THE INCORPORATION OF ACTIVITY-BASED LEARNING AND REFLECTION INTO A NEW INFORMATION SYSTEMS DEVELOPMENT PRACTICE FRAMEWORK FOR BOTSWANA

By

Tjongabangwe Selaolo

Submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy (Information Technology)

in the Informatics Department

Faculty of Engineering, Built Environment and Information Technology

Supervisor: Prof Hugo Lotriet

Date: 20th June 2012

Contents

DECLARATION vi
ABBREVIATIONS vii
ACKNOWLEDGEMENTS ix
ABSTRACT xi
1 INTRODUCTION AND SCOPE OF THE RESEARCH 1
1.1 Introduction 1
1.2 Botswana ISD Practice as context to the Research 2
1.3 Research motivation, problem statement and questions 4
1.4 Research design and methodology 6
1.5 Contribution of this research 8
1.6 Chapter and Content Analysis 9
2 THEORETICAL UNDERPINNING – CULTURAL-HISTOICAL ACTIVITY THEORY. 11
2.1 Introduction 11
2.2 Activity Theory History 11
2.3 Activity Theory – Key Principles 16
2.3.1 Activity System as the Unit of Analysis 16
2.3.2 Historicity of Activity 17
2.3.3 Multivoicedness of an Activity System 21
2.3.4 Internal contradictions 21
2.3.5 Expansive transformation of Activity Systems 23
2.4 Conclusion 24
3 LITERATURE REVIEW ON ISD PRACTICE AND LEARNING 25
3.1 Introduction 25
3.2 An Activity based view of Information Systems Development (ISD) 25
3.2.1 Historical Evolution of Information System Development Practice in General and in Activity Theoretical Terms 27
3.3 Learning 33
3.3.1 A Heuristic Model for Analysing Learning in Current ISD Practice 34
3.3.2 The Case for Situated Learning for Analysing the Collaborative Redesign effort 39
3.3.3 Two representative practice based theories 41
3.3.4 Lave and Wenger's – Legitimate Peripheral Participation 42
3.3.5 Engeström's Expansive Learning Theory 47

3.3.6 Expansive Learning Studies from Literature 54
3.3.7 Expansive Learning Theory as a framework for analysing learning during collaborative design of a new ISD practice for Botswana 59
3.4 Conclusion 60
4 RESEARCH DESIGN, METHODOLOGY AND DATA 62
4.1 Research Design Framework 62
4.2 Research Questions and the Unit of Analysis 67
4.3 Data Collection 70
5 CURRENT BOTSWANA ISD PRACTICE 76
5.1 Introduction 76
5.2 The Current Botswana ISD Practice Model 76
5.3 The Case Project 78
5.3.1 The PEX Organisational Background 78
5.3.2 PEX Project Conceptualisation 81
5.3.3 Project Management Process 82
5.3.4 PEX system requirements 84
5.3.5 Design and Development 86
5.3.6 Post-Implementation Support 91
5.3.7 Post Implementation Review 91
5.4 Conclusion 99
6 COLLABORATION IN ISD PRACTICE REVIEW AND REDESIGN 101
6.1 Introduction 101
6.2 Learning action 1 - Questioning 102
6.3 Learning action 2 – Analyses of Historicity, Contradictions, and Learning 106
6.3.1 Historical Analysis 106
6.3.2 Analysis of Contradictions 110
6.3.3 Analysis of Learning 120
6.4 Learning action 3 – Modeling the new solution 124
6.5 Learning action 4 – Examining the new model 130
6.6 Conclusion 137
7 CONCLUSION AND FINAL THOUGHTS 140
7.1 Introduction 140
7.2 Evaluation of Contribution 140

7.2.1 Contribution to (ISD) Practice 141
7.2.2 Theoretical Contribution 142
7.3 Methodological Contribution 144
7.4 Research Limitations and Opportunities for Future Research 146
7.5 Final Thoughts 148
References and Bibliography 150
Appendix A – PIR User Interview Guideline I
Appendix B – PIR COX Team Interview Guideline II
Appendix C – PIR COX – LEAD DEVELOPER Interview Guideline IV

List of Figures

Figure 1: The research design framework 7
Figure 2: (A) Vygotsky's model of mediated act and (B) its common reformulation (Engeström (2001, p. 134) 11
Figure 3: The Structure of a human activity system (Engeström, 2001, p. 135) 13
Figure 4: (Leontiev's) Hierarchical nature of activities, actions & operations (adapted from Jonassen and Rohrer-Murphy, 1999, p. 63) 13
Figure 5: Two interacting activity systems (Engeström, 2001, p. 136) 15
Figure 6: Historical Forms of work (adapted from Victor & Boynton, 1998) 18
Figure 7: Four Levels of contradictions in a network of activity systems (Pg 4, Centre for Activity Theory and DWR Research, Helsinki website 03.08.2011) 23
Figure 8: ISD Historical Evolution - Social Actors & Technology Changes (Adapted from Avison and Fitzgerald (1988, p. 11) 29
Figure 9: Strategic learning actions and corresponding contradictions in the cycle of expansive learning (Engeström 2001, p. 152) 53
Figure 10: Developmental Work Research Schematic / Design (adapted from Engeström, 1999, p. 7) 64
Figure 11: The Current Botswana ISD Practice Model 77
Figure 12: PEX Functional Structure 79
Figure 13: PEX Project Structure 83
Figure 14: Design and Development process for the PEX system 87
Figure 15: Current Botswana ISD Network of Activities 105
Figure 16: Historical Development of Botswana ISD Practice from 1969-1995 to 1995-now 110
Figure 17: Representation of Primary and Secondary Contradictions 117
Figure 18: Historical and Hypothetical Analysis of Contradictions in Current ISD Practice 119
Figure 19: Learning Evaluation Checkpoints in the New ISD Process 126
Figure 20: Learning Evaluation Checkpoints in the Design Process 127
Figure 21: Reflecting on Learning 128
Figure 22: New ISD Activity System 129

List of Tables

Table 1: Historical structure of activity by Leontiev (Engeström 1990, p. 197) 14
Table 2: ISD Practice Evolution by Time Period 30
Table 3: Acquisition Learning and Formalised Learning Summary 37
Table 4: Research Questions Summary 70
Table 5: Research Data Summary 74
Table 6: PEX Staff Profile 80
Table 7: Profile of Functional Users involved in the PEX Project 84
Table 8: Division of Labour for the Developer Team 87
Table 9: PEX System Functionality 89
Table 10: PEX Project Review Scope (from PIR Report, 2008, pg 7) 92

Table 11: Users and Developers PIR Responses on Learning 96
Table 12: Botswana ISD Practice Historicity Summary 107
Table 13: Summary Perspectives of Current Challenges 111
Table 14: Learning Analysis based on Rogers (2003) classification – 'Task' Conscious Learning or 'Learning' Conscious Learning 121
Table 15: Summary of suggested Improvements 125

DECLARATION

I declare that the thesis which I hereby submit for the degree of Doctorate in Philosophy (Information Technology) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

SIGNED: _____

DATE: _____

ABBREVIATIONS

AT	Activity Theory
ATIG	Activity Theory Interest Group
BCL	Boundary Crossing Laboratory
CHAT	Cultural Historical Activity Theory
CL	Change Laboratory
CoP	Community of Practice
COX	Company X
CSF	Critical Success Factors
DFD	Data Flow Diagrams
DIT	Department of Information Technology
DWR	Developmental Work Research
ELT	Expansive Learning Theory
GIT	Government IT
GITREP	Government IT Representative
GUI	Graphical User Interface
ICT	Information & Communication Technologies
IS	Information System
ISD	Information Systems Development
ISDM	Information System Development Methodologies
IT	Information Technologies
ITSP	Information Technology Solution Provider
LPP	Legitimate Peripheral Participation
MCST	Ministry of Communications Science & Technology
MTC	Ministry of Transport & Communications
NDP	National Development Plan
OECD	Organisation for Economic Cooperation and Development
PEX	Public Entity X
PIC	Project Implementation Committee
PID	Project Initiation Document

PIR	Post Implementation Review
PMS	Performance Management System
PMBOK	Project Management Body of Knowledge
PRINCE2	Projects in a Controlled Environment 2
RAD	Rapid Application Development
SOUR	Statement of User Requirements
UAT	User Acceptance Testing
VB	Visual Basic
WAN	Wide Area Network

ACKNOWLEDGEMENTS

A learning journey such as the one presented in this study could not have been possible without the significant contribution of several people. I therefore wish to take this opportunity to thank and acknowledge them for the success of this study. First and foremost, my supervisor Professor Hugo Lotriet who introduced me to activity theory (way back in 2006) and also guided me through the difficult and challenging five years of this study. The confidence that he had and instilled in me made it possible for me to see it through to the end.

I wish to also thank the three external examiners Professors' Carina de Villiers, Susanne Bødker, and Sampsa Hyysalo for their sincere and direct contributions to improving the quality and depth of this final product.

I was fortunate enough during the course of the study for having been at the right place in the right time when in 2007, I attended the IRIS30 conference which was held in Tampere, Finland. It was there that I met Dr. Mikko Korpela, who took a great interest in my study and also later introduced me to Professor Paul Nleya who is the chairperson of the Activity Theory Interest Group (ATIG) in Botswana. I thank Mikko for his interest and continued support of my work. Through Professor Nleya, I was allowed membership into the ATIG and was also fortunate to then participate in a seminar facilitated by Professor Reijo Miettinen on 'The foundations of activity theory and its application to the study of development of school' which was in April-May 2008 at the University of Botswana. This added immensely to my understanding of the basic activity theory (AT) concepts and more specifically, to their relationship to learning. The ATIG played a significant role in supporting my study as not only did the members attend the change laboratory sessions, but also assisted in the organisation of the sessions as well as the videography. For the videography, I wish to give special thanks to Nicodemus Merafhe, a member of the ATIG, who volunteered his time to take the video, edit it and provide me with video data set that I later transcribed for analysis.

This study would not have been possible without the approval by the Government of Botswana and more specifically, the approval by the then Ministry of Communications,

Science and Technology (MCST). Special thanks, therefore, go to the then Permanent Secretary of that Ministry, the late Marianne Nganunu, her deputy Mrs Alicia Mokone and the then Director of the Department of Information Technology (DIT), Mrs Joyce Mpete. Joyce not only facilitated the approval of the research, but also became an active participant in the study by according me time for interviews and also directly participating in the change laboratory sessions. I thank her especially for that support and also her expressed desire to see a change in Information System Development (ISD) practice that would result in sustainable development and deployment of information systems facilitated through learning. I strongly believe that the redesigned ISD framework for Botswana will go a long way to addressing that challenge.

Participants in this study were drawn from both the government and private sector. I wish to specifically thank representatives from the following government departments: Department of Agricultural Research, Ministry of Education and Skills Development, Botswana College of Distance and Open Learning (BOCODOL), Department of Curriculum Development, Department of Building & Engineering Services, Department of Water Affairs and the Department of Information Technology. The private sector companies that I wish to thank and acknowledge for their participation are: Consult IT, Corporate Business Solutions (CBS), De Chazal Du Mee Consulting (DCDMC), and Tata Consultancy Services (TCS). I specifically wish to thank Mr Dominic Ferguson (Consult IT) and his staff for agreeing to the extensive interviews and follow ups that were needed as part of the data collection.

Last but not least, I wish to thank my family (husband Dr Edson Tsiababa Selaolo (PhD) and sons Bokani and Karabo) for standing by me throughout the course of this study. They never once complained that between my work and studies I had very little quality time to spend with them, but instead, they encouraged me to carry on until completion. I reserve special and heartfelt thanks to Edson for not only assisting with the editorial work but also pushing me to focus and complete my studies. It is to him that I dedicate this work. His love and support have carried me through the challenges that this study presented.

ABSTRACT

Studies whose focus is finding solutions to practical IT implementation issues / problems such as slow systems uptake and meaningful work improvement are few. This thesis describes how IS practitioners from government and the private sector, together with users came together to redesign the current Botswana ISD work practice in order to address this shortcoming. The result has been the incorporation of activity-based learning and reflection in current ISD practice.

The study adopted Cultural Historical Activity Theory (CHAT) as the framework of analysis as well as the associated Developmental Work Research (DWR) methodology as the research method. An expansive learning cycle was stimulated through change laboratory sessions with participants from government and industry.

The general research question for the study is: '*How should ISD as a systemic work activity be carried out to facilitate effective learning?'* The four sub-questions the thesis focuses on are: '(1) *What constitutes Botswana's ISD practice or how is ISD currently practiced in Botswana?* (2) *What are the users and developers learning and is the learning effective?* (3) *How can current practice be improved in order to facilitate effective learning?* (4) *What do users and IS professionals learn when collaborating in the review and redesign of ISD practice?'*

The study was qualitative in nature and data collection was based on interviews, archival data, observations as well as data from change laboratory sessions. Data from the change laboratory sessions was video-taped and later transcribed for analysis. Though I used CHAT as the main theoretical tool for analysis of ISD and learning, I also used additional theoretical concepts on learning to assist with the analysis and redesign of new practice. These are concepts relating to two types of learning that are found in any setting or environment i.e. conscious / learning conscious learning and unconscious / task conscious learning as well as concepts relating to reflection-on action.

Analysis of learning in current Botswana ISD practice shows that current learning is not effective because it does not provide the right balance between conscious and unconscious learning. Current learning tasks are predominantly geared towards

unconscious learning. The solution to this practical learning problem, which constitutes improvement to practice, is the incorporation of activity-based learning and reflection through the introduction of learning evaluation checkpoints throughout the ISD process. Furthermore, during the collaborative redesign sessions it emerged that: 1) learning was collective and distributed agency and 2) learning was expansion of the object in multiple dimensions.

The study makes both theoretical and practical contributions. The theoretical contribution is through the application of learning concepts such as the two types of learning (i.e. conscious and unconscious learning) and expansive learning to the review, analysis and redesign of ISD practice with the participation of representatives from government and the private sector. In terms of the practical contribution, a new Botswana ISD practice model that incorporates activity-based learning and reflection has been designed, and findings from examination of the model suggest that it has potential to address current learning deficiencies and thus contribute to efforts of avoiding IS failures.

Key words: change laboratory, cultural-historical activity theory, information systems development, learning, reflection.