felt that this method of teaching is generic and could be used in any educational environment. The fundamental objective of tertiary education is to develop each learner's talents, to build on their individuality and to give them a way of coping with a world that is overflowing with information [Ross, 1997]. Above all, learners must learn that learning is not only practised in education but that learning is fast becoming the new form of labour [Zuboff, 1988]. In group learning situations students will not only study the contents of the subject but will also learn lifelong skills needed to function in a modern society. Many of our students are from educationally disadvantaged backgrounds and are inclined to memorize their work verbatim. It was felt that a new learning methodology should be explored to remedy this situation.

Learning takes place in informal, as well as formal situations, including both education and training, which interpenetrate one another [Watts & McNair, 1995]. Not only does knowledge of the individual's team-role profile lead to more appropriate contributions in team learning situations, but also to better appreciation of the contribution of other team members. When members of a team are familiar with the team-role strengths and weaknesses of other team members, this leads to more realistic expectations of their potential contributions and better utilisation of time and energy. Our experience indicates that less time is wasted on the lengthy and often disruptive process of role clarification and dealing with unproductive

competitive behaviour. The insight and knowledge gained through individual team-role profiles in team learning situations seem to lead to mature understanding of the self, which enhances any future team, as well as individual, learning situation.

Both qualitative and quantitative instruments of measurement were used to collect the data.

Design and method

In this course the method of teamwork and co-operative learning was used. Students were placed into teams using Belbin's team-role concept [Belbin, 1993]. A formal lecture was presented whenever students experienced a problem with a section of the work or was used to summarise work that was learnt the week before. Most periods and tutorials were used for teamwork activities. Each group had to do research on a topic for a presentation. Teams needed to construct mind maps [Buzan, 1995] of each chapter and finally a mind map was constructed summarizing all the work of the semester. Students were expected to prepare for class to enable them to participate in team activities. A weekly report on their progress (via e-mail) was expected from each group.

Data was collected using self-administered questionnaires and interviews were conducted with groups to obtain feedback on this teaching method.

Results

The 63 students attending this course came from varied cultural and socioeconomic backgrounds. The home languages spoken by these students were as follows: 17.5% spoke Xhosa, 40.4% spoke English, 15.8% spoke Afrikaans and 26.4% spoke other African languages, such as Zulu, Sotho, Venda, Tswana, etc.

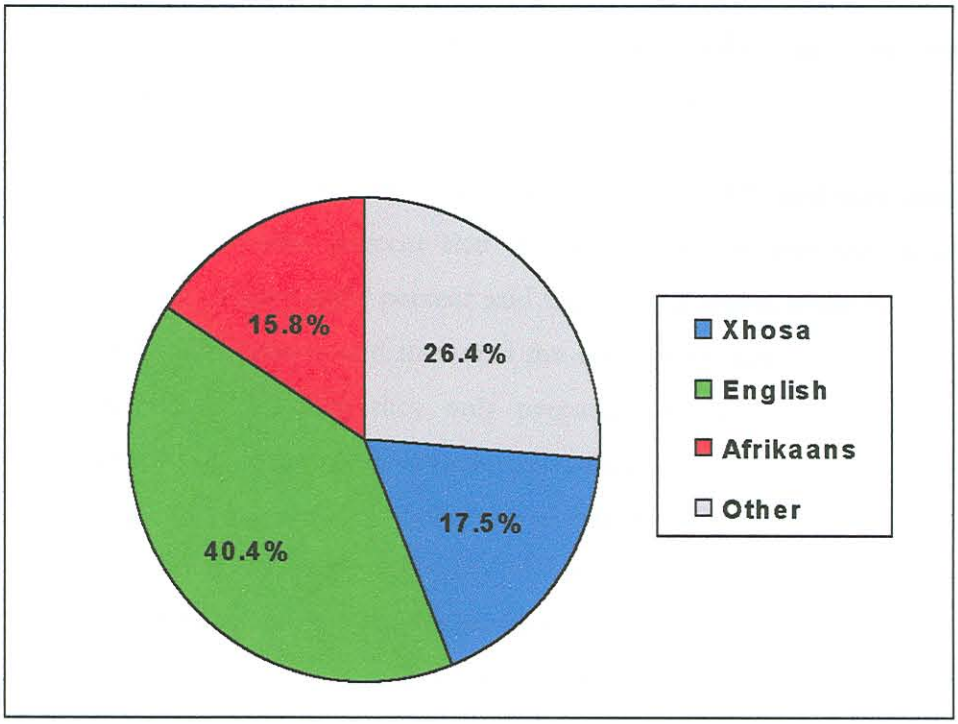


FIGURE 23: Language distribution of the 1997 Computer Science study group

Sixty-one percent were enrolled for a B.Sc. degree. The class comprised mostly males (63.3%). Twenty-one percent of the students were older than 23 years of age. Most of the students had attended public schools (87%) and 10.2% had obtained tertiary qualifications prior to university enrolment.

Only 37% of the students said that working in a group improved their self-esteem. Only 11% said they preferred conventional lectures above this method of lecturing. Sixty percent of the students enjoyed doing the computer project. The computer practical was found to be difficult by 16% of the students. The majority of students felt that not enough assistance was given whilst doing the computer practical.

Nine percent found it difficult to express themselves in English and to understand concepts due to language difficulties. The textbook was always easy to read for 47% of the students. Forty-nine percent used their own

computers at home. Seventy percent said they used e-mail. The Internet was accessed regularly by only 54% of the students.

The course was enjoyed by 64% of the class, whilst 29% said they were not so sure. Fifty-nine percent said they liked the way that the class was conducted. Eighty-eight percent said they almost always attended lectures. Twenty-eight percent said they read the relevant sections before attending class, whilst 43% said they only prepared occasionally. Ninety-seven percent said the lecturer's attitude was positive when approached. Sixty-three percent said they were always well informed of what was expected of them. Seventy-four percent felt that enough opportunity was given to discuss problem areas with the lecturer. Fifty-one percent of the students indicated that they preferred blocked courses – that is, that one module is completed before the next is started. Sixty-four percent felt that the progress reports helped with their time management.

Language group comparisons

Due to the small numbers in some language groups, the language groups with similar profiles were combined to form groups large enough for statistical comparison purposes. For some questions the Afrikaans and English-speaking students (32) were combined and compared with the African language students (25), and in other cases, English-speaking students (23) were compared to all students with a home language other than English (34).

The English and Afrikaans-speaking students had not obtained any tertiary qualification before entering university, whereas 24% of the African language group were qualified in another direction prior to entering university (Fisher's exact test $p=0.0049$).

Significantly more of the African and Afrikaans-speaking students felt that they were influenced by group members (Fisher's exact test $p=0.014$) and

experienced insight into the role they could play within a team positively (Fisher's exact test p=0.037). These students preferred teams constituted using Belbin's team-role concept compared to a random selection (χ^2 = 4.482, p = 0.034).

It was felt by the African and Afrikaans home language group that mind maps gave a broader perspective of the work (Fisher's exact test p=0.0024); they felt that it was important to present the mind maps (Fisher's exact test p=0.014) and enjoyed this experience. Significantly more of these students enjoyed the lecturing style that incorporates teamwork and cooperative learning (Fisher's exact test p=0.026).

African home language students prepared before attending class more than their counterparts (Fisher's exact test p=0.0049). Although the χ^2-test is not valid (due to too small numbers in the cells in the table) the data indicates that none of the English-speaking students felt that they were prejudiced towards people of other cultures before getting to know them in a group situation. Many of the Afrikaans and some of the African home language students felt some prejudice towards other cultures before getting to know them in a team situation.

No difference was found in the matric English marks between the groups. The Afrikaans and English-speaking students did significantly better in the Computer Science modules, matric mathematics and matric average, compared to the African language students.

Comparisons between B.Sc. and B.Com. students

The B.Com. students felt that they had learnt to cooperate with other students (Fisher's exact test p=0.0036). More of the B. Com. students were inclined to change their course registration since their original registration (Fisher's exact test p=0.037). Significantly more of the B.Sc. students prepared before attending class (χ^2 = 8.386, p = 0.015). This correlates well

with the fact that these students also preferred the more informal format of lectures (Fisher's exact test p=0.015).

The B.Sc. students did significantly better in the Computer Science Network module examination.

Gender comparisons

Significantly more females felt that team members understood what they tried to communicate (Fisher's exact test p=0.033); they felt that they knew the students in the class on a more personal level compared to other classes they attended (Fisher's exact test p=0.011). More males felt that group work gave them the opportunity to talk and discuss the study material (χ^2 = 4.339, p = 0.037). More females obtained an A, B or C for their matric mathematics compared to the male students (χ^2 = 4.189, p = 0.041).

Age group comparisons (≤ 23; > 23)

Thoughts, feelings and reactions are kept private by older students during group discussions (Fisher's exact test p=0.0082). More of the older students had a tertiary qualification before entering university (Fisher's exact test p=0.013). Younger students did significantly better in CS323 (Mann-Whitney = 4.3688, p = 0.0366).

Even though correlation was calculated using all marks, no significant correlation could be found between the Computer Science and matric marks. Thus the matriculation results could not be used to predict success rate in Computer Science courses in this group of students. Regression analyses, with CS324 (the Network module) marks as the dependent variable, proved to be inconclusive.

Qualitative research findings

Questionnaire comments and e-mailed reports

Teams were expected to e-mail the minutes of their weekly meetings to the lecturer. This was done to keep the lecturer informed of their progress and to allow intervention if the need arose. Conflict resolution as well as the ability to function productively within a team are important lifelong skills. Therefore students were expected to resolve their problems but could call on the lecturer for advice and intervention if necessary. In general, the groups reported positively on their progress and team functioning. In a few cases it was necessary to intervene; problems were resolved by consultation with the individual members of the team and the team as a whole.

As part of the questionnaire students could write a comment. Only sixteen students commented on the course. Of these comments eight were positive, three indifferent and five negative.

Interviews

To obtain additional information, interviews (using the "Reflective Conversation" protocol [Schön, 1983]) were conducted with two members of each team.

It transpired that students enjoyed the more **informal method of lecturing** [Venter & Blignaut, 1998: Appendix H(ii), 14 and Appendix I, 1 – 35]:

> *The teaching method was fresh and different…*
>
> *I don't think there's a problem with working like, in class like that. Sometimes you get bored when the person stands there and speak a long time and all these long things. What I like is participating and asking questions, it is much better, that way. We did enjoy the course.*

The way in which the classes were conducted I like this way. You rely on yourself and learn by yourself. You don't just guess things, no spoon-feeding! As a final-year student, the following year you will be doing honours then you go to masters, so if the lecturer does everything it is not good, there is no growth.

Students also enjoyed **working in a group**:

Yes, working in groups you meet different people and you learn from them. I tutor maths 114 so they also have this group work so – I actually like it. At first year we done this workshop - once you've done that – it is better than just normal lectures.

Yes, it was quite nice, I mean, okay, we had our problems, but it was quite nice. The fact that besides having the lecturer behind you and hand in over, instead you've done it for your group. It was a totally different feeling and I enjoyed it.

Yes, I did enjoy working in a group. It breaks down the task into like smaller parts so that you don't actually have to do everything yourself. You can give it to different people to do. Certain parts - you can make a big job smaller.

But where I did get the sense of camaraderie was in the practical. You really get to know each other – the character came through -- under stress, true to type and those who are committed and those who are not committed. You can get a sense of their character and their strengths and weaknesses.

...group work has been quite helpful in encouraging a person to appreciate what you are studying and I think most of us enjoyed it.

I think that it was fantastic. Well, I knew a lot of people, but I couldn't say I related to them openly, fairly. And I think this year has been the best year to be able to talk to people.

Students indicated that they now **reflected more** on their learning:

Ja. Because now you actually have to go out yourself and find out, whereas when the lecturer stands in front and just gives you that – OK fine, you just take that and learn that. Now we have to like try and understand it by ourselves, try and work it out by yourself.

So, in the beginning it was a bit difficult, but when I started out, it was maybe, probably because of my attitude, maybe of – like I am used to work alone. But later on -- I see the benefits of it and I also see the negative side. You learn from each other, we discuss and you get different ideas and different views or -- and the other part also. But because working in a group it is less work on the individual itself so you can become a little lax on the other side as well.

Yes definitely! During the first semester I used to memorise everything – I did not try to understand it. Now I find that if you try to understand it, it makes it less work. And easier.

Students felt **empowered**:

I didn't actually think that for networking that we actually would have to set up a network. I didn't actually expect it, but it is actually fun.

The project is quite a learning experience. Because we actually had to get up and meet with people that work in the field. So, it's not actually off closed in the varsity. You actually go out and meet all these people. You can learn things from – that experience –

The things that were said there, I mean that amazed me. I never thought I could be a leader, but – in that assessment it says something like that.

They acquired **lifelong skills** such as **social, conflict resolution, management and leadership skills**:

Yes, definitely, because you learn to work with people.

Before this year I didn't know anybody. I just knew their faces in the class. Since we formed the group, in the first semester I named people, and now, it is different group. Now I've learnt to know many people.

Ja, it has. It is nice, I think that is the nice part about it that when you go home it is not like first semester where you just set myself to do that, whenever I want to. Now I cannot and I think it is preparing us for life. That is a good aspect of that.

Actually I want to talk about the relationships. -- I haven't actually met Winston before, I met him in this group. He is a nice guy and - most of the groups are nice - I mean it brought the whole class like together. I think that is nice about group work where formal lectures is just you sit down and you listen to the lecturer and finished your work up and you only busy with your own curriculum.

Because I find my style to be very individual, and you always cause conflict within the group if you don't watch yourself.

Getting a pace and getting a sense of where you all coming from because we had all different ideas about things and how to do things. Ja and that was the biggest struggle, but being together as a group, that was fine.

Mind maps summarised the study material effectively:

There is a structured approach to it. So the mind map shows you exactly this comes from this section …

Yes, they help a lot. Sometimes when you see a diagram you remember most of the things.

I think it has its advantages and disadvantages, like we just said now. One of the advantages is that it let the student work more.

Now, the mind maps was a good idea, in fact, and I try to learn according to them and I could focus say for instance on certain things that's on the mind maps, and I just know here and there and I just can expand what it is. Oh, the mind maps was a very good idea!

Yes, when like, after we've done - each one our own mind map - we brought it together. While we were compiling the big one, we discuss certain things.

Some had their reservations about the **Belbin team roles** but the majority indicated that they had **gained new insights into themselves** and it had made them realise their strengths and weaknesses. As one student said:

The first role that everybody gave me on my list was a Shaper and I thought of myself as an Implementer because I know like eventually I have to get this thing done and so then I will do it. So I don't know –

Okay, you read through it and then, like, think 'who is this?'

Yes, as compared to last semester where we were chosen in alphabetical order. It wasn't nice. We clashed a lot -- everybody wanted to be a leader, even though we chose one –

Discussion and conclusion

Our university is committed to the concept of lifelong learning as underpinned by this extract from its new mission statement –

The university will - encourage and provide opportunities for lifelong learning through programmes and courses …

Lifelong learning is about providing the skills to develop learning abilities needed throughout each person's life. The information age and globalization require special communication skills and it is therefore rather surprising that only 70% of the students regularly use e-mail and even fewer

(54%) use the Internet. It would be expected that at third-year level ALL students would use e-mail and the Internet regularly. Perhaps it is because only 49% of students have access to a computer at home.

It is interesting to note that in 1997 the majority (63%) of third-year students studying Computer Science at our university was male. Significantly more of the females felt that group work gave them the opportunity to talk and discuss the study material. Could this be ascribed to the fact that the majority of the class was male or that the field is traditionally male dominated? Females therefore may have felt intimidated when participating in large class discussions.

In modern society great emphasis is placed on the ability to function constructively within a team as the complexity of problems necessitates more than an individual insight. Most of the students felt that working in teams did not only contribute to their understanding of the subject but gave them the opportunity to develop their personal and social skills. Most students experienced the innovative method of lecturing positively. Students with a language disadvantage felt that the creation of mind maps gave them a broader perspective of the work and felt that it increased their understanding of the subject.

Research in teaching and learning methods is a cyclical process with continuous adaptation and refinement as problem areas are identified and rectified. The quantitative and qualitative methods of measurement are complementary and allow a holistic perspective of the situation [Lincoln & Guba, 1985].

RESEARCH QUESTION	INTERVENTION	RESULTS OF CASE STUDY 4
TEAM CONSTITUTION How should teams be constituted?	Belbin team-role theory was used to constitute balanced teams in 1997.	Some commitment problems - could be resolved.
FORMAL/INFORMAL LECTURE RATIO How often should small group learning be alternated with plenary sessions and formal lectures?	Most periods used for informal teaching, small group learning and *ad hoc* lectures.	Only 11% said they would have preferred conventional lectures.
SUCCESSFUL LEARNING What could be considered a successful learning experience?	The use of cooperative learning with mind mapping was continued.	*You don't just guess – no spoon-feeding.*
MEASURING SUCCESS How is success measured?	Academic achievement Conceptual learning Equity Prosocial behaviour	Could not be proved conclusively. *I used to memorise everything* *...we all had different ideas about things...* -
ASSESSMENT How should students be assessed?	Group work mark increased, still formal examinations	In new curriculum continuous evaluation will be allowed to a greater extent.

TABLE 7: Summary of the results of CASE STUDY 4 in terms of the research questions

The study was continued in 1998 in order to collect more data. To do significant analyses on the nine Belbin team roles and the various groupings of roles, more data was needed. The next period, the first semester of 1998, will now be discussed as Case Study 5.

CASE STUDY 5 – TOWARDS THE 21ST CENTURY – NEW TRENDS IN TERTIARY EDUCATION. THE FIRST SEMESTER OF 1998.

[Blignaut & Venter, 1999]

Quantitative and qualitative data were collected from two groups in the first semester of 1998, namely Statistics (second year STA215) and Computer Science (third year CS314).

Results of the Statistics class - 1998 (first semester)

Descriptive statistics

The class consisted of 88 students of whom 46.9% were female. The students came from varied cultural backgrounds. The home languages spoken were as follows: 33.3% spoke Xhosa, 22.2% spoke English, 28.4% spoke Afrikaans and 16% spoke other African languages such as Zulu, Sotho, Venda, etc. Eighty-one percent were B.Sc. students; the remainder were B.Com. students. It is interesting to note that 17.7% changed their course (direction) since initial course registration. Forty-seven percent were younger than 21 years and only 13.6% older than 23 years. Only 10.4% obtained a matriculation average of an A or a B.

Only 11.4% of the class used their own computer at home and only 33.3% used e-mail or the Internet on a regular basis. Ninety-one percent of the students enjoyed the course and 90% enjoyed the way the class was conducted. The attendance of lectures was thus very high (84%). It is disappointing however, that only 12.5% indicated that they prepared prior to attending lectures and 44% said they prepared sometimes. The group method of lecturing was preferred above conventional lectures by 77.5% of the students. The majority of students (61.5%) had their first contact with computers at university.

Inferential statistics

Language comparisons

Significantly more of the African home language speakers said they kept their thoughts and feelings to themselves when doing group work and said group members influenced them. The African language speakers were more positive about working in a group; however, they disagreed with the statement "*It was interesting to see how people rated me*". More African language speakers felt prejudiced towards members of other cultures - before group work. Significantly more of the African home language speakers said they kept their thoughts and feelings to themselves when doing group work.

The non-African language speakers used the Internet on a more regular basis. More English and Afrikaans home language speakers expressed support when ideas were disclosed. More of the Afrikaans speakers disagreed with the statement *"I am influenced by group members"* compared to the English and African home language speakers. In general the English speakers felt group members probably influenced them.

Significantly more of the Afrikaans and English home language speakers achieved a matric average of an A, B or C. Only 23% of the African language speakers used a computer before entering university, whereas 41% of the Afrikaans and 70% of the English home language speakers made contact with computers before university level.

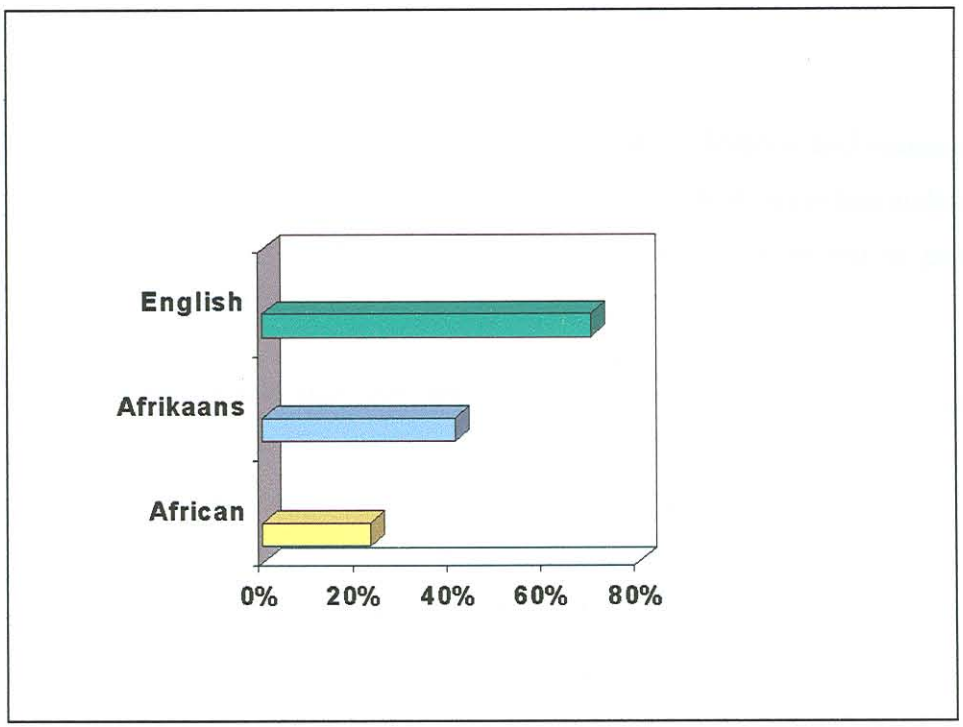


FIGURE 24: Percentage of the language group that used computers before attending university

More of the Afrikaans home language group said they found it difficult to express their thoughts in English. None of the Afrikaans speakers said that little help was available whilst doing practicals. More Afrikaans and English speakers used their own computers at home. The majority of English home language speakers used e-mail regularly. More Afrikaans home language speakers prepared before attending class.

Degree

More B.Sc. students found it interesting to look at the mind maps of other groups and B.Com. students said they had gained insight into their team roles.

Gender

Females were more likely to discuss their ideas, feelings and reactions to what was taking place within the group. Male students were less inclined to take risks in expressing new ideas and feelings, and were not as positive about working in groups.

Females felt that they got help from group members when they needed this. Fewer males agreed that the Belbin team profile was a good reflection of their personality. Males enjoyed doing assignments more than their female counterparts. More male students disagreed with the statement *"Computer practicals were difficult"*. More male students used a computer at home. The male students used e-mail significantly more and accessed the Internet on a more regular basis.

Age

All the older students felt that the group's contributions were useful and that the mind maps increased their understanding of the subject. More of the younger students felt that the group included them in what they were doing. The male students are significantly older compared to the females.

More of the younger students obtained an A, B or C as their matric average compared to the older students who generally obtained a D or E. Many older students had obtained another qualification prior to enrolling for this course. The older students preferred formal to informal lectures.

For many of the older students this course was their first encounter with computers. Significantly more of the younger students had been exposed to computers at school level.

Mark comparisons

Females outperformed their male counterparts in the group work mark. Although not significant, the male students did better in the computer examination. In the 1997 study, significant differences were found when the male students obtained higher marks in the computer examinations, in both semesters, compared to the females.

No significant differences were found when comparing the B.Sc. and B.Com. groups with respect to the various marks.

The English and Afrikaans home language speakers outperformed the African language students in the computer examination, the semester, exam and final mark.

No significant differences in the marks of the two age groups were found. Students who registered prior to 1996 obtained significantly lower marks in the STA215 exam and final sections of the mark composition.

Qualitative research findings

E-mail survey questions and answers

Each group needed to respond to the following questionnaire via e-mail. In total three groups did not respond at all and two groups did not respond to all the questions asked.

QUESTIONS ASKED TO EACH GROUP	POSITIVE RESPONSE	INDIFFERENT RESPONSE	NEGATIVE RESPONSE
Did you enjoy working in a group?	6	4	2
What do you think of the Belbin roles?	6	1	5
Have you changed your way of learning?	8	1	2
Did working in the group change your perceptions of people in your class?	8	0	2
Did the mind map help you to understand the work?	8	0	2
How do you rate the practicals?	5	2	2
Were the tests reasonable?	9	1	0
Computer assignments (Statistics group)	6	4	0
Did you find the lecturing style acceptable?	11	1	0

TABLE 8: Summary of e-mailed responses to questionnaire posed to the Statistics class

Questionnaire comments

Each student completed a self-administered questionnaire at the end of the semester. In this questionnaire students could add individual comments.

Students were positive about using the mind maps and the method of lecturing. As reflected by the students [Blignaut & Venter, 1999: Appendix G(i), 1 – 3]:

> *I think that mind maps are very useful and you should stick to the way in which you conduct your lectures. I have really enjoyed the way in which lectures were conducted. Although I didn't really like the group work, it gave me insight to how people are and to what I was capable of doing.*
>
> *I enjoyed doing this course and I am going to pass it.*

If funds are available, additional assistants will be employed to assist students during group work sessions. This was a problem identified by the students:

> *During practical periods more assistants should be available.*

This teaching method goes beyond that of teaching subject matter. This comment summarizes the outcome of this teaching strategy [Blignaut & Venter, 1999: Appendix G(ii), 4]:

> *The course goes beyond the teaching theory and subject matter. The group work helped me to assess my communication skills and weaknesses. Eventually, all courses should be this way.*

Results of the Computer Science study group - 1998 (first semester)

Quantitative research findings

Descriptive statistics

The class consisted of 49 students of whom 45.5% were female. The students came from varied cultural backgrounds. The home languages spoken were as follows: 29.5% spoke Xhosa, 36.4% spoke English, 15.9% spoke Afrikaans and 18.2% spoke other African languages such as Zulu, Sotho, Venda, etc. Seventy-four percent were B.Sc. students; the remainder were B.Com. students. It is interesting to note that 18.6% changed their course (direction) since initial course registration. Twenty-three percent were younger than 21 years and only 23% were older than 23 years. Only 4.7% obtained a matriculation average of an A or a B.

Only 23.8% of the class used their own computers at home, only 72.1% used e-mail and 66.7% used the Internet on a regular basis. Fifty-six percent of the students enjoyed the course but only 40% enjoyed the way the class was conducted. In spite of this the attendance of lectures was very high (88%). It is disappointing, however, that only 25.6% indicated that they prepared prior to attending lectures and 46.5% said they prepared sometimes. The group method of lecturing was preferred above conventional lectures by 35% of the students and 25.6% were undecided. The majority of students (58.1%) had their first contact with computers prior to university. Forty-four percent felt that concepts were difficult due to the language and another 30.2% were undecided.

Inferential statistics

Significantly more of the African home language students felt that the group work gave them an opportunity to talk and discuss the study material. More of the African students liked the way the class was conducted (lectures combined with group work) and they indicated that they

paraphrased or summarized what other members had said before they responded or made a comment. None of the African language students used their own computers at home.

Significantly more English-speaking students felt the strongest about the following comment "*Mind maps do not help me when studying the relevant sections*". Significantly more of the non-African language students used their own computers at home. More of the Afrikaans students changed their courses during their study period.

Degree

B.Sc. students felt that group members accepted them just the way they were. Significantly more of the B.Sc. students could identify with this comment *"My fellow group members tell me when I bother them"* and they felt that mind maps increased their understanding of the subject.

The B.Com. students found it easier to remember the important facts once the mind map had been drawn.

Gender

The male students felt that the group work helped them to understand the study material better, whereas the majority of females were unsure. More of the male students felt that group work allowed them to be more dependable and to do their assignments. Significantly more of the male students felt that the textbook was easy to read.

The female students felt that the presentation gave them the opportunity to learn about other aspects of computer science. All the females felt that their group members valued them as persons apart from their skills or status.

Age

More of the older students disagreed with the following statement *I give support to group members who are struggling to express themselves intellectually.* However, when other members disclosed their ideas, feelings and reactions to what was currently taking place in the group, they felt that they could express acceptance and support. Significantly more of the older students felt that group work gave them the opportunity to talk about and discuss the study material.

Mark comparisons

It is interesting to note that the test and year marks correlated significantly with the exam mark. No significant differences were found between the marks of the genders or between the marks of the B.Sc. and B.Com. students.

The non-African language students did significantly better in their examination and subsequently the final mark (combination of the year mark and the exam mark) was also significantly better. The younger students did significantly better in tests.

Qualitative research findings

E-mail survey questions and answers

It was expected of each group to report weekly (via e-mail) on their progress. This was done partly to allow groups to manage their time more efficiently, but also to keep the communication lines open between lecturer and students. It was successful in that it allowed the lecturer both to monitor the groups and their group function carefully, but also to intervene when necessary.

Some groups gave excellent reports on their progress and the development of the team coherence could be seen [Blignaut & Venter, 1999: Appendix GG, 1 – 17]:

> *We are uncertain as to how we involve Th-- as he is seldom present in lectures (he is working and everyone is sympathetic to his situation).*

And then in a subsequent e-mail:

> *We were uncertain of Th--'s role in the group's activities, but he has been present often lately and has presented us with lots of valuable info on our topics.*

Another group were less positive and commented:

> *Our group had problems such as non-attendance and sometimes non-cooperation. The non-attendance made it difficult for some of us to finish in time and that was the same reason that caused the lateness of the presentation. We agreed that by the 24th everything would be finished but to my surprise we were not even halfway. Being in a group taught me something, that if you see that someone is failing, then try to take over because at the end of the day the whole group will suffer.*

The following were some of the comments made during the weekly e-mailed reports [Blignaut & Venter, 1999: Appendix GG, 1 – 17]:

> *Insufficient lectures, but when there was one you had an excellent lecturing style. It was relaxed and it did not seem like a lecture.*

> *The CS314 course was an interesting experience in how the normal way of lecturing can be transformed into something creative, and exciting.*

> *I sometimes sit down and listen to classic music and think about how good you have been to all of us. I really enjoyed doing group work, you know, dividing work among a group of people really makes life easier. Thanks once again for coming up with a master plan.*

> *Enjoyment? - So far, it was interesting, - It was different!*

The mind maps kept us up to date with the chapters. It put all the chapters into perspective.

Very early in the term, the groups were asked to respond to an e-mailed questionnaire (via e-mail).

E-MAIL QUESTIONNAIRE	POSITIVE RESPONSE	INDIFFERENT RESPONSE	NEGATIVE RESPONSE
Did you enjoy working in a group?	6	-	2
What do you think of the Belbin roles?	4	2	2
Have you changed your way of learning?	5	1	2
Did working in the group change your perceptions of people in your class?	7	0	1
Did the mind map help you to understand the work?	5	2	1
Did you enjoy UNIX?	5	4	-
Difficulty of tests – was it easy?	2	3	3
Amount of work – just right?	1	-	7
Mind maps in test - was it helpful?	4	3	1
Was the presentation of literature survey a worthwhile endeavour?	5	-	3
Is the lecturing style satisfactory?	1	4	3
Do you understand the work?	2	6	-
Did you enjoy the course?	3	4	1

TABLE 9: E-mailed comments on the Computer Science course

Only one group did not respond at all. The table (*Table 9*) is a brief summary of the questionnaire. It seems as if this class (contrary to previous classes) did not enjoy the way lectures were presented but they did enjoy the group work. This tendency was confirmed by the quantitative analysis.

Questionnaire comments

Each student completed a self-administered questionnaire at the end of the semester. In this questionnaire students were invited to make individual comments. Twenty-two of the 49 students responded; of these ten were positive, eight gave positive criticism and four were negative.

A student who was positive about group work and drawing mind maps commented as follows [Blignaut & Venter, 1999: Appendix GG, 1 – 17]:

> *The implementation of group work and mind maps is a good idea. Because being a student is not how much you can cram in for a test or the exam but more about your understanding of the course. What I can say is that it was a lot of work and juggling our time between Computer Science and our other subjects was extremely difficult and stressful. But I assume that this was good when put under pressure under working conditions.*

Others experienced group work positively, although one had some reservations:

> *On my part the way the course was presented was very good. It actually gives us strength, confidence to actually explore the computer on our own.*
>
> *I like group working, help communicate with other people.*
>
> *Implementation of lectures in a group approach is good, since the practice is also implemented in groups. However, it's a long way to find team members who will cooperate effectively. I am aware of need for working in teams; however, due to present grouping, I did not enjoy it as much....*

Some gave positive criticism:

> *The CS314 had helped me a lot in improving my self-esteem and to work in a group environment. More time must be scheduled for more topics to be presented in class by the lecturer.*
>
> *I loved this way of presenting the lectures, but there are a few concerns. My suggestion is to have lectures on the particular chapters to be covered that week, the first few periods of the week and then assigning work projects/assignments for the group to do for the rest of the week. I think that the project discussions have dominated group sessions and little or no time was spent on the actual course work.*
>
> *The grouping idea is fine and did work for us to know others and discuss certain topics of our study. I feel the textbook is unnecessarily repeating certain things. The mind maps only helps when you have used it while studying. The presentation is a frightening experience especially because it's done in a big venue. I feel we had too little time to do a lot of things and having had time we would have done better. I have gained a lot from the course.*

To summarise, it seems as if the students enjoyed the group approach but felt uncomfortable with the style of lecturing. They come from a background of formal lectures and feel safe in such an environment. In future the traditional lectures ("chalk-and-talk") should perhaps be phased out more gradually and students should be eased into a teamwork/cooperative learning environment more slowly.

RESEARCH QUESTION	INTERVENTION	RESULTS OF CASE STUDY 5
TEAM CONSTITUTION How should teams be constituted?	Belbin team-role theory used to constitute balanced teams in 1998.	Some commitment problems could be resolved in both Computer Science and Statistics groups. Belbin constituted teams seem to be more successful.
FORMAL/INFORMAL LECTURE RATIO How often should small group learning be alternated with plenary sessions and formal lectures?	Formal lecture given once or twice a week; the rest of the time is spent in small group learning situations.	Statistics group enjoyed informal lectures (77.5%); in contrast 40% of the 1998 Computer Science group indicated that they preferred formal lectures.
SUCCESSFUL LEARNING What could be considered a successful learning experience?	Cooperative learning (where students help/teach each other) and mind mapping was used again.	Data indicate that it was successful – *The course goes beyond teaching theory and subject matter … eventually all courses should be this way.*
MEASURING SUCCESS How is success measured?	▪ Academic achievement ▪ Conceptual learning ▪ Equity ▪ Prosocial behaviour	- *…mind maps put chapters into perspective…* - -
ASSESSMENT How should students be assessed?	Continuous evaluation with less emphasis on examinations – these are still necessary as the university requires examinations.	Have not established which ratio would best reflect the learning that has taken place.

TABLE 10: Summary of the results of CASE STUDY 5 in terms of the research questions

The next study is a meta study of some of the previous case studies. The number of students in each of the separate case studies prevented such an investigation, as the variations of team-role profiles are too many to do any significant statistical analyses. In the meta study the data of the 1997 and 1998 case studies were collated in order to allow valid quantitative analyses on the team role data of the combined group.

META STUDY: TO EXAMINE TEAM ROLES, A STUDY (USING THE DATA OF THREE OF THE CASE STUDIES) WAS UNDERTAKEN.

Introduction

The data of the 1997 and 1998 case studies have been combined to form a data set of 203 students; it increased the sample size and thus allowed valid quantitative analyses on the groupings of team roles. (The 1995 and 1996 study periods' data could not be used as the 1995 data was qualitative data only and the 1996 questionnaire and that of the 1997/1998 cycles differed.) Only the three dominant team roles of each student were used for analyses. These were then grouped into four groupings (control, ideas, leadership and support) as well as three groupings (acting, social and thinking) for further analyses.

Method

The students who participated in the study were a combination of Computer Science (48.3%) and Statistics students (51.7%). One record of a student who repeated a course, or who took courses in both Computer Science and Statistics, was kept and the other deleted so that no student was duplicated on the data set. For each of the students with duplicate records, the record with the highest final mark was kept (See Appendix D).

Results

Forty-seven percent of this combined group was female and the majority was older than 21 (70.6%). Interestingly, Computer Science is still male dominated (58%) and Statistics attracted more females (53%). Two thirds are studying towards a B.Sc. degree (66.7%) and one third towards a B.Com. degree. Their home languages are: Xhosa (25.5%), English (32.3%), Afrikaans (19.3%) and other African languages such as Zulu, Ndebele, South Sotho, etc. (22.9%) (See *Figure 25*).

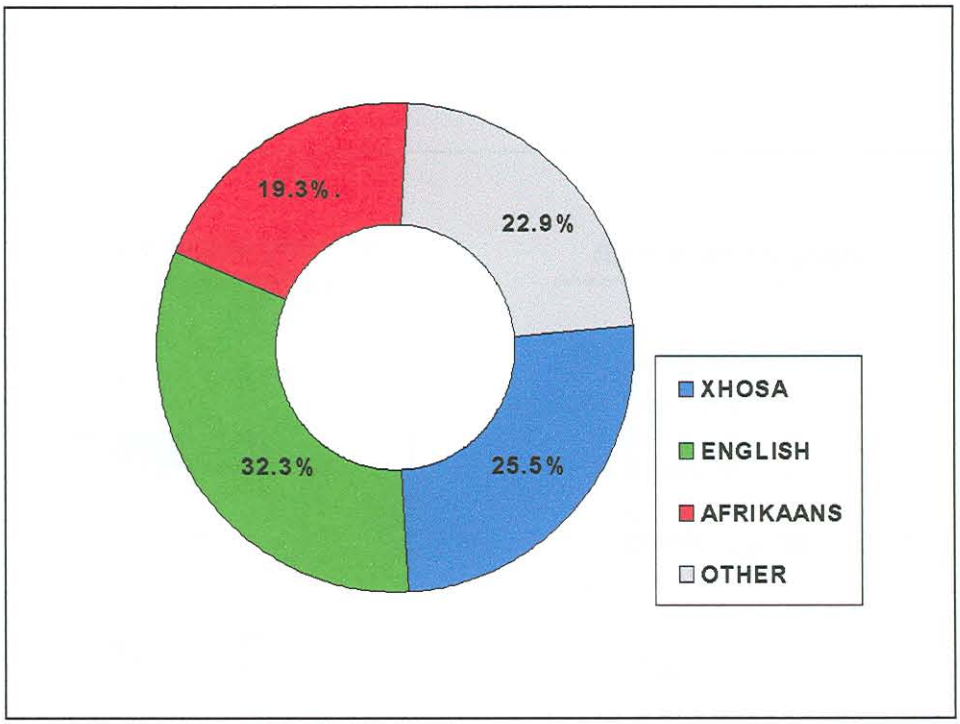


FIGURE 25: Home languages of the combined group

Although the group method of lecturing (opposed to conventional lectures) was preferred by only 56.3%, the majority (65.8%) enjoyed working in a group and liked the way the class was conducted (69.6%). Most of the students (75.5%) felt that the group motivated them to do their share. Significantly more of the female students felt that they learnt to work in a team ($\chi^2 = 7.552$, $p = 0.023$).

Once again it is disappointing to note that only 42.3% access the Internet regularly and of these the majority are men ($\chi^2 = 13.373$, $p = 0.001$). Only a mere 23.9% use a computer at home. Students from this combined group (of 203 students) felt that it was easier to remember the relevant facts after drawing the mind map (78.9%) and that all the relevant information

was included in the mind map (71.1%). Most felt that they had gained insight into their strengths and weaknesses (78.1%) according to Belbin.

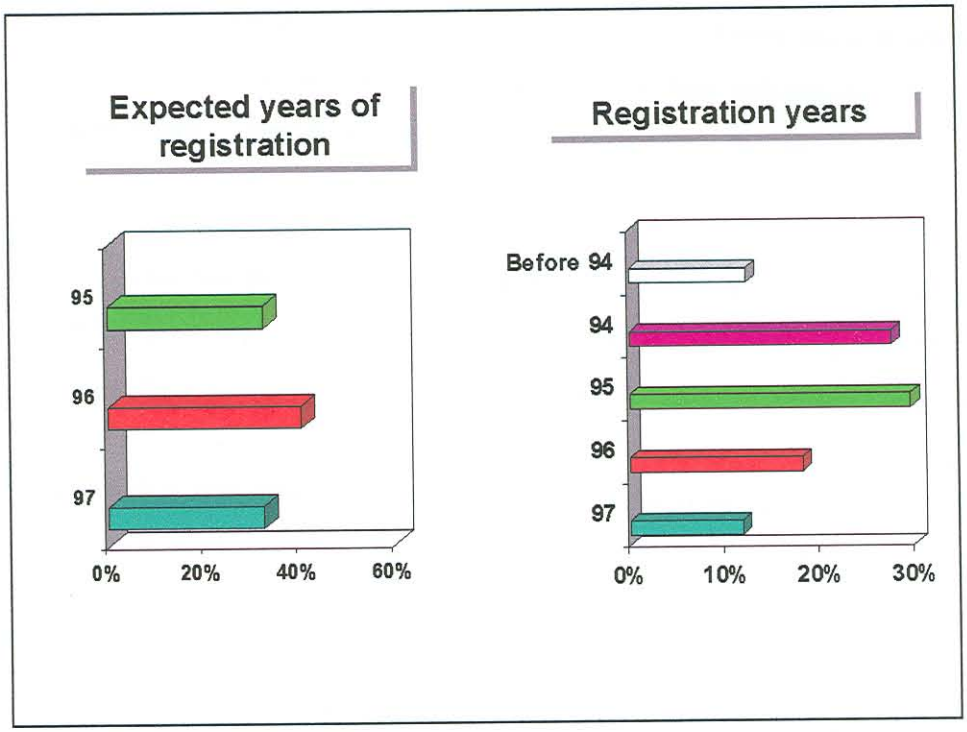


FIGURE 26: Years of registration

The data of this meta study was collected during the 1997 and 1998 academic years. At the time the students were either in their second academic year (the Statistics group) or third academic year (the Computer Science group). It is thus normal to expect that the students of the combined group would have registered in 1995 (27.1%), 1996 (40.4%) and in 1997 (32.5%). However, the picture is quite different – see *Figure 26*.

A co-researcher and industrial psychologist, Deon Stoltz, interpreted the data as follows.

Belbin's research indicates that the overrepresentation or underrepresentation of team roles (imbalances) in teams cause predictable problems, unless the teams are made aware of these imbalances and taught appropriate coping strategies. Experience in the management development arena has confirmed these findings.

The team-role profiles of the Computer Science group of students reveal a high representation of the control roles (30.6%) and ideas roles (33.7%). This indicates that they will be able to develop and implement ideas in a fairly well-organised fashion in a learning situation. However, the danger exists that new ideas will be implemented by "trial-and-error", because the Monitor Evaluator role makes for only 20% of the control roles. The presence of the Completer Finisher role (20% of control roles and 6.1% of all team roles) is also low and, as a result, a lack of attention to detail may lead to omissions and unnecessary mistakes in the learning situation.

The Plant role (88% of the ideas roles) is well represented and should lead to an abundance of self-generated ideas and alternatives to explore. However, the learning teams may find it difficult to identify the better ideas, because of the low representation of the Monitor Evaluator role (6.1% of all the team roles and only 20% of the control roles). The teams may also be subjected to disruptive conflict. Experience indicates that a high incidence in teams of individuals who display a combination of Plant and Shaper team-role strengths and weaknesses leads to overly egocentric behaviour. The Resource Investigator accounts for only 12% of the ideas roles (4.1% of all team roles), and this may cause an inward focus (lack of "investigative" interaction with other teams or their learning environment, thus "re-inventing the wheel").

The learning teams (of the Computer Science group) may experience a strong sense of urgency (the Shaper role accounts for 81% of the leadership roles and 13.3% of all team roles), but this can lead to the suppression of valuable contribution from other less assertive team members. When considering the frequency of role 1 (the most dominant role) of this group it reaffirms the above contention. Investigative skill and the ability to listen with insight need to be developed, as the natural representation of these skills in this group is low.

The students studying Statistics seem to be a more diverse group with a more balanced representation in all the role groupings. When considering each student's two most dominant team roles, it seems as if assertive leadership and implementation skills are well represented within the group, but that there is a shortage of coordinating and analytical skills.

When comparing the relationship of the first, second and third most dominant team-role groupings of the composite group (Computer Science and Statistics), some interesting findings come to the fore (see *Table 11*). It is noted that when the control roles are most dominant, it is followed by Support roles in both the second and third positions. A possible explanation for this pattern is the very low incidence of the Completer Finisher and Monitor Evaluator roles, especially in the Computer Science group (both 6.1%).

A very interesting observation, however, is the lack of any consistency following the ideas roles in the most dominant position. This has been observed constantly over many years of team-role profiling.

FIRST DOMINANT ROLE GROUPING	MOST LIKELY SECOND DOMINANT ROLE GROUPING	MOST LIKELY THIRD DOMINANT ROLE GROUPING
Control	Support	Support
Support	Control	Ideas
Leadership	Ideas	Control
Ideas	Any	Any

TABLE 11: Cross-tabulation of team roles (See Appendix D)

Even though the perception may be that students whose dominant roles are in the thinking and leadership categories should be the high achievers this was not found to be so (See *Mark comparisons within role groupings*, Appendix D). For each of the role groups the average final mark achieved was *very* similar, therefore dominancy of role grouping has no bearing on achievement.

Discussion and conclusion

In this chapter the study period was broken up into and discussed in five distinct periods. As pointed out before, although the research methodology used was not that of the case study, each period was discussed as a unique but interlinked case study. The research methodology used in this study is typical of the grounded approach, where advantage was taken of emergent themes [Pandit, 1996]. According to Pandit the grounded theory is not generated *a priori* and then tested, rather, it is "*inductively derived*" at. ("*Theoretical saturation*" is reached when similar instances are seen again and again. It then becomes necessary to move on to the investigation of a new category.)

At this stage it is probably necessary to "stand back" and re-evaluate what has been achieved with this longitudinal research effort.

Groups were constituted with the aid of Belbin's [1993] team-role methodology. Belbin defines a team role as –

> *...a pattern of behaviour characteristic of the way in which one team member interacts with another where his performance serves to facilitate the progress of the team as a whole.*

He maintains that each of the nine identified team roles has a distinctive contribution to make to successful team functioning. These team roles are: Plant, Resource Investigator, Coordinator, Shaper, Monitor Evaluator, Teamworker, Implementer, Completer Finisher, and Specialist. Each team role has a set of "allowable" weaknesses associated with it, and Belbin describes these allowable weaknesses as the cost of the positive contribution to the team of the team role.

Some common threads run through all the years of the research. The language of instruction is a foreign language for most of the students and is therefore one of the main reasons students resort to verbatim studying. The use of cooperative learning addresses this problem as it allows students to express themselves in the language of the subject and also creates an opportunity for them to verbalise their understanding of the work in a small, familiar and empathetic group.

Most of the students, in their second or third academic year, are older than 21 years of age. (And a relatively large proportion of the students in their third academic year are older than 23.) It was initially assumed that many students start their university career at a later stage, which would underwrite the assumption that students are from academically disadvantaged backgrounds. However, when looking at the years since registration of these students, it was found that fewer than 20% of academic second-year

students are indeed in their second year at university (*Figure 26*). Most spend three or more years to reach their second academic year. It would thus seem that students generally need more than the required three years to complete their bachelor degrees and are using a year (or more) at university to bridge the gap between school and university. It is thus clear that many of the students' schooling did not adequately prepare them for tertiary education. On the other hand, the backlog that many experience in their first year is eradicated by the time that they reach their third year (*Figure 20*).

In one of the case studies it was possible to compare the traditional lecturing method ("chalk-and-talk") with the small group learning method. It was found that students did significantly better when the latter method was used. The majority of the students enjoyed this new approach to learning. They enjoyed working in a group and the group motivated them to do their share. The students felt that they reflected more on their learning and that the mind map gave them a broader perspective of the work.

In general, although it is always still possible to improve, the approach seems to have achieved its objectives:

TEAM CONSTITUTION	In all the case studies students indicated that they enjoyed working in the Belbin constituted teams.
FORMAL/INFORMAL LECTURE RATIO	In all the case studies (except Case Study 5) students enjoyed the informal lectures and were satisfied with the formal/informal lecture ratio.

SUCCESSFUL LEARNING	Students felt that they learnt more, and did not have to resort to verbatim studying
MEASURING SUCCESS	When using Cohen's criteria to measure success the approach was indeed successful
ASSESSMENT	Within the constraints of university teaching small adaptations were made to assessment. It is felt that assessment still needs to be adapted to reflect the learning that has taken place.

When the data of the 1997 and 1998 case studies were combined, analyses indicated that there was a high representation of the control role (30.6%) and ideas role (33.7%) in the Computer Science group. This may indicate that they will be able to develop and implement ideas; however, with the low representation of leadership (16.3%) and social roles (19.4%) in this group, it is questionable if solutions to problems posed would be client-orientated.

The students studying Statistics seem to be a more diverse group with a more balanced representation in all the role groupings. Assertive leadership and implementation skills are well represented within this group, but there is a shortage of coordinating and analytical skills. It was found that dominancy of role grouping has no bearing on achievement.

The results of this meta study are important in that it emphasises the need for the constitution of "balanced" teams. However, there is a natural deficiency of certain team roles in certain groupings, for example, the Computer Science group showed a deficiency in the leadership and social role groupings. Students will have to be made aware of these role shortages

in their grouping, so that they can develop the necessary skills to be able to assume these roles.

In Chapter 5, the research findings will be viewed from several different perspectives; these include the use of Habermas' knowledge interests from his critical social theory; hermeneutics; and Giddens' "*consequences of contemporary modernity*" as viewpoints. The emergent themes will allow the development of a framework for group constitution for small group learning in the field of information technology. This framework will be developed in Chapter 6.

Chapter 5

INTERPRETATION OF RESULTS

The Eye altering alters all.

William Blake, "*The Mental Traveler*" [1800-10]

Introduction

In this chapter the results of the five case studies, dealt with in Chapter 4, will be viewed and interpreted from three different perspectives. These perspectives include:

- the use of Habermas' knowledge interests from his critical social theory;
- hermeneutics; and
- Giddens' "*consequences of contemporary modernity*".

By viewing the problem from various perspectives, it is felt that emergent themes will come to light and that this can lead to the creation of a theoretical framework for group constitution for small group learning in the field of information technology. As was pointed out previously, SSM (with both quantitative and qualitative instruments of measurement) was the encompassing research methodology used in the five case studies. Lee [1991] showed that the traditional positivist approach can be integrated with - and supported by - the interpretive approach. Thus an additional layer of research is now added to see if the results could benefit the study.

Throughout this "viewing" process, the three basic elements of grounded theory, namely, concepts, categories and propositions, are kept in mind. Corbin and Strauss [1990] contend that it is from conceptualisation of data

that theory is developed. Categories, a higher level and more abstract than concepts, *"are the 'cornerstones' of developing theory"*.

And then finally, propositions are developed that generalise relationships between – *"a category and its concepts and between discrete categories. One begins with an area of study and what is relevant to that area is allowed to emerge"* [Strauss and Corbin, 1990: 23].

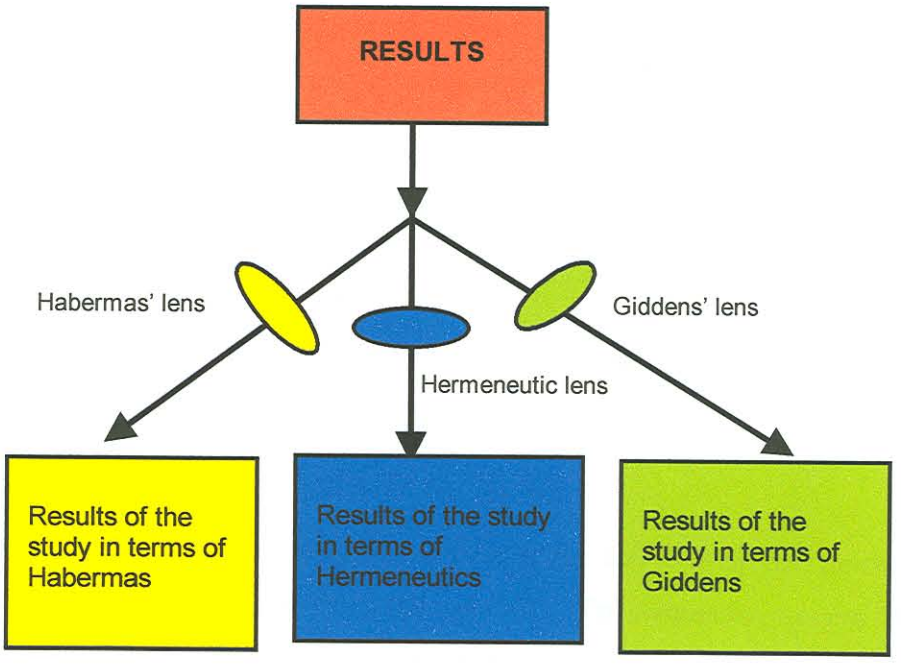


FIGURE 27: Viewing the research results through various "lenses"

Research methodologies used in this thesis were both positivist and nonpositivist. This was done with the intention to view the research *problem* from as many different vantage points as possible. The various facets of the problem will now be *interpreted* using a variety of perspectives. These interpretations will be used to create a theoretical framework for group constitution for small group learning in the field of information technology.

Sketching the background to Habermas' perspective

Critical social theory [Habermas, 1981] falls within the neo-humanist paradigm in that its primary objective is the improvement of the human condition. It takes into account the human construction of social forms of life. It is grounded in five fundamental assumptions [Ngwenyama, 1991: 269]:

1. People create their social world and can thus change it if they wish.

2. All scientific knowledge about the social world is value laden.

3. Reason is the ability to understand the social world as it is, to criticise it, and to search for alternatives. Therefore, reason and critique are inseparable.

4. The task of critical social theory is reconciling knowledge with the human need for self-improvement. Theory and practice must thus be interconnected.

5. Researchers must collaborate with those affected by the research, thus opening it up to public debate. To summarise, reason and critique must be reflexive in practice.

In line with the above assumptions Habermas [1971, 1974] identifies three types of "*knowledge interests*" which he believes drive all human inquiry:

1. **Technical**: Its concern is the human need for prediction and control of the natural and social world.

2. **Practical**: It has to do with the quest for understanding social forms of life, traditions, social behaviour and relations, and in so doing improving social consciousness and humanity.

3. **Emancipatory**: This knowledge interest is related to the concern for freedom from physical and mental restrictions and social distortions.

Habermas identified two classes of criteria for analysing and validating discussions on research conducted, namely: content and relationship. He is of the opinion that in scientific discourse, jargon must not be used, as it mystifies the content and in so doing violates the principle of ideal discourse.

Habermas constructed the following conceptual framework upon which critical social theory research could be based:

KNOWLEDGE INTEREST	OBJECT OF INTEREST	ORIENTATION	KNOWLEDGE PRODUCTS
TECHNICAL	Natural World	Prediction	Scientific Knowledge Technology
PRACTICAL	Social Structures Social Relations Tradition	Mutual Understanding	Social Consciousness Humanity
EMANCIPATORY	Technology Social Relations	Social Criticism	Norms for Justice Freedom

TABLE 12: Fundamental Human Knowledge Interests [Ngwenyama, 1991: 270]

The aim of critical social theory is to integrate the three basic knowledge interests into an encompassing approach to inquiry and change. (Active participation, observation, and analysis of the situation and intervention accomplish change.) Critical social theory acknowledges the difference between observing nature and observing people while doing scientific research, since people under observation might adopt different behaviours. Finally, critical social theory accepts that science is NOT value free but that the value of science is the improvement of the human condition (*See* HUMAN CONDITION in Glossary).

Using Habermas' perspective

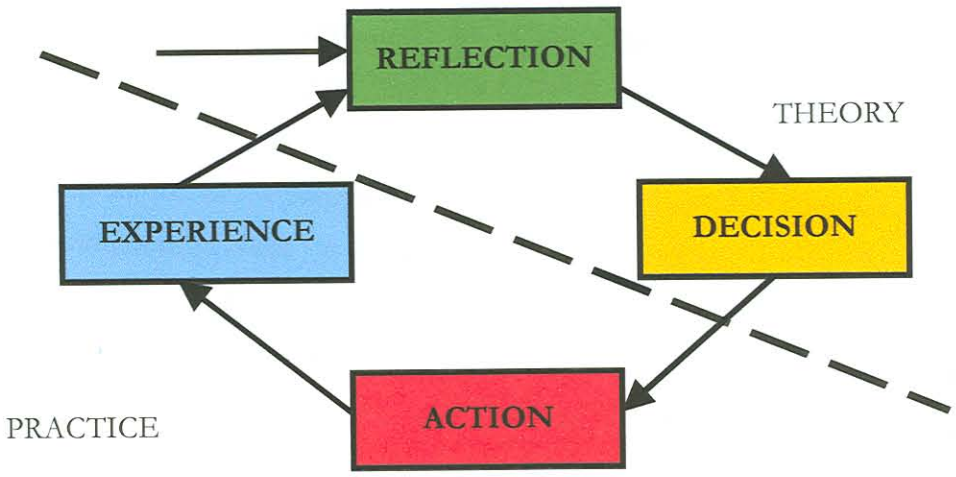


FIGURE 28: The Critical Social Theory Inquiry-Change Process [Ngwenyama, 1991: 272]

EXPERIENCE (see *Figure 28*) showed that there were several situations of concern:

- Historically underprepared students;
- The language barrier;
- Verbatim studying;
- Conventional ("dated") lecturing methods; and
- The fact that the half-life of knowledge in the computer field is diminishing at an alarming rate!

After **REFLECTION** it was **DECIDED** (after some qualitative and quantitative analysis of data was done) that the language of instruction, English, which is a second or third language for most of the students, was one of the reasons that students resorted to verbatim studying. Similarly the other areas of concern, namely verbatim studying etc., were identified. The **ACTION** that was taken to address these concerns, was to introduce cooperative learning, small group learning and mind mapping. This allowed students to communicate in the language of the subject and in so doing improve their communication skills in English, and enabled them to see the work holistically, to develop interpersonal skills and to work productively in teams. Thus **PRACTICE**, namely, experience and action, was alternated with **THEORY**, namely, reflection and decision. This cyclical process was followed and during each cycle some adjustments were made (see *Figure 13*).

According to Habermas the primary objective of critical social theory is the improvement of the human condition. It is also the objective of this study.

In the following table the results of this study are summarised, using Habermas' knowledge interests perspectives.

KNOWLEDGE INTEREST	KNOWLEDGE PRODUCTS	RESULTS OF THE RESEARCH
TECHNICAL	Scientific Knowledge Technology	Students acquired scientific knowledge – they learnt about Operating Systems and Networks. *I used to memorise everthing – I did not try to understand it. Now I find that if you understand it, it makes it less work* [Venter & Blignaut, 1998: 6]. They improved their academic achievement [Blignaut & Venter 1998b: 5]. They applied their knowledge using available technology.
PRACTICAL	Social Consciousness Humanity	Students learnt to respect and value diversity within their teams. *You learn from each other, we discuss and you get different ideas and different views…* *… where I did get the sense of camaraderie was in the practical. You really get to know each other … you get a sense of their character and their weaknesses* [Venter & Blignaut, 1998: 6]. They learnt social skills and communication. *Getting a pace and getting a sense of where you all are coming from because we had all different ideas about things and how to do things. Ja and that was the biggest struggle, but being together as a group, that was fine* [*op.cit.*: 7].
EMANCIPATORY	Norms for Justice Freedom	Furthermore, they were released from the "shackles" of their educationally disadvantaged background. It is an emancipatory experience as mentioned in the qualitative analysis, namely, the unstructured interviews. *I never thought I could be a leader* [*op.cit.*: 7].

TABLE 13: The results of the study in terms of Habermas' Knowledge Interests [Ngwenyama, 1991: 270]

Sketching the background to the hermeneutic perspective

Hermes, the wing-footed messenger-god from ancient Greek mythology, is associated with the task of interpreting that which is beyond human understanding into a form that human intelligence can grasp. The word hermeneutics is derived from this messenger-god's name (Hermes). Although this may be an oversimplification, hermeneutics can be described as a theory of interpretation and understanding. According to Introna, hermeneutic theory, which has been to some degree, especially in the field of Information Systems, been developed by Boland, could be considered *"the absent component that would address the notions of understanding and meaningfulness that are to be part of more recent definitions of information."* Although hermeneutic interpretation was originally used to interpret the Bible it has since evolved and is currently being acknowledged as a method to gain insight into the nature of information [Introna, 1997: 55].

The following five concepts are central to the hermeneutic discipline [Lee, 1993: 14]:

1. **Distanciation**: the separation that occurs between the author and his work. After the passage of time it is removed from its original intended audience and also from its author's culture and society.

2. **Autonomisation**: Separated from the author, the author's work (the text) *"takes on a life of its own"*.

3. **Social Construction**: The text of the author is not restricted to the meaning he had intended. The reader can interpret the work from his own *"socially constructed"* perspective. To explain what is meant by *"social construction"*: man is the product of his social environment and thus sees *"life"* from that perspective. However, he is not the slave of his organisational world but can modify it, by adding or changing some of the existing values of his society.

4. **Appropriation**: The reader of the text interprets it, and makes the meaning of the text "*his or her own*". Thus the meaning of the text is actualised for the reader. Once again, this meaning may differ from the meaning the author had intended.

5. **Enactment**. Once the reader has appropriated the text he or she can now enact the meaning of it. As Lee explains [1993: 15] –

An important point is that ***enactment*** *does not allow me, the reader --, to imagine anything I wish. I do not exercise total free will; rather, as a result of the* ***appropriation****, I am transformed into an agent of the socially constructed world of the organisation.*

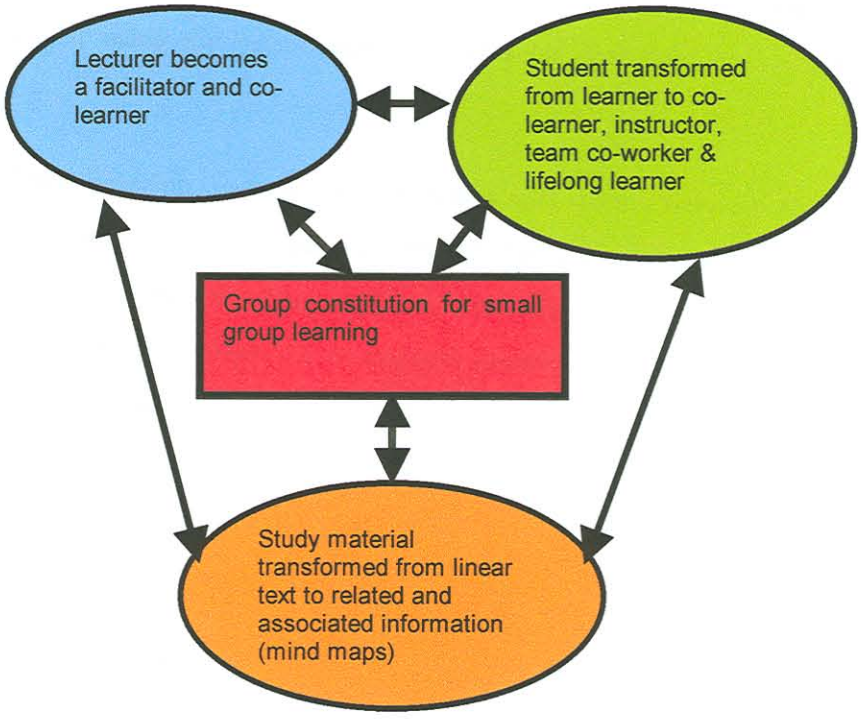


FIGURE 29: The complex whole of the problem researched

Using the hermeneutic perspective

Hermeneutics allows us to understand a complex whole divorced from preconceived conceptions about the meaning of its parts and their interrelationships.

In *Figure 29* the complex whole with its constituent parts, and the interrelationships between these parts, are depicted. As can be seen from the figure, the context of the *"learning environment"* has changed: the lecturer is now a co-learner and a facilitator of learning. The material that is to be learnt has been transformed from linear text to comprehensible, ordered and associated information; and the learner is a team member and lifelong learner. If we interpret the group constitution of the small group learning teams, by using the hermeneutic concepts (as described by Lee), we see that –

1. **Distanciation**, namely, the separation that occurs between the author and his work, has occurred between the intended use of the Belbin team roles and the actual application of them. (Belbin intended the use of his methodology for managerial teams.) The concept of lecturer becomes distanciated from the preconceived perception of what it means to be a lecturer. The lecturer now becomes a facilitator and co-learner and not someone who presents lectures in a "chalk-and-talk" fashion.

1. **Autonomisation**: Separated from the "originator", the Belbin methodology "*takes on a life of its own*" in that it is now used to develop skills needed for lifelong learning rather than constituting effective managerial teams. Similarly, tasks assigned to the teams are separated from their "author" (the lecturer) and *"takes on a life of their own"* in that students create their own understanding of the assignment.

2. **Social Construction**: The "receiver" of the psychometric profile (as compiled by the Belbin software) can interpret his/her function within a team from his own "*socially constructed*" perspective.

   The first role that everybody gave me on my list was a Shaper and I thought of myself as an Implementer because I know like eventually I have to get this thing done and so then I will do it. So I don't know - [Venter & Blignaut, 1998: 23].

   This means that the student does not simply find facts or regurgitate facts found for the assignment but indeed plays a specific role in contributing to the team's collective understanding of the given task.

   So, what we did now, we just told each other, we (are) just going to do the research on this thing –maybe go to the library or the Internet. And then we found out it is too much, to look at everything. It is too much to look at everything, so we divided the work. So we can get input from each other …so we actually learnt that from group work [Venter & Blignaut, 1998: Appendix I, 3].

3. **Appropriation**: This Belbin profile becomes "*his or her own*". Thus the meaning of the Belbin profile is actualised for the "*receiver*". Furthermore, the mind map that is created for the material that is to be learnt is also a transformation of the original text and is thus appropriated by the learner.

   There is a structured approach to it. So the mind map shows you exactly this comes from this section – [Venter & Blignaut, 1998: Appendix I, 2].

4. **Enactment**. The student, after appropriating the meaning of the material to be mastered as well as his or her role within a team, can now enact the meaning of it: thus use the material that is to be mastered and apply it while contributing effectively to the team.

The course goes beyond teaching theory and subject matter. The group work helped me to assess my communication skills and weaknesses [Blignaut & Venter, 1999: Appendix G(i), 4)].

HERMENEUTIC CONCEPTS	RESULTS OF THE RESEARCH
DISTANCIATION	Belbin roles – the intended use is different from the actual use in this research effort Lecturer becomes the facilitator – his/her role is distanciated from the traditional role *I mean it brought the whole class like together. I think that is nice about group work where formal lectures is, you just sit down and listen to the lecturer...*[Venter & Blignaut, 1998: Appendix I, 6].
AUTONOMISATION	Task takes on a *life of its own.* Belbin is now applied to develop lifelong skills instead of constituting effective managerial teams. *Ja, usually I can gather information and then give it to my group and then could work it out (Ja, I am a Resource Investigator)* [Venter & Blignaut, 1998: Appendix I, 1].
SOCIAL CONSTRUCTION	Team member socially constructs team role. Material to be mastered is not verbatimly studied but *understood.*
APPROPRIATION	Belbin role is appropriated by team member. Mind map allows appropriation of study material. *There is a structured approach to it. So the mind map shows you exactly this comes from this section* – [Venter & Blignaut, 1998: Appendix I, 2].
ENACTMENT	Student uses and applies material mastered in order to contribute effectively to team. *...you can't gauge a person's worth from what they study in a book. You know ...* [Venter & Blignaut, 1998: Appendix I, 10].

TABLE 14: The results of the study in terms of the hermeneutic perspective

Sketching the background to Giddens' "*consequences of contemporary modernity*"

Communities are being transformed by modern society with its globalising tendencies driven by the transformation in IT (Information Technology). The reorganisation of social relations and structures has had a profound effect on the individual.

According to Giddens [Giddens, 1990], time and space play a central role in the structuring of social practices [Barrett *et al.*, 1996: 43]. Modern practices allow for the *separation of time and space* in social relations, as they allow relations to exist between "*people present in time and space and between those absent in time and space*".

This separation of time and space "*disembeds*" or "*lifts out*" the local context of the interaction of social relations. An example of this *disembedding mechanism* is the use of the Automatic Teller Machine (ATM) which has necessitated the development of trust in the use of ATMs and has *disembedded* the social relations between banker and clients.

In late modernity social activities need to be revised continuously as new knowledge comes to light. Social life is thus propelled away from the certainty of pre-established rules and practices, giving rise to the concept of *institutional reflexivity.*

The notion of the *separation of time and space* in social relations, which *disembeds* social practices as these were previously known, and the notion of *institutional reflexivity,* are directly connected to the psychological security of the individual and groups.

> *The self may become a reflexive project being continuously explored, constructed, and revised as part of a reflexive process* [Barrett et al., 1996: 44].

Barrett, Sahay and Walsham proposed the scheme (depicted in *Figure 30*) for understanding IT and social transformations from the perspective of Giddens' ideas on the consequences of modernity.

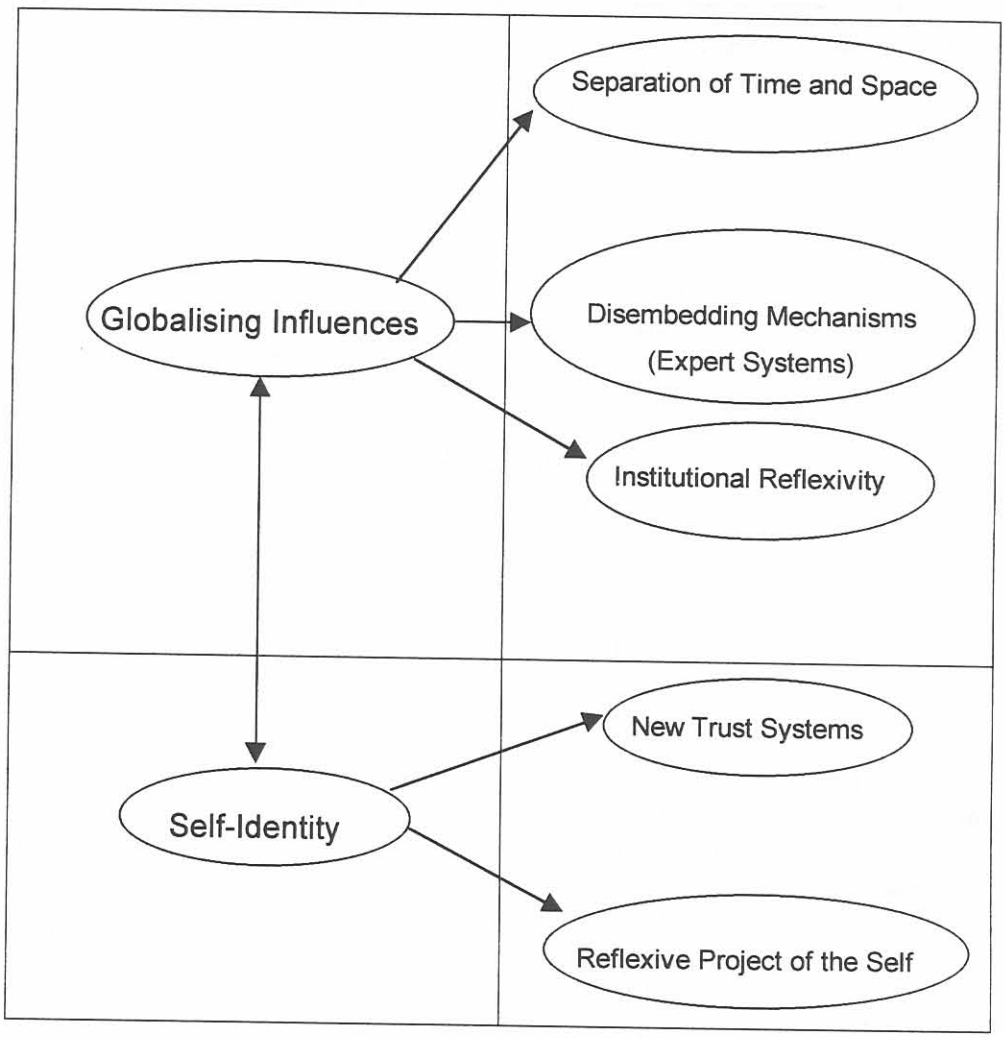


FIGURE 30: Transformation in modernity: Globilisation and self-identity [Barrett, Sahay and Walsham, 1996: 44]

GIDDENS' CONSEQUENCES OF MODERNITY	**TRANSFORMATION**	**RESULTS OF THE RESEARCH**
"GLOBALISATION"	Separation of Time and Space	Students '*meet*' lecturer and team colleagues virtually Learning is removed from the classroom – thus it is separated in time and space
	Disembedding Mechanisms	Traditional student/lecturer relationship changed
	Institutional Reflexivity	Chronic revision of the teaching process Roles of both lecturer and learner revised
INDIVIDUAL TRANSFORMATION	New Trust Systems	Students need to trust new approach And trust their colleagues *...it taught me the importance of punctuality, communication, delegation (and) to trust others and most importantly to be a person others can trust* [Blignaut & Venter, 1998b: Appendix H(i), 2].
	Reflexive Project of the Self	Individual becomes team member Student needs to be reflexive about contribution he/she can make to team

TABLE 15: The results of the study in terms of Giddens' "consequences of contemporary modernity"

Using Giddens' perspective

"Globalising" tendencies

The separation of time and space

E-mail allowed students to "meet" virtually as a team and also to meet virtually with the lecturer. They were able to discuss problems about the study material but also problems experienced with team functioning. All these discussions were "separated by time and space". What is meant is that students could "converse" with the lecturer and their peers without having to be present at the same place, at the same time. This obviously relieves the student from finding the lecturer to discuss something with her. It also allows the student to air problems without the added stress of approaching a superior – this obviously is very emancipating. The learning experience, furthermore, was separated in time and space, as the learning happened in class but also at other "times" and in other "places".

Disembedding mechanisms

The traditional lecturer-student relationship has changed. The lecturer is no longer the "holder" of all the knowledge – in some instances the student may be the expert and the lecturer the learner. In such cases the lecturer thus becomes the co-learner and facilitator whereas the student becomes the expert. This is especially true of new software available on the Internet. It is not uncommon to have students explain new concepts (such as downloading music from the Internet as MP3-files) to the lecturer. The lecturer needs to become emancipated herself to be able to acknowledge her ignorance every now and then.

Institutional reflexivity

These new roles need to be re-examined by both learner and lecturer. The ratio of lectures versus discussion groups needs to be re-evaluated and the roles of the learner and lecturer are constantly revised. Thus it is *"the chronic revision (of social activity) in the light of new knowledge"* [Barrett, 1996: 44].

Individual transformations

This new perspective necessitates a new approach to learning.

New trust systems

Students need to "trust" the new approach also to achieve their personal objectives. They need to accept that verbatim studying is inferior to understanding and that it is impossible to memorise all material as this is changing continuously.

> *Yes they (the mind maps) help a lot. Sometimes when you see a diagram you remember most of the things, now to remember every single thing in the textbook – that is totally* - [Venter & Blignaut, 1998: Appendix I, 2].

Furthermore they need to learn to trust each other (within their teams) and to trust that they will learn from each other.

> *I found the new concept of group work a roaring success. It encouraged students to work since everyone's performance depends on theirs. It taught me the importance of punctuality, communication, delegation to trust others and most importantly to be a person others can trust.*

> *For me … there are advantages and disadvantages to this. But I think this way of working in a group, getting a lecturer in the group, then you focus on specific problems because sometimes everybody doesn't have the same problems. With smaller groups the lecturer can give its direct attention to that specific problem in stead of covering all the work* [Blignaut & Venter, 1998b: Appendix H(i), 2-3].

Reflexive project of the self

The changing nature of the class situation, from being an individual to being a member of a team, pressurises the individual into being reflexive about his or her strengths within a team and the contributions he or she can make to the team function. And to acknowledge the roles which are

low on his or her profile, which need a concerted effort to develop and apply.

> *You really get to know each other – the character come through under stress – true to type and those who are committed and those who are not committed. You can get a sense of character and their strengths and weaknesses.*
>
> *Yes, working in groups you meet different people and you learn from them.*
>
> *...group work has been quite helpful in encouraging a person to appreciate what you are studying* [Venter & Blignaut, 1998: 6].

Conclusion

In this chapter the results of the case studies of Chapter 4 were reviewed and interpreted from three perspectives. The perspectives used in this inductive interpretation were Habermas' knowledge interests, hermeneutics, and Giddens' "*consequences of contemporary modernity*". Without this additional interpretive layer of research it would not have been possible to make sense of the abundance of quantitative results that were collected. With each perspective, certain concepts (relevant to the research) emerged as being more important than others. Thus the additional layer of research indeed proved to be beneficial for the study. In the next chapter these identified concepts are used to develop a conceptual framework for group constitution for small group learning in the field of information technology.

Chapter 6

A CONCEPTUAL FRAMEWORK FOR GROUP CONSTITUTION FOR SMALL GROUP LEARNING IN THE FIELD OF INFORMATION TECHNOLOGY

No man can establish title to an idea – at the most he can claim possession. The stream of thought that irrigates the mind of each of us is a confluent of the intellectual river that drains the whole of the living universe.

Maurice Valency, introduction to "*Jean Giraudoux: Four Plays*" [1958]

Introduction

In the previous chapter the results of the five case studies (discussed in Chapter 4) were reviewed and interpreted from three perspectives, namely: Habermas' knowledge interests, hermeneutics, and Giddens' "*consequences of contemporary modernity*" theory.

In this chapter a conceptual framework of group constitution for small group learning in the field of information technology will be developed. In order to achieve this, a further round of interpretation will be undertaken, using the set of principles for interpretive studies as proposed by Klein and Myers [1999].

The two processes, namely: using the three "lenses" as first "pass" of interpretation, and a second "pass" of interpretation (the interpretation of the findings of the first "pass") using the principles of interpretive research, are graphically depicted in *Figure 31*.

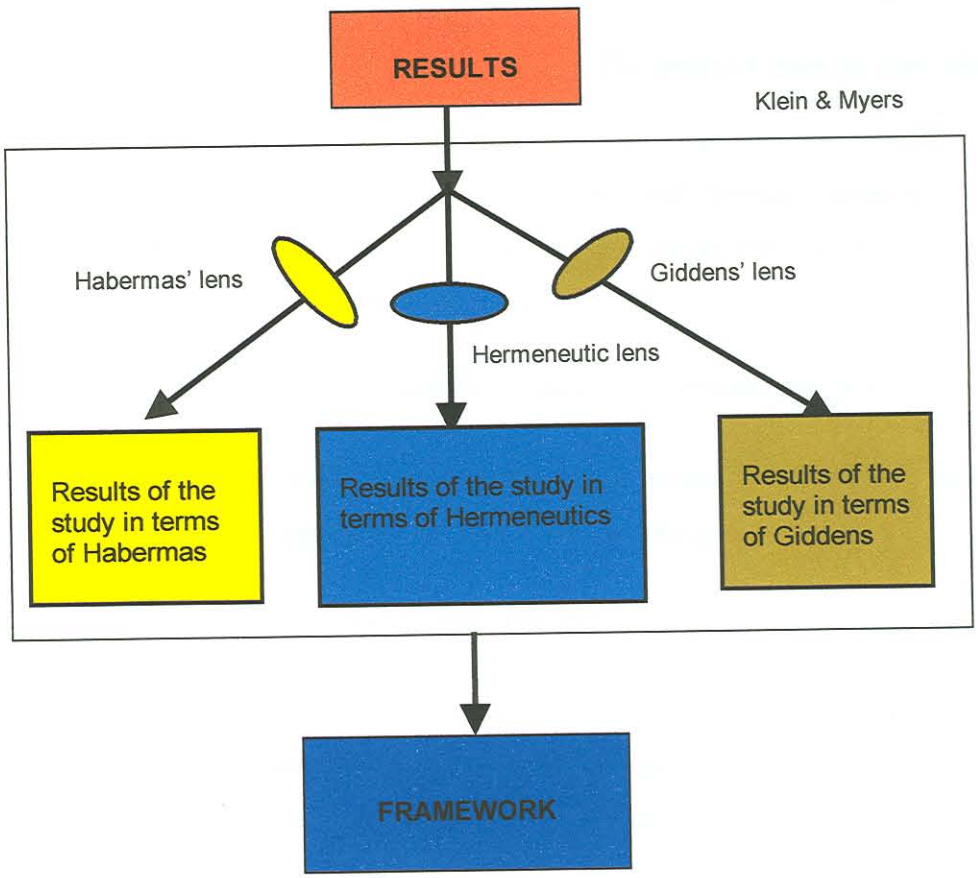


FIGURE 31: Using Klein and Myers' principles to derive a conceptual framework

The **principles** involved in the Klein and Myers approach are as follows:

The background to the interpretive perspective

The principles for evaluating interpretive field studies as proposed by Klein and Myers [1999] are:

1. **The fundamental principle of the hermeneutic circle**. This principle suggests that understanding can be achieved through an iteration process where the meaning of the whole and its parts are considered interdependently.

This process of human understanding is fundamental to all the other principles.

2. **The principle of contextualisation**. The situation must be seen within its context.

   This requires critical reflection on the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.

3. **The principle of interaction between researchers and the subjects**

   ... requires critical reflection on how the research materials (or "data") were socially constructed through interaction between the researcher and participants.

4. **The principle of abstraction and generalisation**. Principles 1 and 2 should be kept in mind when interpreting the results of the research and

   ...requires relating the ideographic details revealed by the data interpretation through the application of principles 1 and 2 to theoretical, general concepts that describe the nature of human understanding and social action.

5. **The principle of dialogical reasoning**. Sensitivity is required to identify contradictions between preconceptions and actual findings –

   ...guiding ... the actual findings with subsequent cycles of revision.

6. **The principle of multiple interpretations**. Participants interpret similar incidents differently, thus it –

   ...requires sensitivity to possible differences in interpretations.

7. **The principle of suspicion**. Researchers need to be aware of bias and the twisting of the "truth" and

   ...systematic "distortions" in the narratives collected from the participants [Klein & Myers, 1999].

These principles, as described by Klein and Myers, were used to evaluate the results achieved in a first attempt at deriving a framework (see *Figure 32*), and will aid the further refinement thereof.

Using the Klein and Myers approach to develop a preliminary framework

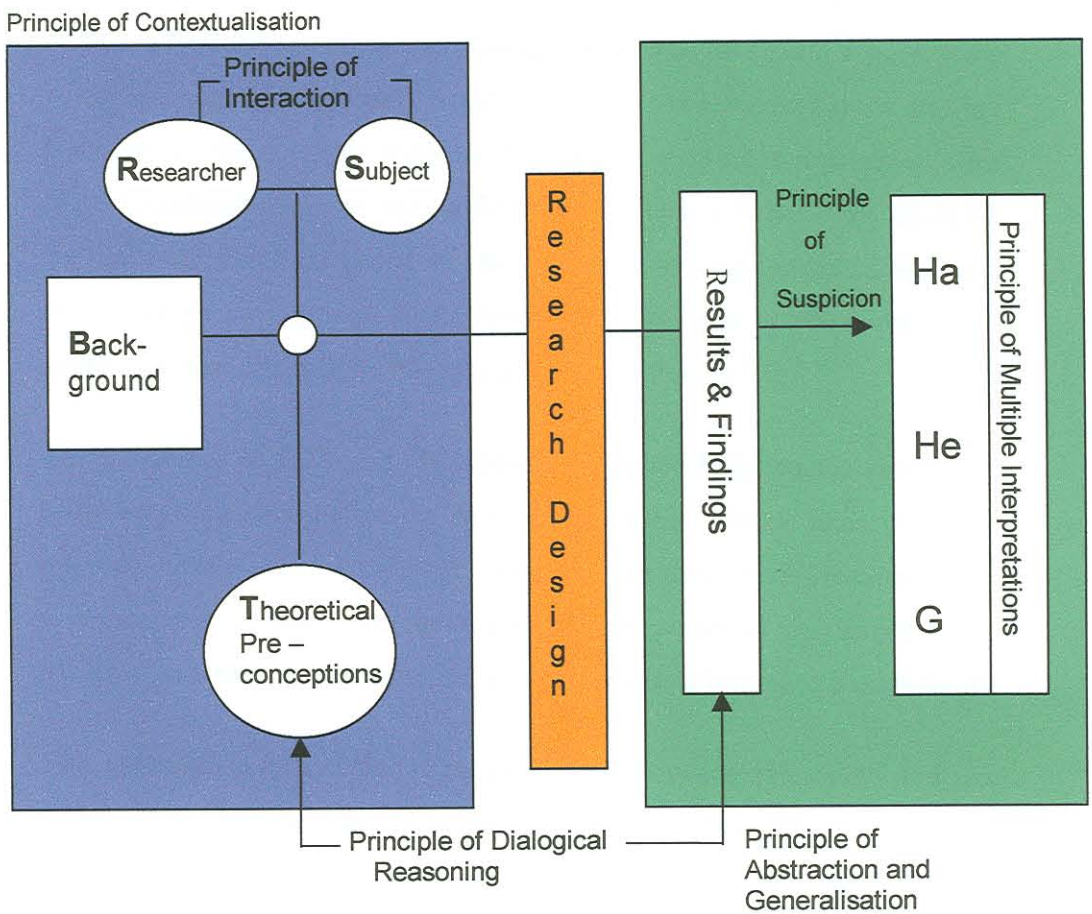


FIGURE 32: Towards a framework for group constitution for small group learning in the field of information technology

The framework above was derived (using Klein and Meyers) as follows:

The principle of contextualisation – puts the research problem into context. The context includes the researcher, the subject and the background to the problem as well as the theoretical preconceptions of the researcher. The researcher in this case is the lecturer, and the subject is the students at UWC. The background to the problem is that these students are from academically disadvantaged backgrounds, and they have a poor grasp of the language of instruction, namely English, as the majority speak another language at home. The students thus resort to verbatim studying with limited understanding of the underlying concepts of the study material. Furthermore the throughput of these students is unacceptably low. The theoretical preconceptions of the researcher forms part of this context as it guides the research and the interpretation of the results.

The **principle of dialogical reasoning** is applied between the theoretical preconceptions that guided the research and the results or findings of the research. But as can be seen (in *Figure 32*), the theoretical preconceptions was the result of the researcher's social construction of the subjects (the students) and their background (an academically disadvantaged background).

The interaction principle. The interaction between researcher and the subject of the research cannot be ignored. Thus the researcher needs to be sensitised to the "subjectivity" of interpretation. For example during interviews, the questions posed can pre-empt the answers given. When interpreting results this must be kept in mind.

Several interpretations, namely, Habermas' knowledge interests, Giddens' *"consequences of contemporary modernity"* and hermeneutics, represent the **principle of multiple interpretations.** This allows the researcher to examine, confront and reconcile contradictions that can arise from using different viewpoints to interpret the research findings.

The principle of suspicion as indicated can reveal distortions in the interpretation of the research results. The results, *"have a life of its own"*, and using the interpretive "lenses", this *"life of its own"*, as well as "biases", can be determined.

The principle of abstraction and generalisation is applied "over" the results and findings as well as the attempt to view the research from several perspectives. Generalisation and abstraction, in the tradition of grounded theory, will allow common and prominent themes to emerge.

The hermeneutic circle principle implies that understanding is achieved by *"iterating between considering the interdependent meaning of the parts and the whole that they form"* [Klein & Myers, 1999: Figure 1]. With each "pass" (of interpretation) the understanding of the research problem and the findings of the research become more complete. This is indeed a cyclical process; the problem is revisited several times and from several perspectives.

Critique

The conceptual model depicted in *Figure 32*, when considered closely, does not represent a conceptual model for *understanding* group constitution for small group learning in the field of information technology but rather a conceptual model for understanding the *research process* that has taken place.

In an attempt to refine the rough framework that has been developed in *Figure 32*, consider an alternative as depicted in *Figure 33*. The right square depicts the **Principle of Abstraction and Generalisation** applied to the results and findings of the research as well as the results of the first "pass" of multiple interpretations of the findings. This subset of *Figure 33* will now be considered separately and the Principle of Abstraction and Generalisation will be used as an "abstraction and generalisation tool" to derive a conceptual framework for *understanding* group constitution for small group learning in the field of information technology.

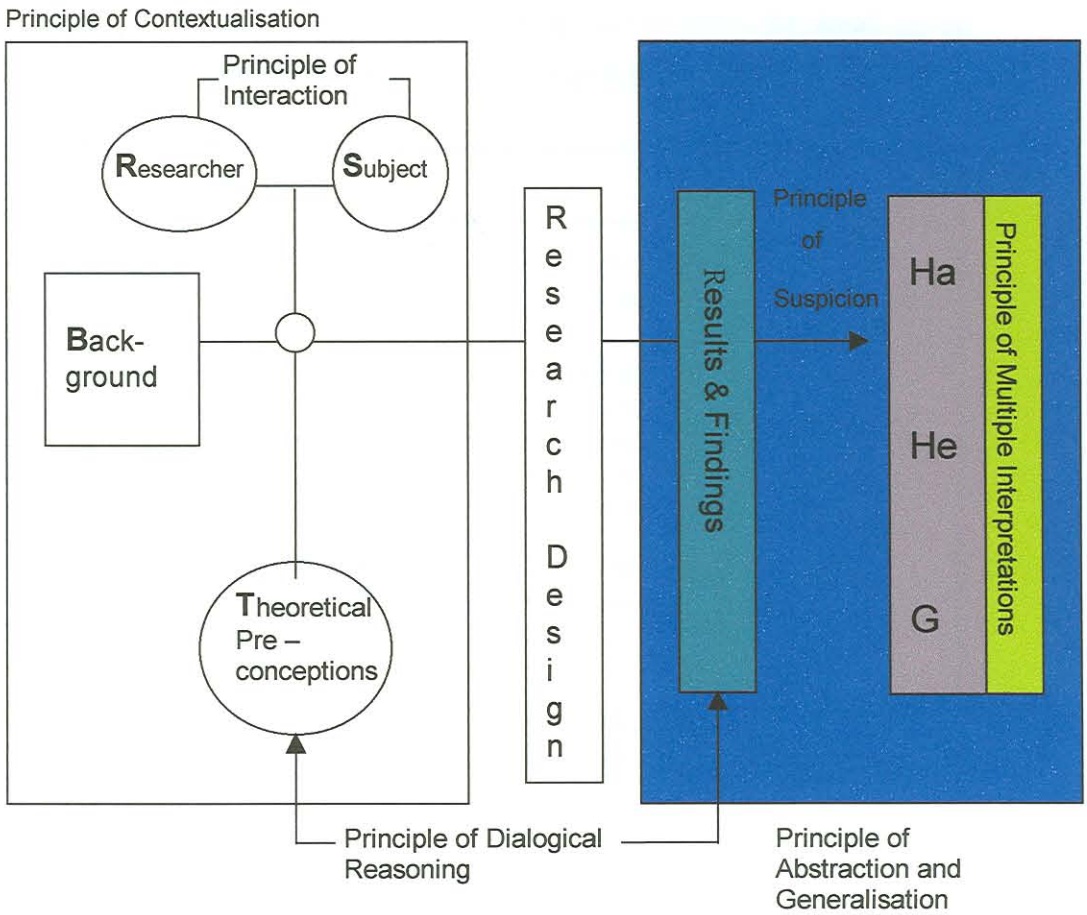


FIGURE 33: Towards a final framework for group constitution for small group learning in the field of information technology

The principle of abstraction and generalisation requires relating the factual details revealed by the data interpretation to general concepts that describe the nature of *human understanding* and *social action.* In the following table (*Table 16*) the concepts that describe the nature of human understanding and social action, are applied to both the student and the lecturer (in small group learning). Since both the researcher and subject (lecturer and student) are transformed after the implementation of this teaching strategy.

The impact of the intervention of group constitution for small group learning in the field of information technology is thus revealed:

	Student	Lecturer
Human	Reflexive project of the self (Reflect on learning, and role within team) Technical Knowledge Interest (Learn about subject, improve academic achievement and apply knowledge learnt)	Institutional Reflexivity (Chronic revision of teaching methods) Technical Knowledge Interest (Lecturer has knowledge about subject, cooperative learning and teamwork, but learns about group development and applies this new knowledge gained.)
Social Action	Disembedding Mechanism (Transformed from individual to team member, tasks/study material previously "linear" now mind maps) New Trust Systems (Must trust effectiveness of small group learning and trust team members) Separation of time and space (Students meet with lecturer virtually as well as with team members) Autonomisation (Students create their own understanding of the study material) Social construction, appropriation and enactment (of team roles as well as appropriation of tasks to be completed) Empower and emancipate Practical Knowledge Interest (Social consciousness and valuing diversity)	Disembedding Mechanism (From lecturer to facilitator) New Trust Systems (Trust that new role will not let him/her lose control) Separation of time and space (Virtual classroom has no time boundaries) Autonomisation (Lecturer is to accept the different interpretations of tasks set) Distanciation (Intended use of Belbin roles distanciated from original use, lecturer distanciated from traditional role)

TABLE 16: A framework for understanding group constitution and small group learning in the field of information technology

In the traditional higher education teaching model the lecturer and student relationship can be described as follows:

	Student	Lecturer
Human Understanding	Technical Knowledge Interest (Learn about subject and apply knowledge learnt)	Technical Knowledge Interest (Lecturer has knowledge about subject)

TABLE 17: Traditional lecturer-student relationship

If *Table 17* is compared to *Table 16*, it is noted that in *Table 17* the complete *social action* dimension as well as the reflexive project of the self and institutional reflexivity of the *human understanding* of the previous table (*Table 16*) are lacking. Compared to traditional higher education, small group learning thus adds a further dimension, namely a *social action* dimension, to the learning experience of the student as well as the lecturing/learning experience of the lecturer. Both student and lecturer (in the small group learning model) are compelled to reflect on their learning and teaching.

The framework for understanding group constitution for small group learning in the field of information technology developed and described in *Table 16* can be used to understand the various facets of this teaching methodology, as follows:

The impact on the student

Human understanding

Reflexive project of the self. In this model the student gets the opportunity to reflect on his/her learning. Memorising the study material is not an option as it is expected of the student to converse with their peers about the work, and that will not be possible without understanding the work. Furthermore,

the student comes to know his/her strengths and weaknesses and the role he or she can play within the team.

Technical knowledge interest. The student learns about the subject and how to apply the knowledge acquired. This method allows students to improve their academic achievement in the subject.

Social action

Disembedding mechanism. The student is transformed from an individual to a team member. Thus in the class situation he/she is not merely an individual who needs to pass a subject but he/she is a team member who will discuss the subject material with his/her team. It is thus important to pay attention and to deliver on time. Previously cramming was an option; now it is not, as students need to continuously know what is happening in class to be able to contribute to team discussions. The learning material that was traditionally "linear" and could be memorised is now related facts and concepts on a mind map that is not memorised but rather understood.

New trust systems. Students need to trust the effectiveness of small group learning and that it will achieve their individual needs. They also need to trust the team, that team members will share the work and that they will deliver on time. Furthermore students need to accept the responsibility of team tasks and be trustworthy team members.

Separation of time and space. It is possible to "meet" (virtually) with team members and the lecturer at all times via the Internet. Problems can be discussed without having to be at the same place at the same time. And problems can be any kind of problem, not necessarily only academic problems. The student thus feels that he or she is not merely a student that is studying a specific subject but is seen in totality by peers and the lecturer.

Autonomisation. Each student's interpretation of his/her dominant team roles and his/her enactment of these roles will be unique and thus will "*take*

on a life of its own". Similarly tasks assigned to the teams will be interpreted from each team's perspective and thus *"take on a life of their own".*

Social construction, appropriation and enactment. To understand any work or material it must be appropriated and socially constructed by the learner. In the team situation appropriation is necessary before work can be discussed. Similarly the team roles need to be appropriated by the learner before these roles can be enacted.

Empower and emancipate. Students feel empowered and emancipated with this methodology. They are no longer totally dependent on the lecturer but feel that they can stand on their own two feet.

Practical knowledge interest. Students become more socially conscious when expected to function within a team. They learn to value diversity as they come to realise that each team role has some specific strength to contribute to the team.

The impact on the lecturer

Human understanding

Institutional reflexivity. It is important for the teacher/researcher to reflect on his/her teaching practices. Thus the lecturer needs to *be prepared* to chronically revise his/her teaching methods. Reflection alone will be of little use if the lecturer is not prepared to change his/her teaching methods.

Technical knowledge interest. The lecturer traditionally knows his/her subject but now needs to become knowledgeable about cooperative learning and teamwork. Furthermore he/she needs to be able to assist teams with conflict resolution and must be aware of how groups develop.

Social action

Disembedding mechanism. The lecturer now becomes a facilitator. Therefore in the facilitative mode he/she must be able to dispel fears the students may

have about work or the team, elicit student opinions, and value the students' contributions by not being overly critical but being supportive of their endeavours.

New trust systems. The lecturer must trust that he or she, in this new role of facilitator, will not lose control. He or she is now not the "holder" of all the information but rather the guide to the information and in this role will have to sometimes be able to say "I do not know".

Separation of time and space. In the virtual classroom (with no time boundaries) the lecturer must be prepared to be "available" at all times. Thus the lecturer is not able to limit access to him or herself and must be prepared to answer e-mailed questions at any time. The separation of time and space is beneficial for the student but not so much for the lecturer. The lecturer will thus need to adapt to this changed environment – this is indicated in *Figure 34* by positioning the "separation of time and space"-rectangle a bit more to the right.

Autonomisation. Students create their own understanding of tasks set by the lecturer. It could be interpreted in a way unintended by the lecturer *"taking on a life of its own"*. With this teaching method the lecturer should be open to change, he/she should allow the students the freedom to interpret tasks from their perspective. He/she must thus be prepared to accept innovative or different interpretations of set tasks without feeling intimidated. Here again the lecturer will need to flexible and will need to make substantial changes to his lecturing style – in *Figure 34* the "autonomisation"- rectangle is therefore positioned slightly more to the right.

Distanciation. It is thus clear that the lecturer is distanciated from his/her traditional role. Similarly the intended use of Belbin roles is distanciated from their original use, namely, to create effective teams in the workplace.

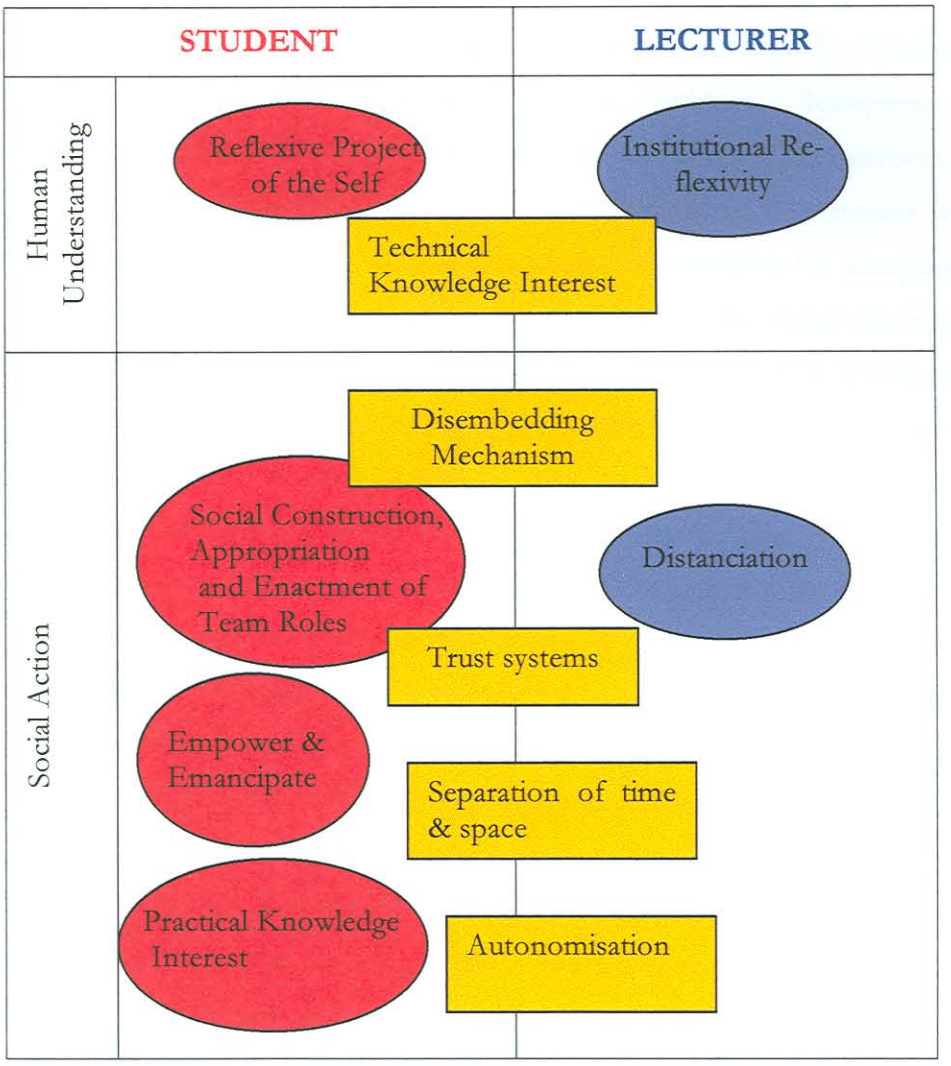


FIGURE 34: The final framework for understanding group constitution for small group learning in the field of information technology

The final version of the framework is depicted in *Figure 34*. In this figure, the ovals indicate the impact of "group constitution for small group learning" on the student (red) and lecturer (blue). The rectangles (yellow) indicate the impact that this methodology has on both students and lecturer.

Conclusion

In this chapter a framework was developed to understand group constitution for small group learning in the field of information technology. It was achieved by a cyclical process in which the original findings of the

case studies were interpreted using three perspectives, namely: Habermas' knowledge interests [Ngwenyama, 1991], Giddens' *"consequences of contemporary modernity"* theory [Barrett *et al.*, 1996] and hermeneutics as developed by Boland [Introna, 1997]. The findings of this process were then further interpreted using Klein and Myers' principles for interpretive studies [1999]. The framework depicted in *Figure 34* summarises the impact that group constitution for small group learning in the field of information technology will have on the learner as well as the lecturer. It can be used to demonstrate to both students and teachers the impact of the intervention. It shows how students should reflect more on their learning and their roles within a team, and how the lecturer should reflect on the teaching methods used and the effectiveness of teams. Socially students will develop new trust systems, they will learn how to negotiate a virtual world (separated in time and space) and they will construct and appropriate their own understanding of the study material. They will be empowered. The role of the lecturer will change and he or she will become a facilitator who gives his or her students the freedom to interpret tasks from their perspectives without feeling intimidated or out of control. With such a framework the lecturer will be able to prepare him or herself for the task ahead and it will furthermore allow him/her to prepare the class for this changed environment/approach. This could enhance the success of the approach.

Small group learning adds a social dimension to both the learning experience of the student and the facilitating experience of the lecturer. The developed framework will aid the lecturer and student in understanding the implications and benefits of the resultant transformation, if this teaching strategy is adopted.

In the next and final chapter of this thesis the findings of the study will be discussed and evaluated.

Chapter 7

FINDINGS, DISCUSSION AND EVALUATION

My joy in learning is partly that it enables me to teach.

Seneca, *"Letters to Lucilius"* [1st Century]

Introduction

In Chapter 1 some research questions were posed. These will now be revisited and "answered" in terms of the research that was done. The quality of the interpretation of the research done, as well as the methods that were implemented, will then be evaluated. Finally, the contribution this study makes to the body of knowledge currently available in the information systems field will be discussed.

Revisiting the research questions posed in Chapter 1

Several questions were posed in Chapter 1 in order to break down the larger problem of "underprepared second-language students, who are mostly from disadvantaged backgrounds, and who are inclined to memorise study material without the necessary understanding" into its constituent parts represented by each of the posed questions. We will now consider each of the asked questions together with the study's findings.

Team constitution

The posed question

How should teams be constituted? Should it be fluid in the sense that teams change for each setting? Can teams be put together in such a way that learning/work is enhanced and not influenced by team dysfunction?

Findings

In this study the preferred method for team constitution was the Belbin methodology. Students were grouped together in terms of their Belbin team-role profiles in order to form "balanced" teams. The size of the class and availability of resources mostly determined the size of the teams and teams functioned as a unit for the period of instruction.

In general students enjoyed their Belbin-constituted teams more than teams put together arbitrarily. One student, when asked if she enjoyed the Belbin-constituted team, responded:

> *Yes as compared to last semester where we were chosen in alphabetical order. It wasn't nice. (Then) we clashed a lot – everybody wanted to be a leader, even though we chose one...* [Venter & Blignaut, 1998: 7].

When considering the psychometric profile of each student it was found that the dominant role category (for example leadership) of a student has no bearing on achievement (See Appendix D, *Mark comparisons within role groupings*).

Learning was enhanced as students did significantly better in the non-traditional classes compared to the traditional "chalk-and-talk" classes [Blignaut & Venter, 1998b].

Formal/informal lecture ratio

The posed question

How often should discussion groups/teamwork be alternated with plenary sessions and formal lectures to make learning successful?

Findings

One formal lecture period was scheduled per week with the others all conducted as tutorial or group work sessions. A plenary session was held if a number of teams experienced similar problems.

The more informal format of the lectures was experienced positively by most students; 69.6% of the combined group agreed with the statement: *"I liked the way the class was conducted"* (See Appendix D). The same was found when the qualitative data was analysed –

> *Sometimes you get bored when the person (lecturer) stands there and speak a long time -- What I like is participating and asking questions, it is much better that way...* [Venter & Blignaut, 1998: Appendix I, 3].
>
> *The way in which the classes were conducted I like this way – no spoon feeding* [Venter & Blignaut, 1998: 35].

In one case study (Case Study 5) the students enjoyed the course but felt uncomfortable with the style of lecturing. Coming from a background of formal lectures they probably felt unsafe in this more informal environment. Most students accepted the given ratio of lectures versus group sessions.

Successful learning

The posed question

What could be considered a successful learning experience? According to De Villiers [1996b] the success of cooperative learning depends on the ability of learners to teach each other. This researcher would like to add that if students enjoy learning it could be considered to be successful.

Findings

The Learning Pyramid (depicted in *Figure* 8) indicates that retention rate when "teaching others" is in the order of 90%. We can therefore deduce that successful learning is learning with a high retention rate. Cooperative learning creates the opportunity for peers to teach each other and it could therefore indeed be seen as successful learning.

From the qualitative findings it would indeed seem to be the case:

> *You learn from each other, we discuss and you get different ideas and different views*... [Venter & Blignaut, 1998: Appendix I, 1].
>
> *When I go and read myself I understand more. I didn't understand it then, but when I hear it from the lecturer or from other (team) members, it all fall in place, like a puzzle* [Venter & Blignaut, 1998: Appendix I, 9].
>
> *During the first semester I used to memorise everything – I did not try to understand it. Now I find that if you try to understand it, it makes it less work. And easier* ... [Venter & Blignaut, 1998: Appendix I, 25].

Measuring "success"

The posed question

How is this measured?

Findings

We will now evaluate our findings using Cohen's [1994] suggested criteria for measuring the successful implementation of small group learning:

- Academic achievement – this type of achievement stresses basic skills such as memorisation of factual materials

  In one case study (Case study 3 [Blignaut & Venter, 1998b]) students in the small group learning class achieved significantly better.

- Conceptual learning and higher-order thinking - stresses learning through thinking

  From our qualitative findings this seemed to be the case:

  The implementation of group work and mind maps is a good idea. Because being a student is not how much you can cram in for a test or the exam but more about your (own) understanding [Venter & Blignaut, 1999: Appendix GG(i), 16].

- Equity or equal status within the group – this is typically measured by noting the participation rates of students of differing statuses.

  My experience was that students participated well in their teams -

  It has brought one (collective) personality to the class [Venter & Stoltz, 1996: Appendix E, 3].

  ...we had all different ideas -- but being together as a group that was fine [Venter & Blignaut, 1998: Appendix I, 7].

- Positive intergroup relations (in a multi-ethnic setting) and desirable prosocial behaviours such as being cooperative and friendly.

  Students enjoyed working in a group – only 11.2% of the combined grouping (the data of Case Studies 3, 4 and 5 combined) disagreed with the statement *"I enjoyed working in a group"* (See Appendix D).

  Students learnt to be cooperative and friendly -

  Before this year I didn't know anybody. I just knew their faces...[Venter & Blignaut, 1998: Appendix I, 4].

  The tension is gone now that we know each other [Venter & Stoltz, 1996: Appendix E, 4].

Assessment

The posed question

A new teaching paradigm necessitates new assessment instruments. But how should students then be assessed?

Findings

Students were continuously evaluated and assessed, as advocated by Jaques [1991] –

> *Evaluation works best if it is seen as a continuous process engaged in by all those who contribute to the setting up and participating in the group.*

Some peer assessment was introduced and groups earned a collective mark for their group mind map.

It is, however, felt that assessment still needs to be re-visited, as formal examinations are still the norm.

Quality of research interpretation

Positivist interpretation

For four (of the five) case studies presented in this study, both quantitative and qualitative data were collected. The quantitative data was collected by means of self-administered questionnaires. The quality of the positivist research was assured by using the services of a professional positivist researcher, Rénette Blignaut. (The statistical package SAS was used to analyse the quantitative data.)

The data of the 1997 and 1998 groups (Case Studies 3, 4 and 5) were combined to form a data set of 203 students. This data set was used to interpret the team-role data. The quality of this interpretation was assured by using the services of an industrial psychologist, Deon Stoltz from Auckland University of Technology, New Zealand, to assist with the interpretation of the quantitative team-role data.

Nonpositivist interpretation

The quality of the nonpositivist interpretation was assured by viewing the findings through the "lenses" of two seminal thinkers in interpretive qualitative research, namely, Habermas and Giddens. A further "lens", that of hermeneutics, was also employed. Field notes, e-mail comments, e-mail letters, interviews (conducted with the use of Schön's "reflective conversation" protocol) and open-ended comments on questionnaires served as qualitative data. The qualitative data was interpreted mostly by identifying specific themes, by marking appropriate themes in the text by

hand. Although software packages exist to aid in the analyses of this type of data, these were not used (mainly because it was not available).

Evaluation of contribution

Whetten's [1989], previously the editor of the AMR (Academy of Management Review) wrote an article on what he considers to be the necessary ingredients of a theoretical contribution. In his article he poses three questions, namely:

- What are the building blocks of theory development?
- What is legitimate value-added contribution to theory development?

And finally:

- What factors are considered in judging conceptual papers?

According to Whetten, the four essential elements (building blocks) to develop a theory are the following.

What. What variables, factors and concepts should be considered part of the explanation of this contribution? Two criteria need to be considered, namely *comprehensiveness*, the inclusion of all the relevant factors, and *parsimony*, deleting factors that have little to add to the understanding of the contribution.

It is the opinion of this researcher that the contribution is comprehensive and that the irrelevant information was omitted.

How. After identifying the factors that constitute the contribution it is necessary to reflect on how they are interrelated.

> *Together the* ***What*** *and* ***How*** *elements constitute the domain or subject of the theory. The more complex the set of relationships under consideration, the more useful it is to graphically depict them* [Whetten, 1989: 491].

(Thus **What** and **How** describe and provide a framework for interpreting empirical observations.)

The findings of this contribution were graphically depicted in Chapter 6 as a framework.

Why. Why select certain factors? What are the underlying assumptions of the theory or model? The logic of the proposed conceptualization should be of interest to other researchers.

> *Therefore, authors should push back the boundaries of our knowledge by providing compelling and logical justifications for altered views* [Whetten, 1989: 491].

Why thus explains. It is a theoretical discussion of the implications of the study's results.

The factors that were considered important in this contribution were discussed as research questions in Chapter 1. The current knowledge about these factors were highlighted in Chapter 2 and a framework for this altered view of small group learning was developed in Chapter 6.

Who, Where and When

These questions set the boundaries of generalisation and set the sensitivity to context, where and when it is happening. This is especially important for theories based on experience.

The context of this study was taken into account in this contribution. It is mentioned in the framework that was developed (in Chapter 6) for the

understanding of group constitution for small group learning in the field of information technology.

A number of questions (as advocated by Whetten [1989]) are now used to judge the theoretical contribution of this study.

What's new?

Does the study make a significant contribution to current thinking?

Academic programmes in all disciplines, and in computing and related disciplines in particular, are currently in flux in tertiary institutions all over South Africa and indeed, all over the world. Most are in a process of restructuring in order to address the ever diminishing funding that is available for education. This could lead to increased tuition fees, which could trigger a drop in enrolments, especially at historically disadvantaged institutions.

The situation is compounded by:

- the need for graduates from these particular communities that are currently underrepresented in the South African work force;
- the fact that the retention rate of students from academically disadvantaged communities is low and similarly that the throughput rate is not what is expected; and
- the fact that employers expect graduate students to have the skills to function in a fast-paced, internationally competitive and information-based workplace which translates into a need for "lifelong" learning skills.

The applicability of traditional teaching methods in a modern society thus needs to be re-evaluated. This contribution can stimulate this, currently

very lively, debate on the teaching of computer-related subjects and lead to the adoption of the proposed new teaching methodologies for teaching in computing and related fields.

So what?

Will the theory change the teaching of computer-related subjects? Are linkages to research evident? Are solutions proposed for remedying alleged deficiencies in current theories?

Computing is a central technology and its graduates are expected to collaborate with other disciplines in order to keep up with changing challenges.

> *We cannot create an environment in which students learn these skills by the tradition of presentation oriented lectures* [Denning, 1993: 102].

Apart from the fact that students, with the approach advocated in this thesis, acquire much-needed lifelong skills, as shown in the case studies discussed in Chapter 4, it was also shown in the results of Case Study 3 that students achieved academically significantly better with this approach.

In Chapter 2 the literature that deals with similar research efforts was discussed. What is new, in this thesis, is that several approaches, such as cooperative learning, teamwork and group constitution, have been combined into a framework for group constitution for small group learning in the field of information technology, adding a new dimension to research that has been done in this field. A framework for understanding group constitution for small group learning in the field of information technology has been developed in Chapter 6 and can be used to understand the dimensions this method adds to traditional teaching.

Why so?

Are the underlying logic and supporting evidence compelling?

The research viewed the problem from both a positivist and nonpositivist stance. SSM [Checkland & Scholes, 1990] was used to manage the research process and the interpretive approach [Klein & Myers, 1999] was implemented to make sense of the collected data. A framework for group constitution for small group learning was developed using an inductive interpretation. The three perspectives used in this induction were Habermas' knowledge interests, hermeneutics, and Giddens' "*consequences of contemporary modernity*" theory. In Chapter 3 the various research methodologies were discussed and it was motivated why an integrated positivist/interpretive approach was followed in this study. This research has brought the importance of and the urgency for the need for change in the teaching of computing-related subjects to the fore. The five case studies, as well as a meta study discussed in Chapter 4, highlighted the reasons for the study as well as the conclusions derived from the study.

Well done?

Does the thesis reflect seasoned thinking, conveying completeness and thoroughness?

Both the research problems as well as the results of this study were viewed holistically in that it was viewed and interpreted from several vantage points. The various research approaches were discussed in Chapter 3 and the interpretation of the results was undertaken from more than one perspective in Chapter 5. The perspectives which were used in this inductive interpretation were: Habermas' knowledge interests [Hirschheim & Klein, 1989], hermeneutics [Lee, 1993] and Giddens' "*consequences of contemporary modernity*" theory [Barrett *et al.*, 1996]. Interpretive research principles [Klein & Myers, 1999] were used in Chapter 6 to derive a conceptual framework for group constitution for small group learning in the field of information technology. Finally, this last chapter is used to review

the research using criteria as proposed by Whetten [1989]. This does indicate thoroughness and reflection on the part of the researcher.

Done well?

Is the thesis well written? Does it flow logically? Are the central ideas easily accessed?

In the first chapter of the thesis the "story" of the research was told. In the second chapter, the literature on teamwork, cooperative learning, learning styles, mind maps and assessment was discussed. The research problem was revisited in the third chapter and each study period with its quantitative and qualitative results was explored in more detail. Each period of the study was considered as a case study of a particular intervention. The research approach used in conducting these case studies was that of Checkland and Scholes [1990]. This methodology, as well as the approach used to interpret the results of the case studies inductively, was presented in the fourth chapter. In Chapter 5 the results, obtained from the case studies, were inductively interpreted. Chapter 6 contains the results of this induction in the form of a framework for group constitution for small group learning in the field of information technology. Finally, in this chapter, the findings and the contribution of the research are evaluated.

A professional editor did the "quality control" of the language and a professional positivist researcher controlled the results of the quantitative research. The index and a glossary of terms allow for easy access to the central ideas.

Why now?

Is the topic of contemporary interest to scholars in this area?

The South African Department of Education embarked on a curriculum review in 1995 that culminated in the publishing of Curriculum 2005 in 1997. This new curriculum has brought concepts such as teamwork, group

work, lifelong learning and critical thinking to the fore. Furthermore, the transformation that is currently taking place in postapartheid South Africa has changed most universities' student population profiles from linguistically and culturally **homogeneous** student bodies to student bodies that are linguistically, culturally and even academically **diverse**. These changes, apart from providing a challenging education environment, has made the experience of the Historically Black Universities (HBUs) more relevant to tertiary education in general. This thesis with its emphasis on cooperative learning and teamwork in a multicultural environment where the students are from diverse backgrounds therefore could contribute to the discourse on the new approach to teaching in a transforming South Africa.

In the literature much has been said about cooperative learning [De Villliers, 1996a, 1996b], learning in small groups [Brodie, 1995], the effect of cooperative learning on intergroup relations in a multicultural setting in secondary schools [Malory John Du Plooy, 1993], and the teaching of Computer Science [Terry, 1995]. However, none, as far as I know, pulls together cooperative learning, group constitution and the teaching of Computer Science in a multicultural setting, as is done in this study.

There is currently a growing interest in the teaching of computing-related subjects such as Informatics and Computer Science in South Africa. This can be seen from the fact that the University of South Africa (a distance education university that serves a very large student body) has recently advertised posts in Computer Education. At most computer-related international conferences, such as IFIP, ECIS and others, a stream for the teaching of computer-related subjects is included. This thesis can thus contribute to the discourse on teaching in the computing-related fields and can be a valuable tool for structuring teams for cooperative learning in multicultural settings.

Who cares?

What percentage of academic readers is interested in this topic?

For one, I care! And there are many more: as mentioned before, there is renewed interest in the teaching of computer-related subjects. This is of utmost importance as the ubiquitous use of computers in all walks of life necessitates well-designed and especially user-friendly software. This can only be achieved through perceptive and socially proficient and able programmers and computer professionals. A paradigm shift in computing, where re-use is the buzzword and no programmer needs to "reinvent the wheel", has been brought about by the Worldwide Web and its related technologies. A similar paradigm shift is needed to adapt learning and teaching just to keep up with this fast changing world.

Computer-related disciplines and even disciplines such as engineering are now embracing computer education. This can be seen from the many conferences that are being planned for the new millennium that either includes a stream for computer education or is entirely dedicated to educating the new engineer. Some of these conferences are:

Educating the New Engineer: The 3rd International KTH (Kungl Tekniska Högskolan) on Engineering Education at the Royal Institute of Technology (June 2000);

The 8th European Conference on Information Systems (July 2000);

25th International Conference on Improving University Learning and Teaching (July 2000);

2nd Global Congress on Engineering Education (July 2000);

5th World Congress on Improving the Innovative Capacity of Students and Teachers and new Educational Techniques and Technologies (September 2000); etc.

The topic is thus relevant to the information systems community and is of academic interest to academics, scholars and researchers in Information Systems.

Further Research

The following aspects were mentioned and referred to in this thesis, but not fully investigated. These aspects merit further research:

- Although the importance of assessment and its application in a changed educational environment was emphasised in this study, more research still needs to be done to evaluate different strategies of assessment. Traditional evaluation methods do not do justice to the lifelong skills acquired when using small group learning as a teaching strategy.

- Assistance and the training of assistants in the laboratories is another aspect that needs further investigation. Although more students now seem to be exposed to computers prior to university (in a 1999 survey of first-year students doing a computer literacy course at UWC, 46% had been exposed to computers prior to entering university), the majority still need thorough assistance in their first year of studying a computer-related subject. This is necessary to fasttrack these students into mainstream computer-related courses.

Conclusions

In this chapter the questions suggested by Whetten [1989] to assess the quality of a theoretical contribution, were posed and answered. It was shown that this thesis makes a legitimate theoretical contribution to theory

development in information technology and as such contributes to scientific progress.

This study reported on a longitudinal research effort, which stretched over four years (1995 - 1998). The research focused on a different approach to tertiary teaching and learning of certain subjects in computing, and investigated, as alternatives to traditional lecture-based teaching, the use of teamwork, cooperative learning and "mind maps" to help students to learn and study more effectively.

The majority of students experienced these alternatives positively. They indicated that working in teams contributed to their understanding of the subject, that they gained on a personal and social level and learnt more in the group than they would have learnt individually.

The results of the research were interpreted through various "lenses", as described in Chapter 5, and used (see Chapter 6) to develop a conceptual framework for group constitution of small group learning of computer-related subjects. This framework can be used, as discussed in Chapter 6, to guide the teaching of computer-related subjects. The framework highlights the added facets of learning the student will experience (social action and human understanding) as well as the facets of student learning that the lecturer will be guiding. Furthermore, the developed framework will hopefully enhance the understanding of the skills needed both to teach and to learn information technology in an ever-changing computer environment.

APPENDICES

APPENDIX A

Questionnaire

University of the Western Cape

Department of Computer Science

Questionnaire for Teamwork and Cooperative Learning Project

Dear Student,

Thank you for completing this questionnaire. It will be used as input to a **research project on teamwork and cooperative learning**. Your responses will be treated with the utmost of confidence.

Please use the answer sheet to answer the following questions. (PLEASE do not forget to fill in your **student number**! The data will be statistically analysed and without the student number it becomes worthless.)

Use the table below when giving your response to the questions.

Always/ Definitely/ Strongly Agree	A
Frequently/ Nearly always/ Agree	B
Occasionally/ Seldom/ Probably	C
Never/ Disagree	D
Strongly Disagree	E

A. Behaviour in Own Group.

1. I offer facts and relevant information in order to promote group discussion.
2. I give my opinions and ideas and provide suggestions in order to promote group discussion.
3. I express my willingness to cooperate with my group members.
4. I expect my group members to be cooperative.
5. I give support to group members who are struggling to express themselves intellectually.
6. I keep my thoughts, feelings and reactions to myself during group discussions.
7. I evaluate the contributions of group members in terms of whether their contributions are useful to me.
8. I take risks in expressing new ideas and my current feelings during group discussions.
9. I communicate to other group members that I am aware of and appreciate their abilities, talents, skills and resources.
10. I share any sources of information or other sources I have with my group members in order to promote the success of the individual members as well as the group as a whole.
11. I paraphrase or summarize what other members have said before I respond or comment.
12. I offer help to anyone in the group in order to bring up the performance of everyone.

B Acceptance of the Student as Group Member.

13. My fellow group members are completely honest with me.
14. My fellow group members understand what I am trying to communicate.
15. My fellow group members interrupt my comments.
16. My fellow group members accept me just the way I am.
17. My fellow group members tell me when I bother them.
18. My fellow group members make it easy for me to be myself.
19. My fellow group members include me in what they are doing.
20. My fellow group members value me as a person, apart from my skills or status.

C. Group Cohesion

21. I try to make sure that everyone enjoys being a member of the group.
22. I discuss my ideas, feelings and reactions to what is currently taking place within the group.
23. I express acceptance and support when other members disclose their ideas, feelings and reactions to what is currently taking place in the group.
24. I try to make all members feel valued and appreciated.
25. I try to include all members in group activities.
26. I'm influenced by group members.
27. I take risks in expressing new ideas and my current feelings.
28. I express liking, affection, concern for other members.
29. I encourage group norms that support individuality and personal expression.

D. Group Work in General

30. I have learnt more in the group than I would have learnt on my own.
31. I enjoyed working in a group.
32. The group motivated me to do my share of the work.
33. The group work helped me understand the study material better.
34. I learnt to cooperate with other students.
35. The group work caused me to be dependable and do my assignments.
36. It was fun working in a group.
37. In the group I got the benefit of everyone's ideas.
38. When I had problems, I got help from group members.
39. The work got done faster and more work was done.
40. The group work gave me an opportunity to talk and discuss the study material.
41. The group work made the study material more interesting.

E. Mind Maps

42. I enjoy doing the mind maps.
43. Mind maps have increased my understanding of the subject.
44. Mind maps give me a broader perspective of the work.
45. Doing mind maps with my team helps me to include all relevant information.
46. It is easier to remember the important facts once the mind map has been drawn.
47. Through mind mapping I have learnt a new way of ordering facts and information.
48. Mind maps do not help me when studying the relevant sections.
49. I cannot see the value of creating a mind map.
50. When writing a test the mind map is useless.
51. It is interesting to see how other groups do their mind mapping.
52. It is important that the mind maps are presented. It enhances my understanding.

F. Belbin's Team Roles

* Questions 56 and 57 only to be answered by Computer Science students.

53. I have gained insight into the role I can play within a team.
54. My team profile is a good reflection of me.
55. It was interesting to see how other people rated me.
56. *The teams that were constituted using the team profiles function better than those that were chosen alphabetically.
57. *Teams function better this semester because of the experience gained in the first semester.
58. I know the students in this class, on a more personal note, better than I do the students in other classes that I have attended.
59. I have learnt to work in a team.
60. I have gained insight into my strengths and weaknesses within a team.

G. Background Information

61. Gender

Female	A
Male	B

62. Age

< 21	A
21 - < 24	B
24 - < 27	C
27 +	D

63. Schooling

Public School in the RSA	A
Private School in the RSA	B
Private School in another country	C
Public School in another country	D

64. **Year Matric was written

Before 1992	A
1992	B
1993	C
1994	D
1995	E

*(** Different from previous questionnaires)*

65. Matric Average Symbol

A
B
C
D
E

66. Maths Matric Symbol

A
B
C
D
E

67. Degree

B.Sc.	A
B.Com.	B

68. Do you have any other tertiary qualifications?

Yes	A
No	B

69. My home language is:

Xhosa	A
English	B
Afrikaans	C
Zulu	D
Other	E

If OTHER, PLEASE fill in your home language in the space provided for your name on the pink answer sheet.

70. When did you first register as a student?

Before 1994	A
1994	B
1995	C
1996	D
1997	E

71. Have you changed your course since your first registration?

Yes	A
No	B

I General

Use the table on the first page to respond to these questions.

72. I was prejudiced towards people of other cultures before getting to know them in my group.
73. Working in a group improved my self-esteem.
74. I prefer formal lectures to the more informal way the class was conducted.
75. I have enjoyed doing the computer science project / statistics weekly assignments.
76. The computer practical enhanced my understanding of the work.
77. The computer practical was difficult.
78. I find it difficult to express myself in English.
79. Little help was available whilst doing the computer practical.
80. I use my own computer at home.
81. I use e-mail.
82. I access the Internet regularly.
83. I enjoyed the course.
84. I liked the way the class was conducted (lectures combined with group work.)
85. How often do you attend lectures?
86. Did you find it difficult to understand certain concepts as a result of the language or terminology used in lectures?
87. I read through the relevant sections before attending class.
88. I prefer this method of teaching more than the conventional lectures.
89. Was the lecturer's attitude positive whenever you approached her for help?
90. Was the textbook easy to read?

91. Do you feel that you were always well informed as to what was expected from you, for example: information on tests, tutorials, calculation of evaluation mark, etc.?

92. Was there enough opportunity to discuss problems with the lecturer?

93. I never prepare before attending class.

* The following questions only to be answered by Computer Science students.

94. I prefer courses to be blocked (thus that only the course CS324 was given in all the lecture periods of the second term.)

95. To report on our progress each week helped our group to manage our time more efficiently.

Please tear off and hand in.

ANY OTHER USEFUL COMMENTS?

Thank you for your cooperation.

Regards

Isabel Venter and Rénette Blignaut

APPENDIX B

Questions to guide "unstructured" interviews on group work and cooperative learning

- Do you enjoy working in a group?
- What do you think of the Belbin roles?
- Have you changed your way of learning?
- Did working in the group change your perceptions of people from other cultural groups?
- Did the mind map help you to understand the work?
- Your comments on the practical / project.
- Any other comment?

APPENDIX C

Donald A. Schön's reflective conversation protocol

In this study the preferred method for collecting interview data was the unstructured or semi-structured interview (using the reflective conversation protocol as described by Schön). Reflection-in-action is typically used to explore professional practice. It was felt that the teaching of professionals in the computing field could benefit from such a reflection-in-action-perspective. The interviews were unstructured and conversation-like so that it was possible to probe directions and topics which the researchers did not set out to discuss or evaluate. As in a conversation, the discussion would progress naturally – resulting in the emergence of themes which otherwise could have been overlooked. It allows the researcher to reflect on his/her praxis but also the learner to reflect on his/her learning. The researcher can unintentionally impose unconscious assumptions on the interviewee with his/her choice of questions (sometimes called the "Hawthorne Effect"). By using the conversation protocol this effect could be avoided.

In his book, "The Reflective Practitioner. How Professionals Think in Action", Schön [1983] explores the reflective conversation using two very different professional practices: architecture and psychotherapy. By comparing the reflection-in-action of these professions he describes "*the general form of the process and some of the main criteria of rigor appropriate to it*" [Schön, 1983: 74].

> *In the reflective conversation, the practitioner's effort to solve the reframed problem yields new discoveries which call for new reflection-in-action* [Schön, 1983: 132].

APPENDIX D

QUANTITATIVE ANALYSES OF 1997/1998 DATA SET

Frequencies of 1997 and 1998 data

(No duplicate students in the group.)

Gender

QG1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Female	92	47.7	92	47.7
Male	101	52.3	193	100.0

Frequency Missing = 10

Age

QG2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
<21	57	29.4	57	29.4
21-23	100	51.5	157	80.9
24-27	23	11.9	180	92.8
27+	14	7.2	194	100.0

Frequency Missing = 9

Language

QG9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Xhosa	49	25.5	49	25.5
English	62	32.3	111	57.8
Afrikaans	37	19.3	148	77.1
Zulu	9	4.7	157	81.8
Other	35	18.2	192	100.0

Frequency Missing = 11

GROUP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
c97	55	27.1	55	27.1
c98	43	21.2	98	48.3
s97	39	19.2	137	67.5
s98	66	32.5	203	100.0

Appendix D

GRP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
C	98	48.3	98	48.3
S	105	51.7	203	100.0

Preferred grp method above conv lectures

QI17	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	107	56.3	107	56.3
Probably	51	26.8	158	83.2
Disagree	32	16.8	190	100.0

Frequency Missing = 13

Access Internet regularly

QI11	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	80	42.3	80	42.3
Probably	53	28.0	133	70.4
Disagree	56	29.6	189	100.0

Frequency Missing = 14

Used my own computer at home

QI9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	45	23.9	45	23.9
Probably	18	9.6	63	33.5
Disagree	125	66.5	188	100.0

Frequency Missing = 15

Group motivated me to do my share

QD3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	148	75.5	148	75.5
Probably	31	15.8	179	91.3
Disagree	17	8.7	196	100.0

Frequency Missing = 7

22 The SAS System

1999 11:25 Tuesday, September 28,

Group members' contributions useful

QA7	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	77	39.7	77	39.7
Probably	78	40.2	155	79.9
Disagree	39	20.1	194	100.0

Frequency Missing = 9

Easier after mind map drawn

QE5	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	153	78.9	153	78.9
Probably	28	14.4	181	93.3
Disagree	13	6.7	194	100.0

Frequency Missing = 9

Team mind maps include relevant info

QE4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	138	71.1	138	71.1
Probably	40	20.6	178	91.8
Disagree	16	8.2	194	100.0

Frequency Missing = 9

Learnt working in team

QF7	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	147	77.4	147	77.4
Probably	36	18.9	183	96.3
Disagree	7	3.7	190	100.0

Frequency Missing = 13

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11:25 Tuesday, September 28, 1999

Gained insight into strenghts+weaknesses

QF8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	150	78.1	150	78.1
Probably	35	18.2	185	96.4
Disagree	7	3.6	192	100.0

Frequency Missing = 11

Gained insight into team role

QF1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	130	68.1	130	68.1
Probably	48	25.1	178	93.2
Disagree	13	6.8	191	100.0

Frequency Missing = 12

Degree

QG7	Frequency	Percent	Cumulative Frequency	Cumulative Percent
BSc.	124	66.7	124	66.7
BComm.	62	33.3	186	100.0

Frequency Missing = 17

Enjoyed working in a group

QD2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	129	65.8	129	65.8
Probably	45	23.0	174	88.8
Disagree	22	11.2	196	100.0

Frequency Missing = 7

Members understand my comments

QB2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	143	73.3	143	73.3
Probably	43	22.1	186	95.4
Disagree	9	4.6	195	100.0

Frequency Missing = 8

I am influenced by group members

QC6	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	84	42.9	84	42.9
Probably	74	37.8	158	80.6
Disagree	38	19.4	196	100.0

Frequency Missing = 7

I liked the way the class was conducted

QI13	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	133	69.6	133	69.6
Probably	37	19.4	170	89.0
Disagree	21	11.0	191	100.0

Frequency Missing = 12

Share info with group members

QA10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Agree	158	80.6	158	80.6
Probably	30	15.3	188	95.9
Disagree	8	4.1	196	100.0

Frequency Missing = 7

25 The SAS System

1999 11:25 Tuesday, September 28,

YR	Frequency	Percent	Cumulative Frequency	Cumulative Percent
85	1	0.5	1	0.5
89	1	0.5	2	1.0
90	2	1.0	4	2.0
91	3	1.5	7	3.4
92	6	3.0	13	6.4
93	12	5.9	25	12.3
94	56	27.6	81	39.9
95	60	29.6	141	69.5
96	37	18.2	178	87.7
97	24	11.8	202	99.5
98	1	0.5	203	100.0

Gender versus some significant questions

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11:25 Tuesday, September 28, 1999

TABLE OF QG1 BY GRP

QG1(Gender)	GRP		
Frequency, Percent, Row Pct, Col Pct	C	S	Total
Female	38	54	92
	19.69	27.98	47.67
	41.30	58.70	
	41.76	52.94	
Male	53	48	101
	27.46	24.87	52.33
	52.48	47.52	
	58.24	47.06	
Total	91	102	193
	47.15	52.85	100.00

Frequency Missing = 10

STATISTICS FOR TABLE OF QG1 BY GRP

Statistic	DF	Value	Prob
Chi-Square	1	**2.411**	**0.120**
Likelihood Ratio Chi-Square	1	2.417	0.120
Continuity Adj. Chi-Square	1	1.984	0.159
Mantel-Haenszel Chi-Square	1	2.399	0.121
Fisher's Exact Test (Left)			0.079
(Right)			0.955
(2-Tail)			0.149
Phi Coefficient		-0.112	
Contingency Coefficient		0.111	
Cramer's V		-0.112	

Effective Sample Size = 193
Frequency Missing = 10

Note this is not a significant finding but just shows the ratio of females versus males in the Computer Science and Statistics groupings.

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11:25 Tuesday, September 28, 1999

TABLE OF QG1 BY QI11

QG1(Gender) QI11(Access Internet regularly)

Frequency, Percent, Row Pct, Col Pct	Agree	Probably	Disagree	Total
Female	26	29	35	90
	13.76	15.34	18.52	47.62
	28.89	32.22	38.89	
	32.50	54.72	62.50	
Male	54	24	21	99
	28.57	12.70	11.11	52.38
	54.55	24.24	21.21	
	67.50	45.28	37.50	
Total	80	53	56	189
	42.33	28.04	29.63	100.00

Frequency Missing = 14

STATISTICS FOR TABLE OF QG1 BY QI11

Statistic	DF	Value	Prob
Chi-Square	**2**	**13.373**	**0.001**
Likelihood Ratio Chi-Square	2	13.592	0.001
Mantel-Haenszel Chi-Square	1	12.518	0.001
Phi Coefficient		0.266	
Contingency Coefficient		0.257	
Cramer's V		0.266	

Effective Sample Size = 189
Frequency Missing = 14

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11:25 Tuesday, September 28, 1999

TABLE OF QG1 BY QF7

QG1(Gender) QF7(Learnt working in team)

Frequency, Percent, Row Pct, Col Pct	Agree	Probably	Disagree	Total
Female	74	15	0	89
	39.36	7.98	0.00	47.34
	83.15	16.85	0.00	
	51.03	41.67	0.00	
Male	71	21	7	99
	37.77	11.17	3.72	52.66
	71.72	21.21	7.07	
	48.97	58.33	100.00	
Total	145	36	7	188
	77.13	19.15	3.72	100.00

Frequency Missing = 15

STATISTICS FOR TABLE OF QG1 BY QF7

Statistic	DF	Value	Prob
Chi-Square	**2**	**7.552**	**0.023**
Likelihood Ratio Chi-Square	2	10.239	0.006
Mantel-Haenszel Chi-Square	1	5.916	0.015
Phi Coefficient		0.200	
Contingency Coefficient		0.197	
Cramer's V		0.200	

Effective Sample Size = 188
Frequency Missing = 15
WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.

Frequencies of the role groupings for the Computer Science group and the Statistics group.

---------- GRP=Computer Science----------

ROLE1 _ 4 GROUPINGS

TEAMS1_4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
CONTROL	30	30.6	30	30.6
IDEAS	33	33.7	63	64.3
LEADERSHIP	16	16.3	79	80.6
SUPPORT	19	19.4	98	100.0

ROLE1 _ 3 GROUPINGS

TEAMS1_3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
ACTING	37	37.8	37	37.8
SOCIAL	20	20.4	57	58.2
THINKING	41	41.8	98	100.0

ROLE1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Compl Finish	6	6.1	6	6.1
Co-ordinator	3	3.1	9	9.2
Implementer	18	18.4	27	27.6
Monit Eval	6	6.1	33	33.7
Plant	29	29.6	62	63.3
Resource Invest	4	4.1	66	67.3
Shaper	13	13.3	79	80.6
Specialist	6	6.1	85	86.7
Team Worker	13	13.3	98	100.0

ROLE2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Compl Finish	7	7.1	7	7.1
Co-ordinator	6	6.1	13	13.3
Implementer	15	15.3	28	28.6
Monit Eval	10	10.2	38	38.8
Plant	19	19.4	57	58.2
Resource Invest	6	6.1	63	64.3
Shaper	15	15.3	78	79.6
Specialist	6	6.1	84	85.7
Team Worker	14	14.3	98	100.0

A high representation of the control role (30.6%) and ideas role (33.7%) in the Computer Science group may indicate that they will be able to develop and implement ideas. However with the low representation of leadership (16.3%) and social roles (19.4%) in this group, it is questionable if solutions to problems posed, would be client-orientated. When considering the

frequency of role 1 (the most dominant role) of this group it reaffirms the above contention. Investigative and ability to listen with insight need to be developed, as the natural representation of these skills in this group is low.

Appendix D

NO DUPLICATE STUDENTS FOR 97 AND 98
13:56 Tuesday, September 21, 1999

---------- GRP=Statistics----------

ROLE1 _ 4 GROUPINGS

TEAMS1_4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
CONTROL	27	25.7	27	25.7
IDEAS	31	29.5	58	55.2
LEADERSHIP	23	21.9	81	77.1
SUPPORT	24	22.9	105	100.0

ROLE1 _ 3 GROUPINGS

TEAMS1_3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
ACTING	38	36.2	38	36.2
SOCIAL	30	28.6	68	64.8
THINKING	37	35.2	105	100.0

ROLE1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Compl Finish	2	1.9	2	1.9
Co-ordinator	2	1.9	4	3.8
Implementer	15	14.3	19	18.1
Monit Eval	10	9.5	29	27.6
Plant	27	25.7	56	53.3
Resource Invest	4	3.8	60	57.1
Shaper	21	20.0	81	77.1
Team Worker	24	22.9	105	100.0

ROLE2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Compl Finish	9	8.6	9	8.6
Co-ordinator	4	3.8	13	12.4
Implementer	15	14.3	28	26.7
Monit Eval	3	2.9	31	29.5
Plant	17	16.2	48	45.7
Resource Invest	12	11.4	60	57.1
Shaper	12	11.4	72	68.6
Specialist	13	12.4	85	81.0
Team Worker	20	19.0	105	100.0

The students studying Statistics seem to be a more diverse group with a more balanced representation in all the role-groupings. When considering each student's two most dominant team roles, it seems as if assertive leadership and implementation skills are well represented within the group, but that there is a shortage of coordinating and analytical skills.

Mark comparisons within role groupings

NO DUPLICATE STUDENTS FOR 97 AND 98

13:56 Tuesday, September 21, 1999

Analysis Variable : MARK

ROLE1 _ 4 GROUPINGS=CONTROL

N	Mean	Std Dev	Minimum	Maximum
57	61.22	11.97	27.00	86.36

ROLE1 _ 4 GROUPINGS=IDEAS

N	Mean	Std Dev	Minimum	Maximum
64	63.42	11.28	46.00	91.00

ROLE1 _ 4 GROUPINGS=LEADERSHIP

N	Mean	Std Dev	Minimum	Maximum
39	64.76	10.28	45.00	89.00

ROLE1 _ 4 GROUPINGS=SUPPORT

N	Mean	Std Dev	Minimum	Maximum
43	60.47	12.05	26.00	87.00

Analysis Variable : MARK

ROLE1 _ 3 GROUPINGS=ACTING

N	Mean	Std Dev	Minimum	Maximum
75	63.54	11.86	27.00	89.00

ROLE1 _ 3 GROUPINGS=SOCIAL

N	Mean	Std Dev	Minimum	Maximum
50	61.51	11.71	26.00	87.00

ROLE1 _ 3 GROUPINGS=THINKING

N	Mean	Std Dev	Minimum	Maximum
78	61.97	11.05	39.00	91.00

NO DUPLICATE STUDENTS FOR 97 AND 98

13:56 Tuesday, September 21, 1999

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable MARK
Classified by Variable TEAMS1_4

TEAMS1_4	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
CONTROL	57	5661.50000	5814.0	375.919673	99.324561
LEADERSH	39	4448.50000	3978.0	329.560707	114.064103
IDEAS	64	6650.50000	6528.0	388.667821	103.914063
SUPPORT	43	3945.50000	4386.0	341.802644	91.755814

Average Scores Were Used for Ties

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.1421 DF = 3 Prob > CHISQ = 0.3702

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable MARK
Classified by Variable TEAMS1_3

TEAMS1_3	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
ACTING	75	8245.0	7650.0	403.753979	109.933333
SOCIAL	50	4899.0	5100.0	360.422518	97.980000
THINKING	78	7562.0	7956.0	406.896081	96.948718

Average Scores Were Used for Ties

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.1811 DF = 2 Prob > CHISQ = 0.3360

The first Belbin role in each student's teamrole profile was used to place a student within a category. Achievement is not related to a specific category.

NO DUPLICATE STUDENTS FOR 97 AND 98

1999 13:56 Tuesday, September 21,

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable MARK
Classified by Variable TEAMS1_4

TEAMS1_4	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
CONTROL	57	5661.50000	5814.0	375.919673	99.324561
LEADERSH	39	4448.50000	3978.0	329.560707	114.064103
IDEAS	64	6650.50000	6528.0	388.667821	103.914063
SUPPORT	43	3945.50000	4386.0	341.802644	91.755814

Average Scores Were Used for Ties

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.1421 DF = 3 Prob > CHISQ = 0.3702

N P A R 1 W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable MARK
Classified by Variable TEAMS1_3

TEAMS1_3	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
ACTING	75	8245.0	7650.0	403.753979	109.933333
SOCIAL	50	4899.0	5100.0	360.422518	97.980000
THINKING	78	7562.0	7956.0	406.896081	96.948718

Average Scores Were Used for Ties

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.1811 DF = 2 Prob > CHISQ = 0.3360

The first Belbin role in each student's teamrole profile was used to place a student within a category. Achievement is not related to a specific category.

NO DUPLICATE STUDENTS FOR 97 AND 98
09:45 Tuesday, September 21, 1999

ROLE1 _ 4 GROUPINGS

TEAMS1_4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	20	9.0	20	9.0
CONTROL	57	25.6	77	34.5
IDEAS	64	28.7	141	63.2
LEADERSHIP	39	17.5	180	80.7
SUPPORT	43	19.3	223	100.0

ROLE1 _ 3 GROUPINGS

TEAMS1_3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	20	9.0	20	9.0
ACTING	75	33.6	95	42.6
SOCIAL	50	22.4	145	65.0
THINKING	78	35.0	223	100.0

ROLE2 _ 4 GROUPINGS

TEAMS2_4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	20	9.0	20	9.0
CONTROL	59	26.5	79	35.4
IDEAS	54	24.2	133	59.6
LEADERSHIP	37	16.6	170	76.2
SUPPORT	53	23.8	223	100.0

ROLE2 _ 3 GROUPINGS

TEAMS2_3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	20	9.0	20	9.0
ACTING	73	32.7	93	41.7
SOCIAL	62	27.8	155	69.5
THINKING	68	30.5	223	100.0

NO DUPLICATE STUDENTS FOR 97 AND 98
ROLE3 _ 4 GROUPINGS

TEAMS3_4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	20	9.0	20	9.0
CONTROL	58	26.0	78	35.0
IDEAS	44	19.7	122	54.7
LEADERSHIP	44	19.7	166	74.4
SUPPORT	57	25.6	223	100.0

Frequencies of the dominant Belbin roles

(All 1997 and 1998 data were used – only one record per student, all duplicates deleted.)

Frequencies of the three dominant roles are given. These three roles are then grouped into four groupings (control, ideas, leadership and support) as well as three groupings (acting, social and thinking).

ROLE1	Frequency	Percent	Cumulative Frequency	Cumulative Percent
CF	8	3.9	8	3.9
CO	5	2.5	13	6.4
IMP	33	16.3	46	22.7
ME	16	7.9	62	30.5
PL	56	27.6	118	58.1
RI	8	3.9	126	62.1
SH	34	16.7	160	78.8
SP	6	3.0	166	81.8
TW	37	18.2	203	100.0

Frequency Missing = 20

ROLE2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
CF	16	7.9	16	7.9
CO	10	4.9	26	12.8
IMP	30	14.8	56	27.6
ME	13	6.4	69	34.0
PL	36	17.7	105	51.7
RI	18	8.9	123	60.6
SH	27	13.3	150	73.9
SP	19	9.4	169	83.3
TW	34	16.7	203	100.0

Frequency Missing = 20

ROLE3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
CF	20	9.9	20	9.9
CO	21	10.3	41	20.2
IMP	21	10.3	62	30.5
ME	17	8.4	79	38.9
PL	27	13.3	106	52.2
RI	17	8.4	123	60.6
SH	23	11.3	146	71.9
SP	25	12.3	171	84.2
TW	32	15.8	203	100.0

Frequency Missing = 20

ROLE3 _ 3 GROUPINGS

TEAMS3_3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	20	9.0	20	9.0
ACTING	64	28.7	84	37.7
SOCIAL	70	31.4	154	69.1
THINKING	69	30.9	223	100.0

In the next tables cross-tabulation is done with the following:

TEAMS1_4 (ROLE1 is grouped into four categories namely, control, ideas, leadership and support). This is cross-tabulated with TEAMS2_4 (ROLE2 also grouped into these same four categories).

Table TEAMS1_4 BY TEAMS2_4:

It is interesting to note that if the first role falls within a control category, the second does not (4.04%). The highest second role of this grouping is the support category (38.6%). If the support category is the most dominant the second role is NOT in the support category (4.65%), but the second dominant category is mostly the control category. If the first role is in the ideas category, the second role is not prominent in a specific category (control (26.6%), leadership (29.7%), support (29.7%)). If the first role falls within the leadership category, the second role is mostly in the Ideas category (38.5%).

TABLE OF TEAMS1_4 BY TEAMS2_4

TEAMS1_4(ROLE1 _ 4 GROUPINGS)	TEAMS2_4(ROLE2 _ 4 GROUPINGS)				
Frequency , Percent , Row Pct , Col Pct	CONTROL	IDEAS	LEADERSHIP	SUPPORT	Total
.	20	0	0	0	0	20
	8.97	0.00	0.00	0.00	0.00	8.97
	100.00	0.00	0.00	0.00	0.00	
	100.00	0.00	0.00	0.00	0.00	
CONTROL	0	9	13	13	22	57
	0.00	4.04	5.83	5.83	9.87	25.56
	0.00	15.79	22.81	22.81	38.60	
	0.00	15.25	24.07	35.14	41.51	
IDEAS	0	17	9	19	19	64
	0.00	7.62	4.04	8.52	8.52	28.70
	0.00	***26.56***	***14.06***	***29.69***	***29.69***	
	0.00	28.81	16.67	51.35	35.85	
LEADERSHIP	0	13	15	1	10	39
	0.00	5.83	6.73	0.45	4.48	17.49
	0.00	*33.33*	38.46	2.56	25.64	
	0.00	22.03	27.78	2.70	18.87	
SUPPORT	0	20	17	4	2	43
	0.00	8.97	7.62	1.79	0.90	19.28
	0.00	46.51	39.53	9.30	4.65	
	0.00	33.90	31.48	10.81	3.77	
Total	20	59	54	37	53	223
	8.97	26.46	24.22	16.59	23.77	100.00

In this section TEAMS1_4 (ROLE1 is grouped into four categories, namely control, ideas, leadership and support) is cross-tabulated with TEAMS3_4 (ROLE3 is also grouped into these same four categories).

In table TEAMS1_4 BY TEAMS3_4 :

TABLE OF TEAMS1_4 BY TEAMS3_4

TEAMS1_4(ROLE1 _ 4 GROUPINGS) TEAMS3_4(ROLE3 _ 4 GROUPINGS)

Frequency / Percent / Row Pct / Col Pct	CONTROL	IDEAS	LEADERSHIP	SUPPORT	Total
.	20	0	0	0	20
	8.97	0.00	0.00	0.00	8.97
	100.00	0.00	0.00	0.00	
	100.00	0.00	0.00	0.00	
CONTROL	0	8	13	16	20	57
	0.00	3.59	5.83	7.17	8.97	25.56
	0.00	14.04	22.81	28.07	35.09	
	0.00	13.79	29.55	36.36	35.09	
IDEAS	0	21	7	16	20	64
	0.00	9.42	3.14	7.17	8.97	28.70
	0.00	32.81	10.94	25.00	31.25	
	0.00	36.21	15.91	36.36	35.09	
LEADERSHIP	0	15	9	1	14	39
	0.00	6.73	4.04	0.45	6.28	17.49
	0.00	38.46	23.08	2.56	35.90	
	0.00	25.86	20.45	2.27	24.56	
SUPPORT	0	14	15	11	3	43
	0.00	6.28	6.73	4.93	1.35	19.28
	0.00	32.56	34.88	25.58	6.98	
	0.00	24.14	34.09	25.00	5.26	
Total	20	58	44	44	57	223
	8.97	26.01	19.73	19.73	25.56	100.00

It is interesting to note that if the 1st role is in the control category, the 3rd is mostly again in the support category. If the 1st role is in the support category, the 3rd role is either in the control or the ideas category. Similarly, if the 1st role is in the leadership category, the 3rd role is either in the control or support category.

In table TEAMS2_4 BY TEAMS3_4 :

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE OF TEAMS2_4 BY TEAMS3_4

TEAMS2_4(ROLE2 _ 4 GROUPINGS)	TEAMS3_4(ROLE3 _ 4 GROUPINGS)				
Frequency / Percent / Row Pct / Col Pct	CONTROL	IDEAS	LEADERSH IP	SUPPORT	Total
.	20	0	0	0	20
	8.97	0.00	0.00	0.00	8.97
	100.00	0.00	0.00	0.00	
	100.00	0.00	0.00	0.00	
CONTROL	0	14	13	14	18	59
	0.00	6.28	5.83	6.28	8.07	26.46
	0.00	23.73	22.03	23.73	30.51	
	0.00	24.14	29.55	31.82	31.58	
IDEAS	0	19	7	12	16	54
	0.00	8.52	3.14	5.38	7.17	24.22
	0.00	35.19	12.96	22.22	29.63	
	0.00	32.76	15.91	27.27	28.07	
LEADERSHIP	0	11	11	4	11	37
	0.00	4.93	4.93	1.79	4.93	16.59
	0.00	29.73	29.73	10.81	29.73	
	0.00	18.97	25.00	9.09	19.30	
SUPPORT	0	14	13	14	12	53
	0.00	6.28	5.83	6.28	5.38	23.77
	0.00	26.42	24.53	26.42	22.64	
	0.00	24.14	29.55	31.82	21.05	
Total	20	58	44	44	57	223
	8.97	26.01	19.73	19.73	25.56	100.00

In the next section cross-tabulation is done with the following:

TEAMS1_3 (ROLE1 is grouped into three categories, namely acting, social and thinking). This is cross-tabulated with TEAMS2_3 (ROLE2 is also grouped into these same three categories). In table TEAMS1_3 BY TEAMS2_3 :

If the 1st role is in the acting category, the 2nd role falls mostly within the thinking category (40%). If the 1st role is in the social category, the 2nd role is mostly in the acting category (44%). If the 1st role is in the thinking category. Interestingly the 2nd role is in the acting category (41%).

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE OF TEAMS1_3 BY TEAMS2_3

TEAMS1_3(ROLE1 _ 3 GROUPINGS) TEAMS2_3(ROLE2 _ 3 GROUPINGS)

Frequency, Percent , Row Pct , Col Pct	.	ACTING	SOCIAL	THINKING	Total
.	20	0	0	0	20
	8.97	0.00	0.00	0.00	8.97
	100.00	0.00	0.00	0.00	
	100.00	0.00	0.00	0.00	
ACTING	0	19	26	30	75
	0.00	8.52	11.66	13.45	33.63
	0.00	25.33	34.67	40.00	
	0.00	26.03	41.94	44.12	
SOCIAL	0	22	12	16	50
	0.00	9.87	5.38	7.17	22.42
	0.00	44.00	24.00	32.00	
	0.00	30.14	19.35	23.53	
THINKING	0	32	24	22	78
	0.00	14.35	10.76	9.87	34.98
	0.00	41.03	30.77	28.21	
	0.00	43.84	38.71	32.35	
Total	20	73	62	68	223
	8.97	32.74	27.80	30.49	100.00

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE OF TEAMS1_3 BY TEAMS3_3

TEAMS1_3(ROLE1 _ 3 GROUPINGS) TEAMS3_3(ROLE3 _ 3 GROUPINGS)

Frequency, Percent, Row Pct, Col Pct	ACTING	SOCIAL	THINKING	Total
.	20	0	0	20
	8.97	0.00	0.00	8.97
	100.00	0.00	0.00	
	100.00	0.00	0.00	
ACTING	0	17	25	33	75
	0.00	7.62	11.21	14.80	33.63
	0.00	22.67	33.33	44.00	
	0.00	26.56	35.71	47.83	
SOCIAL	0	19	11	20	50
	0.00	8.52	4.93	8.97	22.42
	0.00	38.00	22.00	40.00	
	0.00	29.69	15.71	28.99	
THINKING	0	28	34	16	78
	0.00	12.56	15.25	7.17	34.98
	0.00	35.90	43.59	20.51	
	0.00	43.75	48.57	23.19	
Total	20	64	70	69	223
	8.97	28.70	31.39	30.94	100.00

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE OF TEAMS2_3 BY TEAMS3_3

TEAMS2_3(ROLE2 _ 3 GROUPINGS) TEAMS3_3(ROLE3 _ 3 GROUPINGS)

Frequency, Percent , Row Pct , Col Pct	,.	,ACTING	,SOCIAL	,THINKING,	Total
.	20	0	0	0	20
	8.97	0.00	0.00	0.00	8.97
	100.00	0.00	0.00	0.00	
	100.00	0.00	0.00	0.00	
ACTING	0	23	28	22	73
	0.00	10.31	12.56	9.87	32.74
	0.00	31.51	38.36	30.14	
	0.00	35.94	40.00	31.88	
SOCIAL	0	20	16	26	62
	0.00	8.97	7.17	11.66	27.80
	0.00	32.26	25.81	41.94	
	0.00	31.25	22.86	37.68	
THINKING	0	21	26	21	68
	0.00	9.42	11.66	9.42	30.49
	0.00	30.88	38.24	30.88	
	0.00	32.81	37.14	30.43	
Total	20	64	70	69	223
	8.97	28.70	31.39	30.94	100.00

NO DUPLICATE STUDENTS FOR 97 AND 98 59

TABLE 2 OF TEAMS2_4 BY TEAMS3_4

CONTROLLING FOR TEAMS1_4=CONTROL

Note that we are now investigating the relationship between roles 2 and 3 if the 1st role is in the control category. A total of 57 students had their 1st role in the control category and therefore one should note that the sample sizes in each cell are small.

TEAMS2_4(ROLE2 _ 4 GROUPINGS)	TEAMS3_4(ROLE3 _ 4 GROUPINGS)					
Frequency Percent Row Pct Col Pct	. .	CONTROL .	IDEAS .	LEADERSH IP	SUPPORT .	Total
.	0 0.00 . .	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00
CONTROL	0 0.00 0.00 .	0 0.00 **0.00** 0.00	3 5.26 33.33 23.08	1 1.75 11.11 6.25	**5** 8.77 *55.56* 25.00	9 15.79
IDEAS	0 0.00 0.00 .	1 1.75 7.69 12.50	2 3.51 15.38 15.38	3 5.26 23.08 18.75	7 12.28 53.85 35.00	13 22.81
LEADERSHIP	0 0.00 0.00 .	4 7.02 30.77 50.00	3 5.26 23.08 23.08	3 5.26 23.08 18.75	3 5.26 23.08 15.00	13 22.81
SUPPORT	0 0.00 0.00 .	3 5.26 13.64 37.50	5 8.77 22.73 38.46	9 15.79 40.91 56.25	5 8.77 22.73 25.00	22 38.60
Total	0 0.00	8 14.04	13 22.81	16 28.07	20 35.09	57 100.00

It is interesting that if the 1st role is in the control category, neither the 2nd nor the 3rd role is in the control category.

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE 3 OF TEAMS2_4 BY TEAMS3_4

CONTROLLING FOR TEAMS1_4=IDEAS

Note that we are now investigating the relationship between roles 2 and 3 if the 1st role is in the ideas category. There were a total of 64 students with their 1st role in the ideas category and therefore one should note that the sample sizes in each cell are small.

TEAMS2_4(ROLE2 _ 4 GROUPINGS)	TEAMS3_4(ROLE3 _ 4 GROUPINGS)				
Frequency Percent Row Pct Col Pct	. .	CONTROL .	IDEAS .	LEADERSH IP .	SUPPORT .	Total
.	0 0.00 .	0 0.00 .	0 0.00 .	0 0.00 .	0 0.00 .	0 0.00
CONTROL	0 0.00 0.00 .	5 7.81 29.41 23.81	0 0.00 0.00 0.00	6 9.38 35.29 37.50	6 9.38 35.29 30.00	17 26.56
IDEAS	0 0.00 0.00 .	1 1.56 11.11 4.76	0 0.00 0.00 0.00	5 7.81 55.56 31.25	3 4.69 33.33 15.00	9 14.06
LEADERSHIP	0 0.00 0.00 .	6 9.38 31.58 28.57	4 6.25 21.05 57.14	1 1.56 5.26 6.25	8 12.50 42.11 40.00	19 29.69
SUPPORT	0 0.00 0.00 .	9 14.06 47.37 42.86	3 4.69 15.79 42.86	4 6.25 21.05 25.00	3 4.69 15.79 15.00	19 29.69
Total	0 0.00	21 32.81	7 10.94	16 25.00	20 31.25	64 100.00

It is interesting that if the 1st role is in the ideas category, neither the 2nd nor the 3rd role is in the ideas category.

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE 4 OF TEAMS2_4 BY TEAMS3_4

CONTROLLING FOR TEAMS1_4=LEADERSHIP

Note that we are now investigating the relationship between roles 2 and 3 if the 1st role is in the leadership category. There were a total of 39 students with their 1st role in the leadership category and therefore one should be note that the sample sizes in each cell are small.

TEAMS2_4(ROLE2 _ 4 GROUPINGS)	TEAMS3_4(ROLE3 _ 4 GROUPINGS)				
Frequency Percent Row Pct Col Pct	CONTROL	IDEAS	LEADERSH IP	SUPPORT	Total
.	0 0.00 . .	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . .
CONTROL	0 0.00 0.00 .	3 7.69 23.08 20.00	4 10.26 30.77 44.44	1 2.56 7.69 100.00	5 12.82 38.46 35.71	13 33.33
IDEAS	0 0.00 0.00 .	9 23.08 60.00 60.00	1 2.56 6.67 11.11	0 0.00 0.00 0.00	5 12.82 33.33 35.71	15 38.46
LEADERSHIP	0 0.00 0.00 .	1 2.56 100.00 6.67	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.56
SUPPORT	0 0.00 0.00 .	2 5.13 20.00 13.33	4 10.26 40.00 44.44	0 0.00 0.00 0.00	4 10.26 40.00 28.57	10 25.64
Total	0 0.00	15 38.46	9 23.08	1 2.56	14 35.90	39 100.00

It is interesting that if the 1st role is in the leadership category, neither the 2nd nor the 3rd role is in the leadership category.

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE 5 OF TEAMS2_4 BY TEAMS3_4

CONTROLLING FOR TEAMS1_4=SUPPORT

Note that we are now investigating the relationship between roles 2 and 3 if the 1st role is in the support category. There were a total of 43 students with their 1st role in the support category and therefore one should be note that the sample sizes in each cell are small.

TEAMS2_4(ROLE2 _ 4 GROUPINGS)	TEAMS3_4(ROLE3 _ 4 GROUPINGS)				
Frequency , Percent , Row Pct , Col Pct	. CONTROL	IDEAS	LEADERSH, IP	SUPPORT	Total
.	0 0.00 . .	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00
CONTROL	0 0.00 0.00 .	6 13.95 30.00 42.86	6 13.95 30.00 40.00	6 13.95 30.00 54.55	2 4.65 10.00 66.67	20 46.51
IDEAS	0 0.00 0.00 .	8 18.60 47.06 57.14	4 9.30 23.53 26.67	4 9.30 23.53 36.36	1 2.33 5.88 33.33	17 39.53
LEADERSHIP	0 0.00 0.00 .	0 0.00 0.00 0.00	4 9.30 100.00 26.67	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 9.30
SUPPORT	0 0.00 0.00 .	0 0.00 0.00 0.00	1 2.33 50.00 6.67	1 2.33 50.00 9.09	0 **0.00** 0.00 0.00	2 4.65
Total	0 0.00	14 32.56	15 34.88	11 25.58	3 6.98	43 100.00

To summarize, 57 students have their first role in the control category, 64 in the ideas category, 39 in the leadership category and 43 in the support category. For all these categories, if the 1st role is in a category, the 2nd and the 3rd role are not in the same category.

NO DUPLICATE STUDENTS FOR 97 AND 98

09:45 Tuesday, September 21, 1999

TABLE 2 OF TEAMS2_3 BY TEAMS3_3

CONTROLLING FOR TEAMS1_3=ACTING

Note that we are now investigating the relationship between roles 2 and 3 if the 1st role is in the acting category. There were a total of 75 students with their 1st role in the acting category and therefore one should note that the sample sizes in each cell are small.

TEAMS2_3(ROLE2 _ 3 GROUPINGS)	TEAMS3_3(ROLE3 _ 3 GROUPINGS)				
Frequency, Percent, Row Pct, Col Pct	ACTING	SOCIAL	THINKING	Total
.	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00
	.	.	.	.	
	.	0.00	0.00	0.00	
ACTING	0	4	9	6	19
	0.00	5.33	12.00	8.00	25.33
	0.00	**21.05**	**47.37**	31.58	
	.	23.53	36.00	18.18	
SOCIAL	0	8	6	12	26
	0.00	10.67	8.00	16.00	34.67
	0.00	30.77	23.08	**46.15**	
	.	47.06	24.00	36.36	
THINKING	0	5	10	15	30
	0.00	6.67	13.33	20.00	40.00
	0.00	16.67	33.33	**50.00**	
	.	29.41	40.00	45.45	
Total	0	17	25	33	75
	0.00	22.67	33.33	44.00	100.00

NO DUPLICATE STUDENTS FOR 97 AND 98
09:45 Tuesday, September 21, 1999

TABLE 3 OF TEAMS2_3 BY TEAMS3_3

CONTROLLING FOR TEAMS1_3=SOCIAL

TEAMS2_3(ROLE2 _ 3 GROUPINGS) TEAMS3_3(ROLE3 _ 3 GROUPINGS)

Frequency, Percent, Row Pct, Col Pct	ACTING	SOCIAL	THINKING	Total
.	0	0	0	0
	0.00	0.00	0.00	0.00
	.	.	.	
	.	0.00	0.00	0.00
ACTING	0	8	5	9	22
	0.00	16.00	10.00	18.00	44.00
	0.00	36.36	22.73	**40.91**	
	.	42.11	45.45	45.00	
SOCIAL	0	4	0	8	12
	0.00	8.00	0.00	16.00	24.00
	0.00	33.33	**0.00**	**66.67**	
	.	21.05	0.00	40.00	
THINKING	0	7	6	3	16
	0.00	14.00	12.00	6.00	32.00
	0.00	**43.75**	**37.50**	18.75	
	.	36.84	54.55	15.00	
Total	0	19	11	20	50
	0.00	38.00	22.00	40.00	100.00

NO DUPLICATE STUDENTS FOR 97 AND 98

TABLE 4 OF TEAMS2_3 BY TEAMS3_3

CONTROLLING FOR TEAMS1_3=THINKING

GROUPINGS)	TEAMS2_3(ROLE2 _ 3 GROUPINGS)	TEAMS3_3(ROLE3 _ 3

Frequency, Percent , Row Pct , Col Pct ,	ACTING	SOCIAL	THINKING	Total
.	0	0	0	0
	0.00	0.00	0.00	0.00
	.	.	.	
	.	0.00	0.00	0.00
ACTING	0	11	14	7	32
	0.00	14.10	17.95	8.97	41.03
	0.00	34.38	**43.75**	21.88	
	.	39.29	41.18	43.75	
SOCIAL	0	8	10	6	24
	0.00	10.26	12.82	7.69	30.77
	0.00	33.33	41.67	25.00	
	.	28.57	29.41	37.50	
THINKING	0	9	10	3	22
	0.00	11.54	12.82	3.85	28.21
	0.00	**40.91**	**45.45**	13.64	
	.	32.14	29.41	18.75	
Total	0	28	34	16	78
	0.00	35.90	43.59	20.51	100.00

To summarize, 75 students have their first role in the acting category, 50 in the social category and 78 in the thinking category. No specific relationship emerged from these comparisons. It is interesting to note that if the 1st role is in the social category, neither the 2nd nor the 3rd role falls within the social category.

BIBLIOGRAPHY

ANDREWS, S.J. 1994. Some cultural and perceptual implications of courseware development and the use of technology within a multicultural, multilingual society (A cautionary tale). *Computer-Assisted Education and Training in Developing Countries*, edited by P.M. Alexander: 7-13.

ARGYLE, M. 1991. *Cooperation: The basis of sociability.* Kogan Page. London.

ARGYRIS, C. 1990. *Overcoming Organizational Defenses: Facilitating Organizational Learning.* Allyn & Bacon. Boston, USA.

ARGYRIS, C., PUTNAM, R., MACLEAN SMITH, D. 1985. *Action Science - Concepts, Methods, and Skills for Research and Intervention.* Jossey-bass. San Francisco.

BARRETT, MICHAEL, SAHAY, SUNDEEP AND WALSHAM, GEOFF. 1996. Understanding IT and social transformation: Development and illustration of a conceptual scheme. *Proceedings of the 17th ICIS Conference,* Cleveland, OH: 42-50.

BELBIN, R. MEREDITH. 1993. *Team Roles at Work.* Butterworth-Heineman. Oxford, England.

BELBIN, R. MEREDITH. 1981. *Management Teams. Why They Succeed or Fail.* Butterworth-Heineman. Oxford, England.

BEMBRIDGE, T.J. June 1995. *Guidelines for Research Proposal Writing.* FRD Programme Series No 23.

BLIGNAUT, R.J. & VENTER, I.M. 1999. *Towards the 21st Century – new trends in tertiary education.* Technical Report, UWC/TRB/99-01. University of the Western Cape. Bellville.

BLIGNAUT, R.J. & VENTER, I.M. 1998a. Teamwork: Can it equip university science students with more than rigid subject knowledge? *Computers & Education*, 31(3): 265 - 279.

BLIGNAUT, R.J. & VENTER, I.M. 1998b. *Alternative Teaching Methods in Statistics Explored.* Technical Report, UWC/TRB/98-01. University of the Western Cape. Bellville.

BLIGNAUT, R.J., VENTER, I.M. & STOLTZ, D. 1998. "Chalk-and-talk" versus Cooperative Learning. A Comparative Study. *Proceedings of the 15th IFIP World Congress,* edited by Gordon Davies. Vienna/Austria and Budapest/Hungary: 139-148.

BOLAND, R.J. & HIRSCHHEIM, R.A. 1987. *Critical Issues in Information Systems Research.* John Wiley & Sons. New York: 363 - 379.

BORCHERDS, M.M., ENGLISH, P.J., FIELDING, M.L., HONIKMAN, K.S., JACOBS, G.A., KURGAN, A.Z., PICKERING-DUNN, E.K., STEYN, M.E., VAN DER MERWE, N.M. 1993. *Handbook. Guide to Effective Spoken and Written Communication.* Juta & Co. Ltd. Parow, South Africa.

BOT, M. 1997. School Register of Needs: A Provincial Comparison of School Facilities. *Edusource Data News* 17: 1-4.

BOUGHEY, CHRISSIE. 1993. A schema theoretical view of the reading process. *Language Across the Curriculum,* edited by Brenda Leibowitz. University of the Western Cape, Academic Development Centre, Occasional Publications. 2: 1-15.

BRODIE, KARIN MICHELLE. 1995. *Small-group work and ownership of mathematical knowledge.* Unpublished M.Ed. Thesis, University of the Witwatersrand.

BURRELL, G. & MORGAN, G. 1979. *Sociological Paradigms and Organisational Analysis.* Heinemann. London.

BUZAN, TONY. 1995. *The Mind Map Book.* BBC Books. London.

CHECKLAND, P. & SCHOLES, J. 1990. *Soft Systems Methodology in Action.* John Wiley & Sons. New York.

COHEN, ELIZABETH G. 1994. Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research.* 64(1): 1-35.

CRAIG, A. P. 1989. The conflict between the familiar and unfamiliar. *South African Journal of Higher Education* 3(1): 166-171.

CURRICULUM 2005, LIFELONG LEARNING FOR THE 21ST CENTURY. 1997. Issued by the National Department of Education. South Africa.

DAVIS, GORDON B., GORGONE, JOHN T., COUGER, J. DANIEL, FEINSTEIN, DAVID L., LONGENECKER, HERBERT E. 1997. *IS'97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems.*

DE BONO, EDWARD. 1992. *Serious Creativity.* Harper Collins Publishers. London.

DE BONO, EDWARD. 1967. *The Use of Lateral Thinking.* Penguin Books. England.

DE VILLIERS, CARINA. 1996a. *The integration of information technology in a co-operative learning environment.* Unpublished D.Com. (Informatics) - Thesis, University of Pretoria.

DE VILLIERS, CARINA. 1996b. *Cooperative learning notes.* Cooperative Learning Workshop presented at SACLA '96.

DE VILLIERS, CARINA & ROODE, DEWALD. 1995. An alternative teaching approach for information systems. *Proceedings SAICSIT-95,* edited by A.L. Steenkamp: 275-282.

DENNING, PETER J. 1993. Designing new principles to sustain research in our universities. *Communications of the ACM,* 36(7): 99-104.

DENNING, PETER J. 1992. Educating a new engineer. *Communications of the ACM,* 35(12): 83-97.

DETTMER, PEGGY, DYCK, NORMA & THURSTON, LINDA. 1996. *Consultation, Collaboration, and Teamwork.* Allyn & Bacon, a Simon & Schuster Company, Needham Heights, MA 02194.

DOCHY, FILIP J.R. & MOERKERKE, GEORGE. 1997. Assessment as a major influence on learning and instruction. *Educational Testing and Assessment: Lessons from the Past, Directions for the Future* edited by Lorin W. Anderson. International Journal of Educational Research 24(5): 415-431.

DU PLOOY, MALLORY JOHN. 1993. *'n Ondersoek in sekondêre skole na die effek van 'n kooperatiewe leerbenadering op tussengroepverhoudinge.* Unpublished D.Ed. - Thesis, University of Port Elisabeth.

DU PLOOY, N.F. 1993. The "human" side of Information Systems. *Proceedings of the Eighth Annual Conference of the International Academy of Information Management,* Orlando, Florida: 545-564.

DU PLOOY, N.F. 1998. *An analysis of the human environment for the adoption and use of information technology.* Unpublished D.Com.(Informatics) - Thesis, University of Pretoria.

DURNDELL, A. & THOMSON, K. 1997. Gender and computing: a decade of change? *Computers & Education,* 28(1): 1-9.

DURNDELL, A. & LIGHTBODY, P. 1993. Gender and computing: change over time? *Computers & Education,* 21(4): 331-336.

ENDER, RICHARD L. 1991. Determinates of computer competency learning. *Proceedings of the International Academy for Information Management*, edited by Robert W. Stone: 30-43.

EVANS, GERALD E. & SIMKIN, MARK G. 1994. What best predicts computer proficiency? *Communications of the ACM,* 32(11): 1322-1327.

FLOOD, R.L. & JACKSON, M. C. 1992. *Creative Problem-solving: Total Systems Intervention.* John Wiley & Sons. New York.

FOUNTAIN, DICK. 1994. Functional programming comes of age. *Byte,* 19(8): 183.

FOURIE, ERNA & HENNING, ELIZABETH. 1994. Computer literacy in a squatter community school in South Africa. *Computer-Assisted Education and Training in Developing Countries*, edited by P.M Alexander: 79-84.

FRANCES, LESLIE J. 1993. Measuring attitude towards computers among undergraduate college students: The effective domain. *Computers & Education,* 20 (3): 251-255.

FREER, K.J. & ENOCH, L.F. 1994. Small group/collaborative literacy instruction: Lessons learned – future directions. *Adult Basic Education*, 4(3): 129 –143.

GAEDE, OWEN F. 1994. Emerging and converging technologies: Implications for Education and Training. *Computer-Assisted Education and Training in Developing Countries*, edited by P.M. Alexander: 91-95.

GIDDENS, ANTHONY. *The consequences of modernity.* Stanford University Press, Stanford, California.

HABERMAS, JÜRGEN. 1987. *The theory of communicative action: Volume 2, The critique of functionalist reason*, translated by Thomas McCarthy. Polity Press. Cambridge, UK.

HABERMAS, JÜRGEN. 1981. *Theorie des kommunikativen Handelns: Band I, Handlungsrationalität und gesellschaftliche Rationalisierung.* Suhrkamp Verlag. Frankfurt am Main.

HABERMAS, JÜRGEN. 1974. *Theory and Practice*, translated by John Viertel. Heinemann. London.

HABERMAS, JÜRGEN. 1971. *Knowledge and Human Interests*, translated by Jeremy J Shapiro. Beacon Press. Boston.

HANSEN, KLAUS-HENNING. 1993. Teachers' choices of content and context in computer-education courses. *Computers & Education,* 21(1/2): 17-23.

HART, GENEVIEVE, MAKHUBELA, LULAMA, SMITH, MIKE, VENTER, ISABEL & WALKER, MELANIE. 1996. Different Angles of Vision: Teaching tales from the University of the Western Cape. *Teaching in Higher Education*, 1(2): 193 – 211.

HILKE, E.V. 1990. *Cooperative learning.* Bloomington: Phi Delta Kappa.

HIRSCHHEIM, RUDY & KLEIN, HEINZ K. 1989. Four paradigms of Information Systems development. *Communications of the ACM*, 32(10): 1199 – 1216.

HOLD, S.M. 1986. A synthesis of research on organisational collaboration. *Educational Leadership*, 43(5): 22-26.

HOYT, K.A. 1978. *A concept of collaboration in career education.* Washington D.C. U.S. Office of Education.

Interplace III ©, Matching People to Jobs, Belbin Associates.

INTRONA, LUCAS D. 1997. *Management, Information and Power.* MacMillan Press Ltd. Hampshire and London.

IVANCEVICH, JOHN M. & MATTESON, MICHAEL T. 1996. *Organizational Behavior and Management.* 4th Edition. IRWIN. Chicago.

JAQUES, DAVID. 1991. *Learning in Groups.* 2nd Edition. Kogan Page Limited. London.

JOHNSON, DAVID W. & JOHNSON, ROGER T. 1990. Social skills for successful group work. *Educational Leadership.* December 1989/January 1990: 29-33.

JOHNSON, D.W., JOHNSON, R.T. & HOLUBEC, E.J. 1994. *The Nuts and Bolts of Cooperative Learning.* Interaction Book Company. Minnesota.

JÖNSSON, STEN. 1991. Action Research. *Information Systems Research: Contemporary Approaches and Emergent Traditions*, edited by H.E. Nissen, H.K. Klein & R. Hirscheim, Elsevier Science Publishers B.V. North Holland: 371 – 396.

JOST, KAREN LEE & SCHNEEBERGER, SCOTT L. 1994. Educational technology adoption and implementation: Learning from information systems research. *Canadian Journal of Educational Communication,* 23(3): 213-230.

JUNG, CARL. 1977. Psychological Types, translated by R.F.C. Hull. *Collected Works of C.G. Jung.* Volume 6, Bollingen Series XX. Princeton University Press: 12-13, 28, 68.

KENNEDY, I.M. 1994. Cooperative learning and computers understanding the partnership. *Computer-Assisted Education and Training in Developing Countries*, edited by P.M. Alexander: 139-144.

KLEIN, HEINZ K. & MYERS, MICHAEL D. 1999. A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly,* 23(1): 67 – 93.

KOLB, DAVID A. 1984. *Experiential Learning.* Prentice-Hall, Inglewood Cliffs. New Jersey.

Learning Pyramid.
http://cac.psu.edu/ets/presentations/CatalystTexts/pyramid.html

LEE, ALLEN S. 1993. Electronic mail as a medium for rich communication: An empirical investigation using hermeneutic interpretation. *Proceedings of the 14th International Conference on Information Systems* edited by Degross, Janice I. et al., Orlando, Florida: 13 – 21.

LEE, ALLEN S. 1991. Integrating positivist and interpretive approaches to organizational research. *Organization Science*, 2(4): 342-365.

LIDTKE, DORIS K., STOKES, GORDON E., HAINES, JIMMIE & MULDER, MICHAEL C. 1999. ISCC'99 An Information Systems-Centric Curriculum Program Guidelines for Educating the Next Generation of Information Systems Specialists in Collaboration with Industry. *Americas Conference on Information Systems.* Milwaukee, Wisconsin, USA.

LIEBENAU, J. & BACKHOUSE, J. 1990. *Understanding Information.* MacMillan. London.

LINCOLN, YVONNA S. & GUBA, EGON G. 1985. *Naturalistic Inquiry.* Sage Publications.

LIVINI, LEAH. 1993. A model of effective computer-based science education. *Suid-Afrikaanse Tydskrif vir Wetenskap:* 387-389.

Longitudinal Research.
http://www.windsor.igs.net/~nhodgins/descriptive_longitudinal_research_design.html

MAKRAKIS, VASILIOS. 1993. Gender and computing in schools in Japan: The "We can, I can't" paradox. *Computers & Education,* 20(2): 191-198.

MOERKERKE, G. 1996. *Assessment of flexible learning.* Lema B.V. Utrecht.

MONYEKI, M.P. 1994. Matriculation results are a good determining factor for success in a technikon computer data processing course. *Proceedings of the FRD Grantees Report Back Seminar:* 18-29.

MYERS, M. D. *Qualitative Research in Information Systems.* http://www.misq.org/misqd961/isworld/index.html

NGWENYAMA, OJELANKI K. 1991. The critical social theory approach to information systems: problems and challenges. *Information Systems Research,* edited by Nissen, H.E., Klein, H.K., Hirschheim, R. Elsevier Science Publishers B.V. The Netherlands: 267 – 279.

NGWENYAMA, OJELANKI K. & LEE, ALLEN. S. 1997. Communication richness in electronic mail: Critical social theory and the contextuality of meaning. *MIS Quarterly*, 21(2): 145-167.

OLSON, JUDITH S., CARD, STUART K., LANDAUER, THOMAS K., OLSON, GARY K., MALONE, THOMAS & LEGGET, JOHN. 1993. Computer-supported co-operative work: Research issues for the 90s. *Behaviour & Information Technology,* 12(2): 115-129.

OZ, EFFY. 1994. *Ethics for the Information Age.* Wm. C. Brown Communications, Inc. USA.

PANDIT, N.R. 1996. The creation of theory: A recent application of the Grounded Theory Method. *The Qualitative Report*, 2(4). http://www.nova.edu/ssss/QR/QR2-4/pandit.html

POPPLETON, MICHAEL R. & ROBINSON, ANNE E. 1994. Adding Value and Realism to Group Coursework. *Proceedings of the Second All-Ireland Conference on Teaching of Computing.* Dublin, Ireland.

PRETORIUS, JAN HENDRIK OTTO. 1994. Unpublished Masters Thesis: *Ontwikkeling van die Probleemoplossingsvermoë van Eerstejaarstudente in Informatika.* University of Pretoria.

RAINER, MARK. 1999. The myth of graduate unemployability: A different perspective. *The Graduate.* Newsletter of the HRSC. Pretoria: 8-9.

REELER, LESLEY. 1994. Letters to the editor. *Informatics* 3.

REINEN, INGEBORG & PLOMP, TJEERD. 1993. Some gender issues in educational computer use: results of an international comparative survey. *Computer Education*, 20(4): 353-365.

REVANS, REG W. 1980. *Action Learning - New Techniques for Management.* Blond & Briggs, London.

ROETS, RINETTE. 1994. The effects of computer literacy training on educationally disadvantaged pupils. *Proceedings of the Fifth Annual CISNA Conference:* 349-367.

ROODE, DEWALD. 1993. Implications for teaching of a process-based research framework for information systems. *Proceedings of the 8th LAIM (International Academy for Information Management) Conference.* Orlando: 61-78.

ROSS, CHARLES. 1997. The renaissance of education, in *Computer Bulletin,* April: 9-11.

ROWLEY, JENNY. 1994. Teaching IT skills in higher education. *Computer Bulletin,* February: 9-11.

RYDER, M. 1999. *Action Research.*
http://www.cudenver.edu~mryder/itc_data/act/res.html

SAS Institute Inc. 1989. *SAS/STAT® User's Guide*, Version 6. Fourth Edition. Volume 1 & 2, Cary, NC.

SCHÖN, D. A. 1983. *The Reflective Practitioner.* Basic Books, New York.

SCHULTZE, ULRIKE. 1999. A confessional account of an ethnography about knowledge work. Accepted for publication in *MIS Quarterly.*
http://www.cox.smu.edu/faculty/uschultz /research/misq99.pdf

SENGE, PETER M. 1990. *The Fifth Discipline. The Art & Practice of the Learning Organization.* Doubleday. New York.

SENIOR, BARBARA. 1997. Team role and team performance: Is there 'really' a link? *Journal of Occupational and Organizational Psychology,* 71: 241 - 258.

SHARAN, YAEL & SHARAN, SHLOMO. 1990. Group Investigation Expands Cooperative Learning. *Educational Leadership*: 1- 21.

SHASHAANI, LILY. 1993. Gender-based differences in attitudes towards computers. *Computers & Education,* 20(2): 169-181.

SOLTIS, JONAS F. 1984. On the nature of educational research. *Educational Researcher,* 13(10): 5-10.

STRAUSS, J. & CORBIN, J. 1990. *Basics of qualitative research: Grounded theory procedures and techniques.* Sage. London.

SUTHERLAND, FRANCES & SCHULTZE, ULRICKE. 1992. Preparing undergraduates for end-user computing. *Proceedings of the 22nd SACLA Conference :* 9.

TERRY, P.D. 1995. Umbriel – imperative programming for unsophisticated students. *ACM SIGCSE Bulletin*, 20(3): 7-14.

THOMPSON, NOEL. 1991. Computers, curriculum and the learning environment. *Computers & Education,* 16(1): 1-5.

TOOMBS, KAREN. 1990. The potential of the computer to extend our abilities to think - myth or miracle? *New Perspectives No 3 (part II):* 62-67.

TORKZADEH, G. & KOUFTEROS, X. 1993. Computer user training and attitudes: a study of business undergraduates. *Behaviour & Information Technology* 12(5): 284-292.

TUCKMAN, B.W. & JENSEN, M. 1977. Stages of small group development revisited. *Groups and Organisation Studies:* 419 –427.

VAN WYK, C. 1995. *A literature survey on: Possible implementations of a computer literacy curriculum.* Unpublished Honours Project. UWC: 1-8.

VENTER, I.M. 1997. Teams, trying or terrific? A co-operative approach to the learning of Computer Science. *Academic Development*, 3(2): 3-18.

VENTER, I.M. & BLIGNAUT, R.J. 1998. *A Changing World Necessitates New Teaching Methodologies.* Technical Report, UWC/TRB/98-02. University of the Western Cape. Bellville.

VENTER, I.M., BLIGNAUT, R.J. & STOLTZ, D. 1998. Collaborative learning paves the way to lifelong learning. Poster. *The 15th IFIP World Congress* 1998: *Teleteaching.*

VENTER, I.M. & BLIGNAUT, R.J. 1997. *Computer Science a team effort? Using Psychometric Profiles in Team Construction.* Technical Report, UWC/TRB/97-01. University of the Western Cape. Bellville.

VENTER, I.M. & BLIGNAUT, R.J. 1996. Approach to computer literacy in a third world setting. *Computers & Education,* 27(1): 23-30.

VENTER, I.M. & BLIGNAUT, R.J. 1996. *Understanding Factors that Influence Success Rate of Students in Computer Literacy (1995 Follow-up Survey).* Technical Report UWC-TRB/96-01. University of the Western Cape. Bellville.

VENTER, I.M. & BLIGNAUT, R.J. 1995. *Understanding Factors that Influence Success Rate of Students in Computer Literacy.* Technical Report UWC-TRB/95-02. University of the Western Cape. Bellville.

VENTER, I.M. & STOLTZ, D. 1995. *Teamwork and Cooperative Learning in Computer Science.* Technical Report UWC-TRB/95-03. University of the Western Cape. Bellville.

WANG, C. 1998. Applying collaborative learning for enriching adult distance learning via community cable television. *Part II of the Proceedings of the 15th IFIP World Computer Congress,* edited by Gordon B. Davis. Vienna/Austria and Budapest/Hungary: 1057-1073.

WATTS, A.G. & MCNAIR, STEPHAN. 1995. Towards a Strategy for Lifelong Guidance to Support Lifelong Learning and Work, in Bradshaw, David et al.: *Bringing Learning to Life.* The Falmer Press, London.

WHETTEN, DAVID A. 1989. What constitutes a theoretical contribution? *Academy of Management Review* 14(4): 490-495.

WILD, ROSEMARY H. & WINNIFORD, MARY ANNE. 1993. Remote collaboration among students using electronic mail. *Computers & Education,* 21(3): 193-203.

WOODROW, JANICE E. 1991a. Determinants of student teacher computer literacy achievement. *Computers & Education,* 16(3): 247-257.

WOODROW, JANICE E. 1991b. Locus of control and computer attitude as determinants of computer literacy of student teachers. *Computer Education,* 16(3): 237-246.

YIN, R.K. 1994. *Case Study Research, Design and Methods.* 2nd Edition. Sage Publications. Newbury Park.

ZAR, JERROLD H. 1984. *Biostatistical Analysis*. Second Edition. Prentice-Hall. New Jersey.

ZUBOFF, S. 1988. *In the Age of the New Machine: The Future of Work and Power*. Basic Books. New York.

INDEX

J

K

L

M

N

O

P

Q

R

S

T

U

W