

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 Villiers, 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.