

A teaching environment for learning soft skills applicable to Information Systems Development

by

Theda Ann Thomas

Submitted in fulfilment of the requirements for the degree

Philosophiae Doctor (Information Technology)

in the Faculty of Engineering, Built Environment and Information Technology at the

University of Pretoria



ABSTRACT

CANDIDATE:

Theda Ann Thomas

PROMOTER:

Prof. C de Villiers

DEPARTMENT:

Informatics

DEGREE:

Philosophiae Doctor (Information Technology)

KEYWORDS:

Information Systems Education, Joint Application Development,

JAD, co-operative learning, soft skills development, diversity, actor-

network theory.

Information Systems development (ISD) is a complex, social process. The art of Information Systems (IS) development has changed over the years and there has been a growing recognition that Systems Analysts need more than just technical skills in order to do their job. Developing these skills, along with the technical skills is the challenge facing IS lecturers today.

IS departments at tertiary institutions have tended to prepare students very well for the technical needs of systems development. They have given the students the tools and techniques that they need to develop systems in a mechanistic way. There, has been some neglect of the skills that the students need in order to be able to find shared meanings, practise argumentation and be effective in working with users, however. This does not mean that the technical should be neglected, but that students should be able to augment their technical skills with business and interpersonal skills.

This research determined a method by which the techniques of Joint Application Development (JAD) workshops could be combined with the techniques of co-operative learning in order to create an environment where students could learn the soft skills that they need while also learning the modelling skills that are necessary for Information Systems development. The research followed a cyclical pattern of reflecting on the situation, doing literature studies to determine how the learning environment needed to be adapted, working out a theoretical framework for the learning environment, applying the learning methodology and analysing the results obtained from that situation.



The result of the research was a framework that was developed that showed how the JAD and co-operative learning techniques could be used effectively in a classroom with diverse students.



I declare that

A teaching environment for learning soft skills applicable to Information Systems Development

is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

T A Thomas



ACKNOWLEDGEMENTS

I would like to thank my promoter, Carina de Villiers, for her patience, dedication and quick response whenever it was needed. Her comments were most valuable and were greatly appreciated.

Thanks are also due to Rosanette du Toit, Julia Prior and Robert Gerber who acted as observers in the classroom during Case Studies 2,3 and 4.

My thanks also go to Piet Boonzaaier who helped to edit this thesis. Without his help many grammar errors would have gone undetected.

I would like especially to thank my husband, Albert, and my children, Bronwyn and Lloyd, who put up with my having "Mommy's time" during the writing of this thesis.

My thanks also go to the Port Elizabeth Technikon and the National Research Foundation who helped with finances for the research and for travelling around the country.



Table of Contents

| List | of Figures | i |
|------|--|----|
| List | of Tables | |
| Cha | apter 1: Introduction | 1 |
| 1.1 | BACKGROUND TO THE PROBLEM | 1 |
| 1.2 | RESEARCH QUESTIONS | 3 |
| | 1.2.1 What is? | 3 |
| | 1.2.2 Why is? | 4 |
| | 1.2.3 How does? | 4 |
| | 1.2.4 How should? | 4 |
| 1.3 | RESEARCH OBJECTIVES | 5 |
| 1.4 | METHODOLOGY | 5 |
| 1.5 | LIMITATIONS OF RESEARCH | 8 |
| 1.6 | A ROAD MAP TO THE THESIS | 8 |
| Cha | pter 2: Research Methodology | 12 |
| 2.1 | INTRODUCTION | 14 |
| 2.2 | RESEARCH PARADIGMS | 15 |
| | 2.2.1 Positivist Paradigm | 17 |
| | 2.2.2 Interpretive Paradigm | 20 |
| | 2.2.3 Critical Theory Paradigm | 25 |
| | 2.2.4 Pluralistic Approaches | 30 |
| 2.3 | RESEARCH DESIGNS FOR IN-CONTEXT RESEARCH | 32 |
| | 2.3.1 Survey research | 33 |
| | 2.3.2 Experimental designs | 34 |
| | 2.3.3 Action Research | 36 |



| | 2.3.4 Case Studies |
|-----|--|
| | 2.3.5 Action Case |
| 2.4 | RESEARCH METHODOLOGY FOR THIS STUDY 41 |
| | 2.4.1 The Research Paradigm for this study |
| | 2.4.2 The Research Design for this study |
| 2.5 | CONCLUSION 44 |
| | |
| | |
| Cha | apter 3: Social Issues in Information Systems Development 45 |
| 3.1 | A FRAMEWORK FOR ISD |
| | 3.1.1 Behavioural orientations |
| | 3.1.2 Domains of change |
| | 3.1.3 Federated framework |
| | 3.1.4 Development strategies across the orientations 50 |
| 3.2 | USER PARTICIPATION |
| | 3.2.1 Levels of user participation |
| | 3.2.2 An historical perspective of user participation 59 |
| | 3.2.3 Effective user participation |
| 3.3 | SKILLS NEEDED BY IS PROFESSIONALS 64 |
| 3.4 | IMPLICATIONS FOR IS CURRICULA AT |
| | TERTIARY INSTITUTIONS |
| 3.5 | CONCLUSION |
| | |
| | |
| Cha | pter 4: Joint Application Development |
| | |
| 4.1 | THE JAD PARTICIPANTS |
| | 4.1.1 The users |
| | 4.1.2 The IT specialists |
| | 4.1.3 The facilitator 75 |



| | 4.1.4 | The scribe |
|------|---------|---|
| 4.2 | THE. | JAD PROCESS 77 |
| | 4.2.1 | Preparation for the workshop 78 |
| | 4.2.2 | The structured workshop |
| | 4.2.3 | Post workshop |
| 4.3 | PERC | CEPTIONS AND RESEARCH OF JAD 84 |
| 4.4 | JAD II | N THE THEORETICAL FRAMEWORK FOR ISD 87 |
| | 4.4.1 | The use of JAD in the sense-making orientation 87 |
| | 4.4.2 | The use of JAD in the argumentation orientation |
| 4.5 | CONC | CLUSION |
| | | |
| | | |
| Cha | pter 5: | Learning by Co-operation |
| 5.1 | LEAR | NING THEORIES |
| | 5.1.1 | Piaget's Sociocognitive Learning theory |
| | 5.1.2 | Vygotsky's Sociocultural Learning Theory |
| | 5.1.3 | Social Constructivism |
| 5.2 | COLLA | ABORATIVE AND CO-OPERATIVE LEARNING |
| | 5.2.1 | What are collaborative and co-operative learning? 99 |
| | 5.2.2 | Essential features of effective co-operative learning 100 |
| | 5.2.3 | Advantages of co-operative learning |
| | 5.2.4 | Problems with group work |
| | 5.2.5 | Implementing effective co-operative learning |
| | 5.2.6 | Circles of learning co-operative learning method |
| 5.3 | SUMM | ARY |
| | | |
| | | |
| Chap | oter 6: | Diversity in the classroom |
| 6.1 | WHAT | IS MEANT BY DIVERSITY? |



| 6.2 | DIVE | RSITY IN SOUTH AFRICAN TERTIARY EDUCATION | 3 |
|-----|---------|--|---|
| 6.3 | PROI | BLEMS ASSOCIATED WITH DIVERSITY 126 | 3 |
| | 6.3.1 | Problems of stereotyping and prejudice | > |
| | 6.3.2 | Problems associated with diversity of language | 7 |
| | 6.3.3 | Problems associated with diversity of culture | } |
| | 6.3.4 | Problems associated with diversity of gender |) |
| 6.4 | METH | HODS OF DEALING WITH DIVERSITY | |
| | 6.4.1 | Affirming diversity | |
| | 6.4.2 | Develop a student-centred approach | , |
| | 6.4.3 | Dealing with communication issues | |
| | 6.4.4 | Changing students' attitudes | |
| 6.5 | DIVER | RSITY IN GROUPS IN THE CLASSROOM | |
| | 6.5.1 | Dividing the students into groups | |
| | 6.5.2 | Dealing with cultural differences in groups | |
| | 6.5.3 | Functioning of the diverse group | |
| 6.6 | CONC | CLUSION | |
| | | | |
| | | | |
| Cha | pter 7: | An actor-network framework for the use of JAD 144 | |
| | | | |
| 7.1 | ACTO | R-NETWORK THEORY | |
| | 7.1.1 | Principles of ANT | |
| | 7.1.2 | The heterogeneous actor network | |
| | 7.1.3 | Actors in the actor network | |
| | 7.1.4 | Translation | |
| | 7.1.5 | An example of using ANT to study group decision making 157 | |
| | 7.1.6 | Concluding remarks on ANT | |
| 7.2 | AN AC | TOR-NETWORK FRAMEWORK FOR THE JAD WORKSHOP 160 | |
| | 7.2.1 | The actors in the JAD workshop | |
| | 7.2.2 | Translation in the JAD process | |
| 7.3 | CONC | LUSION | |



Chapter 8: Using JAD and co-operative learning

| | | in the classroom | 167 |
|-----|-------|---|-----|
| 8.1 | USING | G JAD IN THE CLASSROOM: CASE STUDY 1 | 170 |
| | 8.1.1 | Preparatory sessions - Case Study 1 | 170 |
| | 8.1.2 | Running the JAD sessions in the classroom - Case Study 1 | 170 |
| | 8.1.3 | Original framework for the use of JAD in the classroom | 173 |
| | 8.1.4 | An overview of the results of the pilot case study | 176 |
| | 8.1.5 | Reflections on Case Study 1 | 183 |
| 8.2 | USIN | IG JAD AND CO-OPERATIVE LEARNING TECHNIQUES : | |
| | CASI | E STUDY 2 | 183 |
| | 8.2.1 | Preparatory group skills awareness - Case Study 2 | 184 |
| | 8.2.2 | Running the JAD sessions - Case Study 2 | 186 |
| | 8.2.3 | The circles of learning co-operative learning method as applied | |
| | | to JAD | 189 |
| | 8.2.4 | A framework for the use of JAD and co-operative learning in | |
| | | the classroom | 191 |
| | 8.2.5 | An overview of the results of Case Study 2 | 193 |
| | 8.2.6 | An overview of group questionnaire and observation results - | |
| | | Case study 2 | 201 |
| | 8.2.7 | Assessment of students learning - Case Study 2 | 202 |
| | 8.2.8 | Reflections on the Case Study 2 | 204 |
| 8.3 | USIN | G JAD AND CO-OPERATIVE LEARNING: CASE STUDY 3 | 205 |
| | 8.3.1 | Preparatory group skills awareness - Case Study 3 | 206 |
| | 8.3.2 | Running the JAD sessions - Case Study 3 | 206 |
| | 8.3.3 | An overview of results of the main questionnaire - Case study 3 | 207 |
| | 8.3.4 | Overview of group questionnaires and observations of the | |
| | | groups - Case Study 3 | 214 |
| | 8.3.5 | Reflections on Case Study 3 | 215 |
| 8.4 | IMPLE | EMENTING IDEAS FOR HANDLING DIVERSITY: CASE STUDY 4 | 216 |
| | 8.4.1 | Methods of dealing with diversity already in the learning | |



| | | environment | 216 |
|------|---------|--|-----|
| | 8.4.2 | Modifications to the learning environment for catering for diversity . 2 | 218 |
| | 8.4.3 | Framework for using JAD and co-operative learning with a | |
| | | diverse student population | 220 |
| | 8.4.4 | An overview of the results of Case Study 4 | 222 |
| | 8.4.5 | Evaluation of group processing - Case Study 4 | 235 |
| | 8.4.6 | Assessment of students' learning - Case Study 4 | 237 |
| | 8.4.7 | Reflections on Case Study 4 | 238 |
| 8.5 | CONC | CLUSION | 240 |
| Cha | pter 9: | A Framework for the use of JAD and co-operative | |
| | | learning methods in the classroom 2 | 41 |
| 9.1 | DESIF | RED LEARNING OUTCOMES | 244 |
| 9.2 | THE U | JSE OF JAD IN THE CLASSROOM 2 | 244 |
| 9.3 | CO-O | PERATIVE LEARNING METHODS | 245 |
| 9.4 | SOCIA | AL CONSTRUCTIVIST LEARNING THEORY 2 | 246 |
| 9.5 | WORK | KING WITH DIVERSE STUDENTS | 248 |
| 9.6 | BUILD | ING THE FRAMEWORK | 248 |
| 9.7 | THE E | XPANDED NETWORK 2 | 50 |
| 9.8 | CONC | LUSION | 51 |
| Cha | pter 10 | : Evaluation and conclusions 29 | 52 |
| 10.1 | ANSW | ERING OF THE RESEARCH QUESTIONS 2 | 52 |
| | 10.1.1 | What is? | 52 |
| | 10.1.2 | Why 2 | 55 |
| | | How does | |
| | 10.1.4 | How should? | 56 |
| 10.2 | EVALU | JATION OF RESEARCH | 57 |
| | 10.2.1 | Evaluation according to seven principles of interpretive | |



| | field studies |
|-------------|---|
| | 10.2.2 Authenticity, plausibility and criticality |
| 10.3 | CONTRIBUTION OF THE RESEARCH |
| 10.4 | FUTURE RESEARCH |
| | 10.4.1. Applying the framework in different cultural environments 268 |
| | 10.4.2 Applying the framework in non-IS subjects |
| | 10.4.3 Co-operative learning techniques in JAD in industry 269 |
| 10.5 | CONCLUDING REMARKS |
| | |
| Dof | erences 272 |
| Keie | erences |
| | |
| App | endix A: Questionnaires |
| | |
| A .1 | QUESTIONNAIRE ON YOUR EXPERIENCES WITH JAD - CASE STUDY 1 . 305 |
| A.2 | QUESTIONNAIRE ON YOUR EXPERIENCES WITH JAD - CASE STUDY 2 . 309 |
| A.3 | QUESTIONNAIRE ON YOUR EXPERIENCES WITH JAD - CASE STUDY 3 . 313 |
| A.4 | QUESTIONNAIRE ON YOUR EXPERIENCES WITH JAD - CASE STUDY 4 . 317 |
| A.5 | GROUP EVALUATION |
| A.6 | BUDDY/ SELF RATING |
| A .7 | BUSINESS SKILLS |
| | |
| Ann | endix B: Case Study Results |
| ∆hh. | endix D. Case Study Nesults |
| B.1 | RESULTS OF CASE STUDY 1 |
| <i>D.</i> 1 | B.1.1 Working in groups - Case Study 1 |
| | B.1.2 Learning in groups - Case Study 1 |
| | B.1.3 Facilitation and language - Case Study 1 |
| | B.1.4 Use of JAD - Case Study 1 |
| B.2 | RESULTS OF CASE STUDY 2 |
| ے. <i>ب</i> | B.2.1 Main questionnaire results - Case Study 2 329 |
| | - B.E. I. IVIGITI MUUULUITUITU TUUULU - CAUU ULUUV Z |



| | B.2.2 | Group questionnaires - Case Study 2 | 333 |
|-----|---------|---|-----|
| | B.2.3 | Assessment of students' learning - Case Study 2 | 339 |
| B.3 | RESUL | TS OF CASE STUDY 3 | 341 |
| | B.3.1 | Main questionnaire results - Case Study 3 | 341 |
| | B.3.2 | Group questionnaires - Case Study 3 | 345 |
| B.4 | RESU | ILTS OF CASE STUDY 4 | 349 |
| | B.4.1 | Main questionnaire results - Case Study 4 | 349 |
| | B.4.2 | Group questionnaires - Case Study 4 | 354 |
| | B.4.3 | Assessment of students' learning - Case Study 4 | 358 |
| B.5 | TABLE | ES OF COMPARATIVE RESULTS ACROSS CASE STUDIES | 360 |
| | B.5.1 | Group composition - comparative | 361 |
| | B.5.2 | Experiences of working in groups - comparative | 362 |
| | B.5.3 | Learning in groups - comparative | 363 |
| | B.5.4 | Facilitation and language - comparative | 364 |
| | B.5.5 | Use of JAD - comparative | 365 |
| | | | |
| Арр | endix (| C: JAD Exercises | 366 |
| C.1 | JAD E | XERCISE EXAMPLE - THE LIBRARY - CASE STUDY 1 | 366 |
| C.2 | JAD E | XERCISE EXAMPLE - THE LIBRARY | 367 |
| C.3 | JAD E | XERCISE EXAMPLE - THE GROCERY STORE | 368 |



List of Figures

| 1.1 | Research approach used |
|-----|--|
| 1.2 | A Road map to the thesis |
| 2.1 | An IS research framework for in-context research |
| 2.2 | The Critical Social Theory and Practice Change Process |
| 2.3 | Methods to use for in-context IS research |
| 2.4 | The process of action research |
| 4.1 | Uses for JAD in the Systems Development Life Cycle |
| 4.2 | A typical JAD room |
| 7.1 | Convergence process |
| 7.2 | Actor-network group decisions - process variables |
| 7.3 | The actors in the JAD workshop |
| 7.4 | An actor-network framework for the use of JAD in industry |
| 8.1 | Layout of the classroom |
| 8.2 | Actors in the learning environment network |
| 8.3 | The JAD workshop in the classroom |
| 8.4 | A framework for the use of JAD in the classroom |
| 8.5 | A revised framework for the use of JAD and co-operative learning |
| | in the classroom |
| 8.6 | Framework for the use of JAD and co-operative learning in |
| | a classroom with diverse students |
| 9.1 | A framework for the use of JAD and co-operative learning in the |
| | classroom |
| B.1 | Scatter plot showing pre- and post-test results - Case Study 2 340 |
| B.2 | Scatter plot showing pre- and post-test results - Case Study 4 359 |



List of Tables

| 3.1 | A federated framework for ISD |
|------|--|
| 3.2 | Capabilities and knowledge expected for IS program graduates 67 |
| 0.4 | 0 |
| 8.1 | Overview of Case Studies |
| 8.2 | Circles of learning method and JAD method |
| 8.3 | Cross-tabulation of pre- and post-test results - Case Study 2 203 |
| 8.4 | Cross-tabulation of pre- and post-test results - Case Study 4 |
| | |
| 9.1 | A comparison of suggestions from social constructivist learning theory |
| | and the learning environment developed |
| | |
| B.1 | Group processing at time 1 and time 3 |
| B.2 | Observer versus self evaluation of group processing - Time 3 337 |
| B.3 | T-test results for marks for Use-Cases |
| B.4 | Group processing evaluation - self and observer |
| B.5 | Group processing at time 1 and time 3 |
| B.6 | T-test results for marks for Use-Cases |
| B.7 | Comparison of composition of students across four case studies 361 |
| B.8 | Comparison of group experiences over the four case studies |
| B.9 | Comparison of learning in groups across the case studies |
| B.10 | Facilitation and Language - comparison across the case studies 364 |
| B.11 | Usefulness of JAD - comparison across the case studies |