# *Chapter 8: Conclusion*

This is the concluding chapter of this thesis. From its beginning, I took up the challenge to investigate computational problems associated with the intertwined issues of distribution of activities and human mobility. This thesis is the product of an extensive and in-depth investigation of computing with contemporary portable computers in a real-life distributed and mobile activity. From the outset, it has been my unwavering aim to unearth the intricacies of this real-life phenomenon from an academic viewpoint. Within this frame, my motive throughout the study was to explore this phenomenon within the context of sanctioned human activities to bring to light the essential and constraining attributes related to the distribution of an activity and their impact on computing.

Here, I round up the outcomes of the thesis – my arguments and submissions of the preceding chapters. First, I present a brief synopsis of the entire thesis and its key arguments in Section 8.1. In Section 8.2, I outline my outstanding contributions made so far from this study. Following this, I discuss the study limitations and suggestions for future research in Section 8.3. Finally, I make a few concluding remarks in Section 8.4.

## 8.1 Thesis Synopsis

Chapter 1 is the introductory chapter in which I outlined the architecture of this thesis by addressing the crucial research issues which confronted this study. These issues consist of the past and contemporary precursors upon which the objectives of this study were derived, as well as the rationale for embarking on this study. In this chapter, I also outlined my inspiration for engaging myself and my resources in this research endeavour. Following this, the scope of the study and the main question of *how the phenomena of mobile computing and the distribution of work-integrated learning mutually shape each other* were presented. This presentation entailed a brief introduction of the empirical case and an outline of the research objectives.

In Chapter 2, I undertook a comprehensive review of the relevant literature of the key areas – learning, mobility and portable ICTs – upon which an understanding of the problem could be derived. I began with the under-researched area of mobility and portable ICTs, placing the pieces of assertions by various researchers together with an aim of building a holistic theoretical understanding of the relationship between human mobility and the use of portable ICTs. Next, the problem or learning was placed under review through an assessment of the various perspectives which have attempted to tackle the multidimensional problem of human development. Piaget's cognitive development as a typical form of individual learning is the starting point of this review. This leads to the counter arguments of Vygotsky who explained development from a social constructivist perspective, and which work-integrated learning exemplifies. I explored other differing viewpoints such as Wenger's Communities of Practice, Miller's Information Processing, Bandura's Social Learning and Kolb's Experiential Learning, and ultimately argued that learning is inherently social. The sociality of the learning process is, hence, applied in a review the usefulness or otherwise of mediating ICTs in contemporary learning activities.

Chapter 3 is the methodology chapter in which I detailed how the empirical study was approached and operationalised. It involved brief explanations of the two main philosophical strands of scientific inquiry – positivism and interpretivism – and subsequently justifications for my choice of the interpretive philosophy. Following this, I outlined the research design as the structure for the operationalisation of the empirical study. The design consisted of justifications for an action research strategy, qualitative evidence, several qualitative data collection techniques such as interviews, conversations and documents. Finally, the techniques and tools which were used in the interpretation of the data were briefly presented.

In Chapter 4, the analytical lens applied in addressing both the empirical and theoretical aspects of the study was also reviewed. I perceive work-integrated learning as a human development endeavour and therefore adopted the Theory of Activity as an analytical lens to conduct this study. This chapter thus presented a detailed commentary on Activity Theory which depicts its developmental psychological principles and its suitability as a theoretical framework for analysing the empirical and theoretical findings of this study. In later sections of this chapter, the principle of

mediation by signs and instruments is integrated into the concept of affordance to show how the various human sense organs function in the perception of affordances of ICTs when they are engaged in the performance of activities.

In Chapter 5, I presented the findings of the empirical work – the study of mobile computing in the WIL activities of the PSP. This is a detailed presentation of the relevant data from an action research conducted within the real-life experience of health professionals trying to derive learning support benefits from PDA applications. In this chapter, I told a story of three continuous stages of use of three different applications, and ultimately, the failure of the technology to satisfy its predetermined purposes. Following this, the key findings – marginalisation of technology and problematic learning conditions – which largely contributed to the technology failure were presented, and led to the analysis of the findings in Chapter 6.

The analysis of Chapter 6 began with the dissection of the WIL into a system of activities comprising of a central activity of the learners and neighbour activities such as the culturally more advanced activity of the instructor, the object activity of the surgical team, the instrument-producing activities which gave birth to the PDA and its applications, and the rule-producing activities which established the administrative set-up of the project. The mutually reinforcing and contradictory relationship between the motives of the central and advanced activities becomes the starting point of this analysis. Upon this, the sense made of the artefact within parameters such as its design properties, mobility, distance and distribution, control and the politics of technology use are teased out. Based on this sense-making, the reconstruction of the PDA is analysed as a factor of the mobility of computing services. Analysis culminates in the development of a conceptual model of human mobility and flexible computing which depicts a paradoxical relationship between the two phenomena.

The discussions of Chapter 8 was a corollary of the analysis of Chapter 7. In respect of the findings and implications of the previous chapter vis-à-vis the research question, it was imperative that the problems of distribution of an activity be properly teased out at an abstract and general level of discussions. *How constraining is distribution* became the pervading problem underpinning these discussions. The constraints were directly sourced from the contradictions between advanced and

central motives, and impliedly, how these contradictions could potentially induce a power struggle between the authorities of any two locations within which workers and learners act. It is predominantly argued that the *balance of control* between these authorities which are exerted on the actions of individuals determined the extent of computing actions by those individuals. In these discussions, I made several arguments, submissions and propositions on distribution and technology use which serve as my key contributions to the advancement of Information Systems.

## 8.2 Research Contributions

At this point, it is necessary to summarise those aspects of this thesis which I consider to be original and novel, which satisfy the criterion of what is termed as "original thought" in the scientific realm, and which are henceforth subject to scrutiny and verification. It must be quickly pointed out that "original" in no way suggests my non-reliance upon the knowledge that other scientific researchers before me have built. Our sense of "original" here rather denotes what new knowledge contribution has been made, and has an implicit connotation of a furtherance of existing knowledge. The utilisation of the principles of the theory of activity in analysing the findings of this study, for example, bears testimony to this unavoidable reliance. These contributions may be summarised as follows:

- Elucidation of the paradoxical relationship between human mobility and flexible computing, based on the strength of immediate control exerted over actions;

- Exposition of the reconstruction of portable ICTs based on drift in utility between the satisfaction of objective and personal motives;

- Revelation of the metacontradictory nature of distributed activities through the identification of locational contradictions as mediators of the contradictions between central and advanced activities; and consequently,

- Proposal of a new model of distributed activity to address the dynamics of workers' or learners' actions in contemporary technology-mediated distribution of work and learning.

For practitioners, these arguments, founded on an empirical study of a real-world adoption and deployment of portable ICTs for distributed learning, can serve as viable guidelines in their adoption and deployment of portable ICTs for the enhancement of learning and skill development of their employees.

For designers of mobile technologies – hardware and software – the insights provided by this research are a rich source of invaluable feedback as far as their design efforts are concerned. Such feedback will eventually result in better or enhanced products useful for tackling societal problems.

### 8.3 Limitations and Future Research

Amid the effort that went into the achievement of the contributions above, the inevitable deficiencies of the study have to be honestly recognised.

The first limitation is derived from the limits of strategy adopted for the inquiry, namely Action Research. Doing Action Research implies conducting idiographic research, which is the empirical study of one single event in a complex world of multiple and interrelated events. The multiplicity and interrelatedness of empirical events suggest that emphasising certain features of an event and overlooking or neglecting others in idiographic research is inevitable. Although idiographic research is generally more comprehensive and in-depth than its nomothetic equivalent, it lacks the advantages of repetition and wider coverage of multiple events which are the norms in nomothetic research. Thus, generalisations from nomothetic research are perceived as more valid than those which emerge from idiographic research; and verification is seen to be unproblematic. However, idiographic research has the advantages of depth and thoroughness of inquiry which are lacking in nomothetic research. And within social science research which this study epitomises, the need for in-depth and comprehensive research of a phenomenon in its context is a necessary requirement. The wider coverage of nomothetic research disregards context, but context is the utmost strength of idiographic research. This strength notwithstanding, I acknowledge the limits of the action research strategy upon which the findings of this study were founded. I also accept that the unique contextual characteristics of every

event or phenomenon may undermine the testing and verification of my general submissions.

The data collection process was also devoid of observations of mobile computing by the PSPs. In such a study, direct evidence of the users' comfortability or frustration with mobile computing in the activity should have been the ideal. I consider the absence of an ideal situation as a problem; and therefore this problem was a significant limitation of the study. As I have already explained in Chapter 3, the legal and ethical implications surrounding the study of health workers in hospitals made it virtually impossible to conduct these direct observations.

Third, in tackling the problem of mobile computing in an activity, another ideal scenario would have been an analysis of the impact of mobile computing in the achievement of learning outcomes. Furthermore, one may argue that this impact would have served in better describing the problem of mobile computing in WIL. As it stands, this study only concentrated on the learning processes and not the outcomes. The outcome of the PSP project was to be determined only in the long-term future and not within the time frame of this study. Given its nature, the outcome would be measured against the criteria such as acceptability by medical professionals, successful assumption of junior doctors' roles and successful delivery of peri-surgical patient care. These criteria are long term yardsticks and not short term. Thus the cognitive aspect of skills acquisition was only a first step towards the achievement of the long-term outcomes. And as far as the long-term was concerned, the time frame of the empirical aspect of this research was some distance away. We are talking here of outcomes which can be appropriately measured at least five years from now, perhaps; and obviously, this study, although a longitudinal one, could not be stretched to cover this period. This implies that the role of the PDAs in the PSPs construction of professional identities, for example, could not be included in the analysis. And in this light, the temporal remoteness of the learning outcomes was a significant limitation in this study.

The problems of non-connectivity of the PDAs to the internet also effectively ruled out any consideration of mobile interaction in the WIL activity. This limitation ensured that only mobile computing could be given proper consideration in the study.

All these limitations present further challenges for future research endeavours into portable technology use in distributed and mobile settings.

### 8.3.1 Future Research Challenges

Circumstances permitting, the study of mobile computing and interaction in a distributed and mobile activity will provide a more holistic picture of the complexities involved in use. It has to be warned, however, that each of computing and interaction are broad sub-areas in technology use which will require a more comprehensive study; and may therefore require more resources to accomplish.

Furthermore, the challenge about the impact of mobile computing and interaction on learning outcomes can also be taken up to espouse the efficacy of these artefacts. Again, a true picture of the impact can only be obtained through a study of both the process and outcome of learning, which represents a more comprehensive task.

Future researchers of mobile computing and interaction must strive to conduct observations – direct and indirect – of technology use during activity. This is an important requirement, which, as far as the limitations of this research are concerned, can fulfil the requirements of building a more holistic evidence of activity-related problems of mobile computing and interaction.

## 8.4 Concluding Remarks

Although the limitations and future research pointers above leave many problems unaddressed, I have spent time to detail and stress my main points which represent the achievements of the objectives which I set at the beginning of this thesis. I could not study the whole world, but I fully admit the unavoidable shortcomings of this study, and I also accept that my arguments and submissions are no more than the first steps in a new direction of understanding technology use in a distributed activity. Yet, I believe that in unearthing the problems inherent in the mutual shaping between distribution of activities and technology use as a central issue in contemporary work and learning, I have made a significant contribution to progress in this area. In spite of this, I am not beyond reproach: I leave my ideas in this thesis to the unqualified scrutiny of all readers and critics. However, while I may be reproached about any

arguments made in this thesis, I do not dread any reproach, because my confidence is grounded on objective interpretations and scientific analyses of my findings.