1   INTRODUCTION AND SCOPE OF THE RESEARCH

1.1   *Introduction*

This research study is my personal journey of learning and exploration. Ever since crossing over from 'formal' teaching (as a high school mathematics teacher) to being an Information Systems (IS) professional and involvement in Information System Development (ISD) initially as a programmer / analyst in a government environment and now as a consultant, I have often wondered whether a lot of issues around IS failures and slow system uptake by users could not be addressed through effective learning, that is learning not just about the final technical artefact that has been developed, but also the potential innovative capacity that the Information Technology (IT) tool brings into work practice improvement. Effective learning can be achieved, I believe, if the 'learners' are aware or conscious of the fact that learning is an outcome of the task or activity they are engaged in or even that they are engaged in a learning activity – which is certainly the case in a school environment. Hence the idea of this research study was born – to study learning in ISD and more specifically to explore how effective learning can be achieved within ISD.

The research was carried out in the context of a developing country, Botswana, which like most countries recognises the strategic value of Information and Communication Technologies (ICT) and their potential to spearhead socio-economic development. There is, however, a dearth of practical IS research in the country and this is meant to address that.

The research, which adopts the developmental work research methodology, uses cultural-historical activity theory (CHAT) principles and framework for analysing current Botswana ISD practice as a work activity. CHAT or activity theory (AT) was chosen as the framework of analysis because it combines concepts of work development with learning which fits well with my research interests. In order to retrospectively analyse the effectiveness of learning in current practice, I have adopted the view of Rogers (2003) and Malcolm et al., (2003) that effective learning can be achieved if we have the right balance between unconscious (task conscious) learning and (learning) conscious learning,

which they claim are the two types of learning that are found in any setting (i.e. work or school). This view is also consistent with the components of an activity as defined by CHAT, in that an activity comprises of conscious actions and unconscious operations (Jonassen and Rohrer-Murphy, 1999; Yamagata-Lynch, 2003; Engeström, 2003; Engeström and Sannino, 2010).

Furthermore, through a collaborative redesign effort between government and private sector representatives made up of IS professionals and users, a new ISD practice model is developed that seeks to enhance learning within current practice. Analysis of the learning that takes place during this redesign effort was performed using Engeström's (1987) expansive learning cycle.

1.2   *Botswana ISD Practice as context to the Research*

Before presenting the problem statement, it is essential that some background information is provided on Botswana to set out the (social) context. Botswana is a self-governing, independent country that attained its independence from British rule in 1966. It is a landlocked country, with semi-arid climate, spanning 582,000 square kilometers and borders Zimbabwe, South Africa, Namibia and Zambia. Botswana has had one of the fastest growing economies in the region and prides itself in prudent economic management. In order to achieve this, Botswana has since independence being guided by successive National Development Plans (NDP) that normally span a six year period. The guiding principles for these plans which echo the interest areas for this research (bolded part), are stated as:

> '… *all human beings are born free and equal in dignity and rights'; 'the right to development is a universal and inalienable right and an integral part of fundamental human rights'**; the human person is the central subject of development;**, 'human beings are at the centre of concerns for sustainable development'; and that 'sustainable development as a means to ensure human well-being, equitably shared by all people, today and in the future, requires that the interrelationships between population, resources, the environment and development should be fully recognized, properly managed and brought into harmonious and dynamic balance'.* (Botswana NDP9 (2003 – 2009), p. 13)

The starting point for this research is that even at the micro level of ISD projects the 'human person should be the central subject of development'. Therefore a by-product of the ISD activity should be 'human development' which can be achieved through an effective learning process. Amongst the major policy thrusts of NDP 9 was the issue of public sector reform through such programmes as Performance Management System (PMS) and computerisation intended to make the public service more efficient. In order to guide these computerisation efforts, Botswana developed a National ICT policy, which notes that:

> *'The Government of Botswana is committed to developing a National Information and Communications Technology (ICT) Policy that will build on recent government initiatives and assist in achieving Vision 2016. In keeping with Vision 2016, it is envisioned that the National ICT Policy will position Botswana for sustained growth in the digital age by serving as a key catalyst in achieving social, economic, political and cultural transformation within the country'.* (Botswana National ICT Policy, p.2, 2005)

The policy Vision states that:

> *'Botswana will be a globally competitive, knowledge and information society where **lasting improvement** (bolding mine) in social, economic and cultural development is achieved through effective use of ICT'.* (National ICT Policy, p.3, 2005)

In the context of the Government of Botswana (GoB), the responsibility to develop policy and standards for deployment of ICTs in government resides with the Ministry of Communications Science and Technology (MCST) and more specifically the Department of Information Technology (DIT). A typical ISD project in the Botswana government will normally follow the ISD process as defined by Korpela et al., (2002) i.e. with four key phases: analysis, design, build and implementation. All phases are supported by project and process management. In terms of the current ISD practice for large scale projects, Government departments often procure services of an independent consulting firm to carry out the analysis work. The analysis work usually entails business process review, review of any existing systems (i.e. manual / automated and if automated this would normally include a review of the underlying technology), requirements elicitation, requirements specification that includes information processing and management,

infrastructure, training and aspects of data conversion. This specification document, known as the Statement of User Requirements (SOUR), is written in a simple business, non-technical language and used as a basis for identification and selection of an IT Solution Provider (ITSP), to supply a package solution and associated customization / implementation services or to develop the solution from scratch, as would have been determined during the Analysis phase. Because of the nature of the analysis brief, in most cases the consulting team from the 'analyst firm' would necessarily include a subject-matter expert (e.g. a roads engineer, transport management economist etc.) to assist with the 'learning and understanding' aspects by the team. In some cases, the consulting team that was engaged in developing the SOUR is engaged to provide project management services that entail supervising the ITSP during the development and implementation of the solution. This situation arises mainly when the client wants to benefit from the technical ISD understanding of the 'analyst firm'. It's important to note that in terms of this model, it is possible that the 'analyst firm' and the ITSP may use different ISD methodologies and techniques. This in some instances presents a challenge for users as the technical 'mediating tools' may differ.

1.3   *Research motivation, problem statement and questions*

ISD projects provide a good opportunity for learning / development of all stakeholders on the nature of IS and its potential for work improvement as it involves or should involve broad and extensive stakeholder consultations. This position is supported by Avgerou (2000) when distinguishing between the 'software engineering' and 'social perspectives' of systems development:

> *'Viewed from a social perspective, the development process is an intervention in an organisation to change the technical means and the information available to people's work. Such a perspective of the systems development process emphasises the importance of understanding the social dynamics that accompany the building or adopting of the technical systems and the organisational and social change related with the systems development project. **What matters in this approach is the improvement of the capacity of people to perform their work tasks in the context of their organisation.*** (Bold mine, for emphasis)' (Avgerou (2000, p. 569))

The importance of learning in ISD cannot be overstated and Wastell (1999) contends that:

> '… *an effective learning process is critical to the success of ISD… inadequate and superficial learning lies behind much IS failure (Lyytinen and Robey, 1998) and that the major problem in ISD is "limited learning, i.e. the limited capability to reflect upon and reframe the institutional and cognitive grounds that support habitual ways of doing things" (Ciborra and Lanzara 1994)'.* (Wastell (1999, p.581-582)

Wastell (1999) points out that the socio-technical nature of IS projects contributes to their complexity, high levels of risk and uncertainty. This is in part due to the need to accommodate interests of multiple stakeholders and the exacting cognitive demands associated with such initiatives. Learning is therefore important to address the complexities in IS projects. On the issue of what the social actors should learn, Wastell (1999) states that:

> '*Normatively speaking, ISD is a process of organisational change in which IT systems are designed and deployed to enable more effective operational practices. To bring this about, the prevailing business paradigm must be questioned with goals, processes, and roles considered afresh in the light of new technological potentialities. Both IS professionals and users must engage in an intensive learning experience, the former to develop a thorough understanding of the business domain, the latter to reflect on current practices and to acquire an understanding of the potential of IT to transform how work is done'.* (Wastell (1999, p.582)

In the 21 years that I have been involved in ISD projects in Botswana and the region, where mainly structured techniques with a mix of participatory techniques have been used, it has not been obvious that effective learning takes place. The manifestation of this problem has been slow systems uptake and minimal work improvement. Though there may possibly be other issues contributing to slow systems uptake and work improvement, non-learning is deemed to be the most critical. This research posits that if indeed effective learning does take place, it should result in higher system uptake and higher levels of work improvement. Thus my research interest is in trying to first of all understand if the current ISD practice which involves IS users, 'analyst firms', and 'developer firms' is resulting in effective learning. My problem statement reads as follows:

> *'The current Botswana ISD practice provides limited opportunity for effective learning'*

The research question derived from the problem statement therefore reads:

> *'How should ISD as a systemic work activity be carried out to facilitate effective learning?*

In terms of the sub-questions for this research, the following therefore arise:

- *What constitutes Botswana's ISD practice or how is ISD currently practiced in Botswana?*
- *What are the users and IS professionals learning and is the learning effective?*
- *How can current practice be improved in order to facilitate effective learning?*

A related question that arises from the above is:

- *What do users and IS professionals learn when collaborating in the review and redesign of ISD practice?*

1.4   *Research design and methodology*

This is a qualitative research study which has adopted Developmental Work Research (DWR) as the research methodology. As is explained in Chapter 4, DWR has been deemed suitable for this research because it is an interventionist approach that is based on CHAT concepts.

The current Botswana ISD practice description is mainly based on data from a single case project, deemed representative of ISD projects in Botswana, which was one of two projects I was engaged in at the time. This facilitated access to the project documents as well as the necessary permissions to carry out the research. I have augmented the selected case data for the initial scoping with archival data from other government reports as well as data from an interview with a representative of the government department responsible for ICT policy coordination and advice, which I have referred to as the Government IT (GIT). Further data was obtained from two change lab sessions that were held with

government and private sector representatives to analyse current practice, redesign a new model as well as examine the model prior to its implementation.

The study includes a review of literature on both ISD practice and learning, which are the two specific areas of research interest. The concepts reviewed as well as examples from similar research are used to inform the analysis of the case with regards to both ISD practice and learning. I have used concepts relating to 'conscious' and 'unconscious' learning to retrospectively analyse learning actions / tasks found in current practice and hence to come to a conclusion regarding the effectiveness of current learning. I further analyse the historicity of current ISD practice using such concepts as ISD methodologies (ISDM), technology and types of applications, social actors etc which I obtained from literature on ISD practice. The research design framework is depicted in Figure 1.
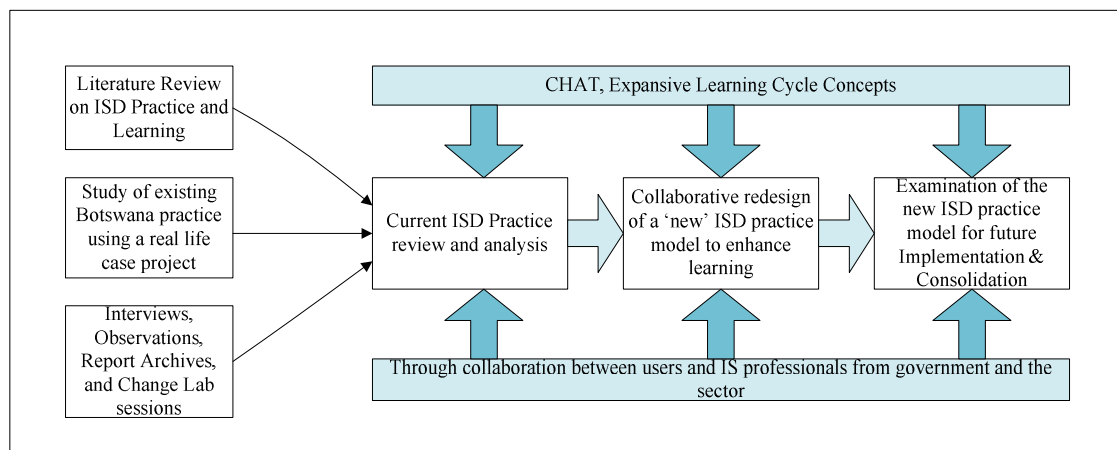

Figure 1: The research design framework

It is important to point out at the onset my combined roles; firstly as the researcher / interventionist, secondly as an IS professional who was involved in the case project as an analyst during the SOUR phase of the project, and thirdly as a Project Manager during the design, development and implementation phases of the case project. The subjectivity resulting from this involvement is acceptable for the choice of methodology and (critical) research paradigm adopted for this research (Pihlaja, 2005; Engeström, 2001). As much as possible during the course of the study I not only used my own personal observations

of ISD practice but also of other IS professionals in the field through interviews and discussions during the change lab sessions in order to enhance the validity of the findings.

1.5   *Contribution of this research*

My aim in conducting research was first and foremost to carry out research that is relevant and contributes to ISD practice. The practice contribution is threefold – firstly in providing an opportunity to Botswana IS professionals to reflect on current ISD practice as well as in redesigning and improving it. This is something that has never been done before in Botswana in a research context. Secondly, the redesigned ISD model is expected to improve practice as it is intended to enhance learning, thus contributing towards improved system uptake and avoidance of IS failure. Thirdly, the research study was expected to contribute towards learning of new ideas and concepts, such as activity theory by users and IS professionals who may not have been aware of these concepts, thereby closing the gap between academia and industry which is growing by the day.

In addition to contribution to practice, results of this research contribute to theory or scientific knowledge relating to information systems development practice and expansive learning studies. There are very few studies that address the topic of learning in ISD, especially based on studying practice in a developing country. A specific theoretical contribution is that the heuristic tool based on the two types of learning (i.e. conscious and unconscious learning) provides a useful tool to analyse learning retrospectively. A further contribution to knowledge is the lessons learnt in the application of activity theory concepts to the study of learning within ISD.

The methodology contribution is in also adding to other studies that have adopted DWR as a research methodology, especially in the context where both government and industry were viewed as participants. The challenges that such an undertaking brings is expected to inform future research. Furthermore, the use of a case project augmented by interview data rather than ethnography provides a new approach to carrying out such studies.

1.6   *Chapter and Content Analysis*

This research study is presented in seven (7) chapters with this introductory chapter outlining the scope, research context, objectives, and the research problem as well as motivation for the study. This first chapter also briefly introduced the research design and methodology as well as the contribution to practice and scientific knowledge (i.e. to theory and methodology).

The second chapter focuses on CHAT, which is the conceptual framework used to analyse current Botswana ISD work practice. The chapter surveys the historical development of activity theory starting from Vygotsky's original concepts of mediated activity to the work by his scholars Leontiev, Luria and others, through to the activity system and network of activities variations that were introduced by Engeström.

In Chapter 3, a literature review concerning the two specific areas of interest for the study is presented i.e. Information Systems Development practice and learning. The review covers key concepts and current thinking in these two subject areas and also provides examples of similar research.

In Chapter 4, the research design and methodology is presented. The chapter elaborates in detail the DWR methodology that has been adopted for this study. It also discusses the data as well as the theoretical concepts that were used for analysis for each of the research questions. The implications of my role as both researcher and IS professional who was involved as analyst and Project Manager for the case project is also discussed in this chapter.

The description of current ISD practice is provided in Chapter 5. The description is based on data from the case project, augmented by interview as well as archival documents. It is provided in the form of brief descriptions for each of the identified actions / tasks that constitute the current ISD work activity. The chapter also includes findings from the post implementation review that was carried out for the case project.

Chapter 6 presents findings and analysis of the epistemic learning actions following Engeström's expansive learning cycle. It elaborates on outcomes from the actions as well as the learning that resulted from those actions. More specifically, the chapter presents the new ISD practice model that incorporates activity-based learning and reflection.

The final chapter, Chapter 7, presents my final thoughts and conclusions on the study. It discusses the contributions as originally intended and what has actually been achieved. It also identifies areas for future research. My final thoughts are presented in the form of tracing my individual learning journey, which for me started 21 years ago when I moved from the classroom to the ICT industry.

2   THEORETICAL UNDERPINNING – CULTURAL-HISTORICAL ACTIVITY THEORY

2.1   *Introduction*

In this research study I use cultural historical activity theory (CHAT) concepts for analysis of both the ISD work activity as well as the learning that takes place during the practice collaborative redesign effort. Therefore, in this second chapter I present a brief account of CHAT from its cultural historical origins of the Vygotsky school to the activity system and network of activities developed by Engeström and is used in most mainstream activity based research.

2.2   *Activity Theory History*

Activity theory draws its roots from the philosophy of Kant and Hegel '… *which emphasised both the historical development of ideas as well as the active and constructive role of humans'* Leontiev (Jonassen and Rohrer-Murphy, 1999, p. 62). It is from this basis that the work of Vygotsky, and Engeström was developed, whose work forms the basis for the three generations of activity theory research (Engeström, 2001).
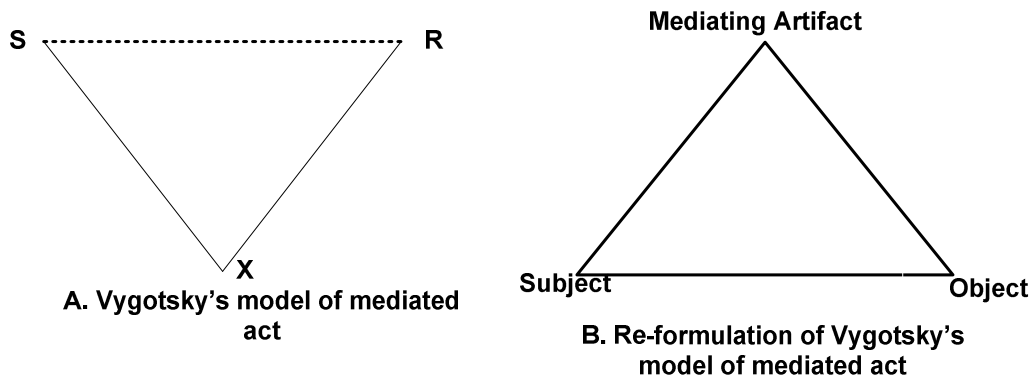

Figure 2: (A) Vygotsky's model of mediated act and (B) its common reformulation (Engeström (2001, p. 134)

The first generation of activity theorists, whose work and ideas were closely associated with the work of Vygotsky, focused extensively on the key concept of *mediation.* This was an attempt by Vygotsky to try and understand the relationship between individuals and their social environment. Vygotsky's theory was that individuals actively construct their understanding of

the environment while engaging in goal-oriented activities. According to Minick (1997) Vygotsky's motivation was that the traditional psychologists were incorrect in separating mind from behaviour in their efforts to investigate the flow of ideas, perceptions, and associations during activity. Vygotsky's contention about the separation of the study of human behaviour from mind and consciousness was that it was:

> *'simply the dualism of subjective psychology – the attempt to study a purely abstracted mind – turned inside out. It is the other half of the same dualism. There, there was mind without behaviour; here, behaviour without mind. And both there and here "mind" and "behaviour" understood as two different phenomena (Vygotsky, 1982, p.81).'* (Minick (1997, p. 119)

Activity theory was developed by Vygotsky's students and colleagues, including Leontiev and Luria, in the 1930s and early 1940s, to address this persistent issue of seeing mind and behaviour as separate and not as an integrated object of psychological research. This split between the Cartesian individual and the untouchable societal structure was addressed by these researchers through the insertion of cultural artefacts into human action.

Figure 2–A, is a pictorial representation of the relationship between stimulus (S) and response (R), which according to Vygotsky was transcended by '*a complex, mediated act*' and Figure 2-B, showing subject, object and mediating artifact is what is commonly used to represent Vygotsky's concept of cultural mediation of actions. According to Engeström (2001), based on this concept of mediation, we should no longer try to understand individuals in society outside of their individual agency in the use and production of artefacts nor outside of their cultural means. This therefore means that understanding the human psyche requires the understanding of object-orientedness of action.

The second generation of activity theory has centred on the work done by Vygotsky's student Leontiev (Engeström, 2001), who introduced the concept of collective activity in order to address a perceived limitation of the original Vygotsky model. The activity system as expanded by Engeström and incorporating the concept of a collective activity is shown at Figure 3 below.
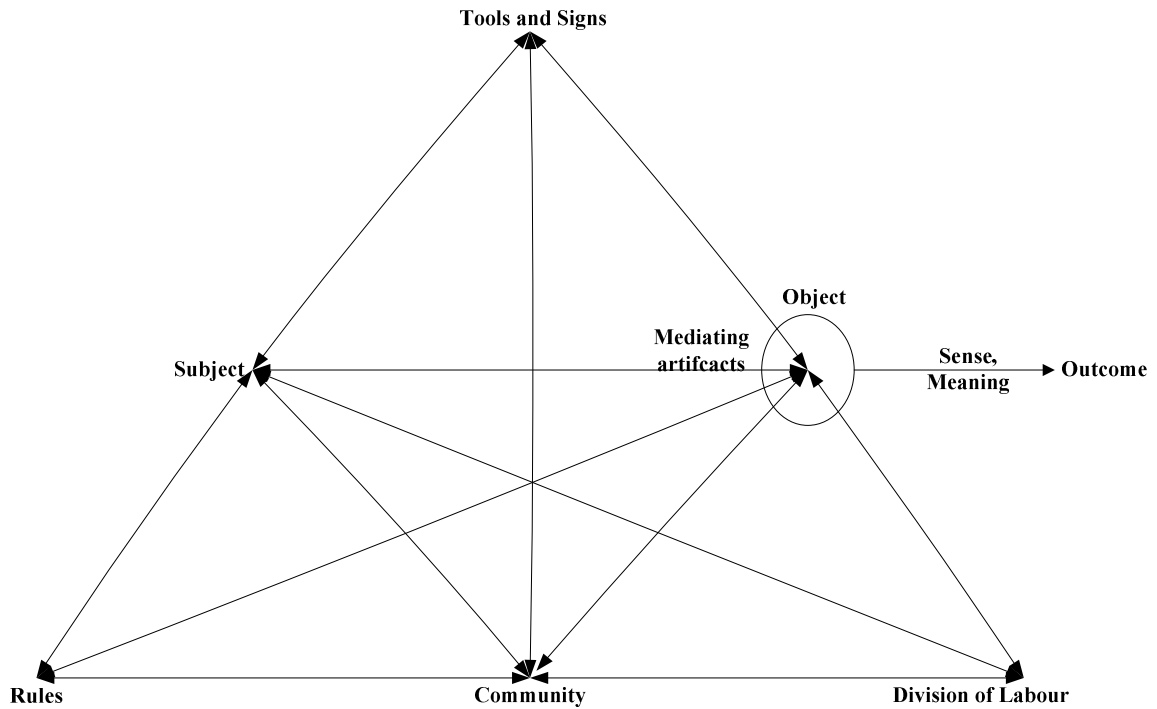
Figure 3: The Structure of a human activity system (Engeström, 2001, p. 135)

A further contribution by Leontiev was his contention that a subject's activity and its corresponding conditions, goals and means are the central link between the organism and its environment. According to Yamagata-Lynch (2003), these non-observable behaviours are linked to the observable behaviours of activity-action-operation in Leontiev's model as depicted at Figure 4.
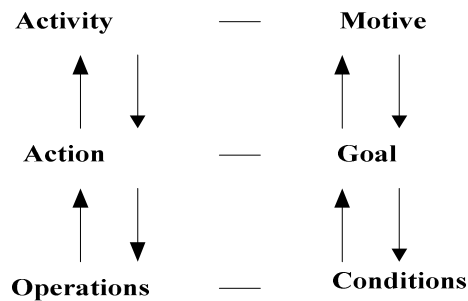

Figure 4: (Leontiev's) Hierarchical nature of activities, actions & operations (adapted from Jonassen and Rohrer-Murphy, 1999, p. 63)

In terms of this model by Leontiev and also as shown in

Table 1, the molar/central unit is *Activity*, which is collective in nature and driven by a complex motive of which the individual actors are not always aware of. Activity consists of goal-oriented individual actions in which the subject is consciously aware of what he or she is trying to accomplish (Engeström, 1990; Miettinen, 1998). So whereas activity is collective, actions are at an individual level. Actions are completed through automatic (or unconscious) operations influenced by specific conditions. And as shown in Figure 4, it is a two way transformation process between the levels whereby actions once internalised turn into automatic operations resulting from repeated practice and actions may be expanded into a collective activity. This research argues that activity / work practice needs the right balance between 'conscious' actions and 'unconscious' operations for there to be effective learning. This argument will be expanded further in the discussion on learning.

Table 1: Historical structure of activity by Leontiev (Engeström 1990, p. 197)

Unit	Directing Factor	Subject
Activity	Objective / Motive	Collective
Action	Goal	Individual or group, Conscious level
Operation	Conditions	Non-conscious

In the third generation of activity theory research, which was undertaken from the 1970s onwards as a result of interest in activity theory from outside the Soviet Union and the identified gap in understanding dialogue, multiple perspectives and networks of interacting activities, the concept of networks of activities was developed (Figure 5). One of the key contributors to the diversity, heterogeneity and multiple perspectives found in activity as a result of the cultural diversity found in society is Michael Cole (Cole, 1996 and 2005; Engestrom, 2001; Roth and Lee, 2007). The result has been that the unit of analysis of activity has been expanded to include the network of interacting activity systems.
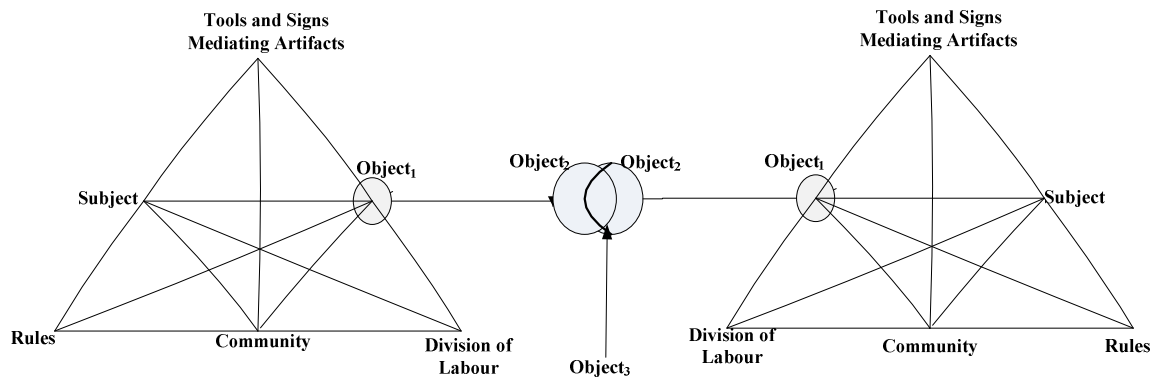
Figure 5: Two interacting activity systems (Engeström, 2001, p. 136)

The schematic representation in Figure 5 of two interacting activities shows the object moving from an initial state of unreflected, situationally given 'raw material' (i.e. object 1, e.g. the need for a system) to a collectively meaningful object constructed by the activity system (object 2, e.g. the system prototype) and finally to a potentially shared or jointly constructed object (i.e. object 3, e.g. a fully functioning system ready for testing). As shown, here, the object of activity is a moving target, which is transitional in nature.

On the basis of the foregoing historical analysis of the development of activity theory, Engeström (2001) identifies five key principles of activity theory i.e.

1) The prime unit of analysis is a collective, artefact mediated and object-oriented activity system, seen in its network relations to other activity systems

2) Activity systems have multiple voices which may result from the different actors engaged in the activity i.e. multivoicedness of activity systems

3) Activity systems are historical formations

4) Activity systems may be characterised by contradictions which act as   sources of change and development

5) There is a possibility of expansive transformations in activity systems.

I will now discuss each of these principles in turn.

2.3   *Activity Theory – Key Principles*

2.3.1   **Activity System as the Unit of Analysis**

This first principle states that an activity can only really be understood and analysed through the components of the activity and its relationship to its network of activities. The components of an activity system (i.e. as depicted at Figure 3) are: Object (with a specific goal), subject, tools, rules, community and division of labour (Miettinen, 1998; Jonassen and Rohrer-Murphy, 1999; Yamagata-Lynch, 2003).

The *object* is the reason for, or basis on which the subject engages in an activity. Using an example of a blacksmith (subject) who uses a hammer (instrument) to mould a piece of iron (object), Engeström (1990) argues that at:

> *'... one moment the piece of iron is a shapeless chunk, at the other moment it is an identifiable, socially meaningful entity. Object is both "anything presented to the mind or senses" and "an end or aim" (Webster's Dictionary, 1987, p. 257). So the object is both something given and something projected or anticipated.'* (Engeström, 1990, p.170)

The object determines the *tools / artefacts* required to transform it into the desired outcome. Engeström (1990) in modifying Wartofsky's three level hierarchy of primary, secondary and tertiary artefacts which was modelled on Leontiev's hierarchical structure of activity , distinguishes between four types of artefacts i.e. the 'what', 'how', 'why' and 'where to' artefacts. The 'what' artefacts, which are similar to Wartofsky's primary artefacts, are fairly easy to notice and define as external physical entities e.g. a hammer required to mould a piece of iron. The first type of secondary artefacts is the 'how' artefact. These explain how a certain object is to be handled using the corresponding 'what' artefact (i.e. how should the hammer be used?). They are therefore partly visible and external but may also be internal (e.g. computer instructions and system procedures are external, but personal versions of these instructions and procedures remain internal and therefore invisible). The second type of secondary artefacts i.e. the 'why' artefacts are mostly internal and are only externalised from time to time through practical actions, gestures, words and symbols (e.g. mental explanatory model of climbing a ladder). They tell us why an object behaves in a certain way and hence justify the selection of the 'what' tools. Finally, the 'where to' artefacts that correspond to tertiary level artefacts on Wartofsky's

model are tools of vision and envisioning the future state of the object such as models, paradigms and aesthetic perception (Engeström, 1990; Miettinen, 1998).

The *subject* could be an individual or groups of individuals (in the case of a collective activity), who use the tools (i.e. internal or external) to transform the object into the desired goal or outcome. The expanded Engeström activity also includes the rules, community and division of labour components that add the socio-historical aspects of mediation omitted by Vygotsky. *Rules*, which could be formal or informal, regulate and guide the subject on the correct procedures for, and acceptable interactions with other community members. The rules can either constrain or liberate the activity. The *community* is the social group that the subject belongs to at the time of engaging in the activity. And finally, the *division of labour* refers to how the tasks are shared among the community members i.e. both the horizontal division of tasks and the vertical division of power and status.

2.3.2   **Historicity of Activity**

Activity systems represent historically identifiable ideal-typical qualitative patterns of work (Engeström, 1990, 2001, 2004; Korpela, 1994; Pihlaja, 2005, Daniels *et. al*, 2007). Victor & Boynton (1998) identify five categories or ideal types of work, which provide a useful way of identifying and analysing historical types. These are craft, mass production, process enhancement, mass customisation and co-configuration (Figure 6). Each type of work generates and requires a certain type of knowledge and learning and progress occurs through learning and leveraging of the knowledge produced into new and more effective types of work.

In craft, the work has low complexity and requires minimal specialisation for the 'individual' worker since it is mostly carried out in a small scale environment (e.g. workshop) with close supervision and tight control.   The subject here is an individual worker or a small group of workers who use simple tools and tacit knowledge to transform the object. This tacit knowledge that the workers have about the product and processes derives from their personal intuition and experience about the customer, the product, the process and their use of tools. The tacit knowledge 'in the head' of an individual worker, is transferred to the other workers through on-the-job apprenticeship. The learning and experience that the workers acquire allows them to describe the details of how they do the work. The description typically covers the steps or

processes of how the products are made or the services delivered. The resulting articulated knowledge can be used to instigate the mass production of the former craft products or services.
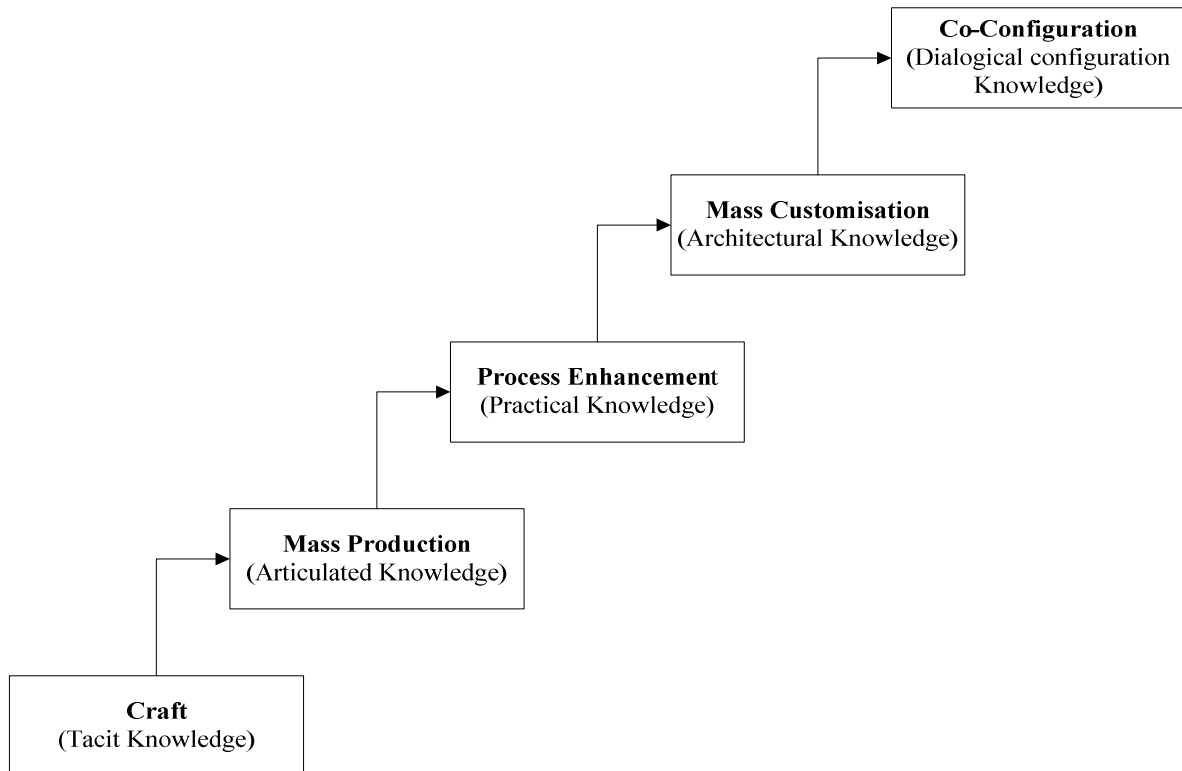
Co-Configuration
(Dialogical configuration
Knowledge**)**

Mass Customisation
(Architectural Knowledge)

Process Enhancement
(Practical Knowledge)

Mass Production
(Articulated Knowledge**)**

Craft
(Tacit Knowledge**)**

Figure 6: Historical Forms of work (adapted from Victor & Boynton, 1998)

Mass production is an upgrade to craftwork in that there is increasing complexity such as can be found in an industrial factory. But with increased complexity comes high centralisation and bureaucratic control because of the apparent need to maintain efficiency. The division of labour is more heirarchised due to the bureaucratic control and workers use the codified articulated knowledge from craftwork to carry out mass production. While knowledge is located "in the heads" of the workers in craftwork, articulated knowledge is located in the "firms head", in documents and standard procedures. The learning that results from mass production is practical knowledge which the workers accumulate from doing a job over and over again.

The third ideal-typical work type, process enhancement is based on horizontal team organisation. In this type of work, workers and managers work together as creative team players ensuring that every process contributes to satisfying the customer by achieving consistently higher quality. The work involved in process enhancement is highly specified and routine, with the routines defined by the workers themselves. In process enhancement workers are equipped with the tools and techniques to apply their practical knowledge in improving the tasks and processes. The learning that results from process enhancement is known as architectural knowledge.

Mass customisation is based on product modularisation and incorporates the concept of precision alongside that of quality in the customisation of a product or service to meet ever-shifting market needs. Mass customization requires a deep understanding of the product or service so that decisions can be made on which variations create value for the customer and which are simply a source of expense and difficulty. When the available variety of options is exhausted (i.e. to customise a product for specific user needs), practices of mass customisation may be renewed. This may include returning to craft work in order to lever out new information recognizing that no universal formula can meet all client demands for precision. Mass customisation has similarities with the fifth ideal-typical work type. The crucial difference between the two being that mass customisation tends to produce finished products and services whereas the emphasis of co-configuration is on continual development of the product or service.

Co-configuration is the emerging form of work which is characterised by collaborative co-design in complex multi-professional settings. It involves the creation of customer-intelligent products or services which adapt to the changing needs of the user. About this Victor and Boynton (1998) state:

> *'The work of co-configuration involves building and sustaining a fully integrated system that can sense, respond, and adapt to the individual experience of the customer. When a firm does co-configuration work, it creates a product that can learn and adapt, but it also builds an ongoing relationship between each customer-product pair and the company. Doing mass customisation requires designing a product at least once for each customer. This design process requires the company to sense and respond to the individual customers needs. But co-configuration work takes this relationship up one level – it brings the value of an intelligent and 'adapting' product. The company then continues to work with this customer-product pair to make the product more responsive to each user. In this way, the customisation work becomes continuous.*

> *[...] Unlike previous work, co-configuration work never results in a 'finished' product. Instead, a living, growing network develops between customer, product and company'.* (Victor and Boynton, 1998, p.195)

According to Engeström (2004) and Daniels et al., (2007), a precondition of co-configuration work is dialogue in which the parties rely on real-time feedback information on their activity. The interpretation, negotiation and synthesising of such information between the parties requires new, dialogical and reflective knowledge tools as well as new collaboratively constructed functional rules and infrastructures.

Co-configuration presents a twofold learning challenge to work organisations. First, co-configuration work itself needs to be learned (learning for co-configuration). Second, within co-configuration work, the organisation and its members need to learn constantly from interactions between the user, the product/service, and the producers (learning in co-configuration). These two aspects – learning for and learning in – merge in practice. Learning in co-configuration settings is normally distributed over long, discontinuous periods of time. It is accomplished in and between multiple loosely inter-connected activity systems and organisations and representing different traditions, domains of expertise, and social languages. The learning that takes place is therefore both personal and organisational.

The historical evolution of ISD can also be modelled using these ideal-typical types of work. For example in ISD there has been transformation from craft work development where the 'techi's' were involved with limited user involvement, to what is now termed agile development using such methodologies as Rapid Application Development (RAD). RAD represents a methodology where prototyping is used for co-configuration with users.

Another important point about historicity in activity systems is that it may take a long period of time to transform an activity system, and that the problems and potentials of any activity system can only be understood against its own history and how it has evolved over time. On how this history can be studied, Engeström (2001) suggests:

> *'History itself needs to be studied as local history of the activity and its objects, and as history of the theoretical ideas and tools that have shaped the activity. Thus medical work needs to be analysed against the history of its local organisation and against the more global history of the medical concepts, procedures and tools employed and accumulated in the local activity'.* (Engeström, 2001, p. 136-7)

In line with this thinking, in Chapter 3, I have presented a summary of the historical evolution of ISD practice globally and later on, in Chapter 6, I present the local historical analysis of current Botswana ISD practice.

2.3.3   Multivoicedness of an Activity System

Activity systems are historically and culturally made and as such they represent multiple layers, multiple viewpoints and multiple voices. Each component of the activity system has a different history that it brings into the activity system, thus adding to the multiple perspectives. The subjects and community members are different and have different perspectives on things; the division of labour introduces levels and positions of power and politics that may also result in different perspectives. This multivoicedness extends to the network of interacting activities and it can be a source of contradictions that may lead to the change and development of an activity (Virkkunen & Kuutti, 2000; Engeström, 2001). Multivoicedness is evident in ISD as a result of the different voices from the different actors (e.g. users, user management, and developers) involved as well as the interacting network of activities (e.g. user activity, user management activity, and developer's activity etc.). This brings in different perspectives to how ISD should be carried out.

2.3.4   Internal contradictions

On internal contradictions, Engeström (1987) identifies four levels of contradictions within an activity system. The *first* level or primary level contradiction arises as a result of the dual nature of commodities and therefore the tension between the use value and exchange value. This primary contradiction can appear in different forms and may be found in each component of the activity system. This implies that each one of the activity system components i.e. subject, object, tool, community, rules, and division of labour, will have an inner primary contradiction relating to its use value and exchange value. In terms of ISD, for example, there could be a primary contradiction between the costs of developing (i.e. exchange value) a solution versus the eventual benefits (i.e. use value) of that solution to the organisation and society.

The second level of contradictions or *secondary* contradictions appear between components of activity systems. This may arise when one of the components of an activity system acquires a new quality as a result of injection or introduction of a new element into it. This new element causes tensions and 'double binds' between elements of an activity system that may lead to change. For example, in ISD, there could be a secondary contradiction between the subject and the tools used if say for instance the adoption of new tools and techniques is not in consonant with the training of subjects who are expected to use them. This may lead to a 'double bind' situation whereby subjects are unable to proceed with the development since they can't articulate and apply the tools and techniques and yet also are not allowed to revert to what they know and have used in the past. Another example here would be a situation where, despite specific rules or standards existing, subjects implement the rules and procedures in an inconsistent manner. Tensions resulting from this contradiction may lead to a change of rules or a change of subjects.

The third level of contradictions are known as *tertiary* contradictions, and these are found '... *between the object / motive of the dominant form of the central activity and the object/motive of the culturally more advanced form of the central activity*' Korpela (1994, p. 81). This may manifest itself in the form of resistance to change from say, an old ISD practice rule to a new one. And finally, the quaternary or fourth level contradictions may be found between the central activity and its neighbour or interacting activities. A new ISD practice model, may for example cause tensions with other existing neighbour activities such as the subject-producing activity.

According to Engeström (2001), contradictions are not synonymous to problems or conflicts but rather represent historically accumulating structural tensions within and between activity systems which may result in change and development of the particular activity system. Figure 7 shows these four levels of contradiction in a network of activity systems:
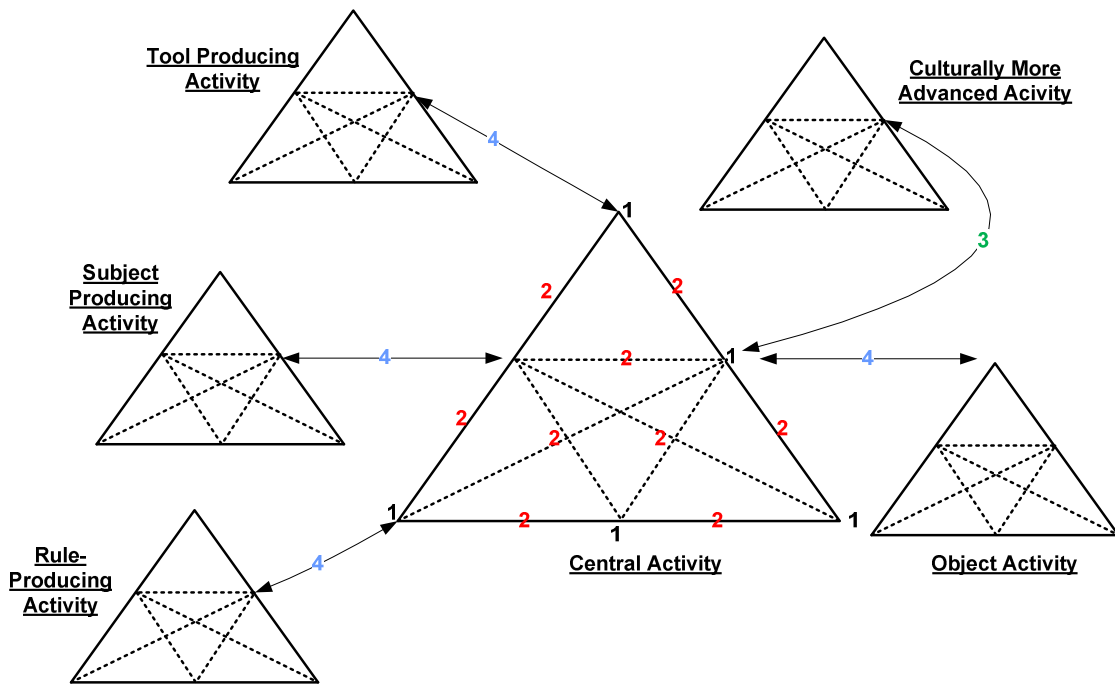
Figure 7: Four Levels of contradictions in a network of activity systems (Pg 4, Centre for Activity Theory and DWR Research, Helsinki website 03.08.2011)

2.3.5   Expansive transformation of Activity Systems

The fifth and final principle identified by Engeström (2001) as arising from the three generations of activity theory research is that of the expansive transformation of activity systems. This expansiveness arises as a result of aggravated contradictions and tensions within an activity system which may prompt the 'social actors' to want to bring about innovative change to the current activity system. This principle of expansiveness is based on Vygotsky's concept of the zone of proximal development which Engeström (2001) redefined as follows:

> *'It is the distance between the present everyday actions of the individuals and the historically new form of the societal activity that can be collectively generated as a solution to the double bind potentially embedded in the everyday actions (Engeström, 1987, p.174).'* (Engeström, 2001, p. 137)

2.4   *Conclusion*

CHAT concepts and principles have been presented in this chapter. The five CHAT principles as outlined in this chapter will form the basic framework for analysing current ISD work practice in Botswana. In chapter 3, I will discuss some of these concepts further as I look at Engeström's expansive learning theory which adopts and uses these CHAT concepts. In a similar manner, DWR, as the adopted research methodology will also be discussed further in chapter 4. These CHAT concepts provide useful tools to analyse and understand current Botswana ISD practice as it highlights issues relating to context, historicity and contradictions.