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# Transformative Applications of ICT in Education: The Case of Botswana expansive School Transformation (Best) Project

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***Abstract.** Best project was launched under auspices of World Information Technology Forum (WITFOR) Education Commission during 2005 to investigate transformative applications of ICT in education. Activity Theory, Development Work Research and Change Laboratory were underpinning frameworks used. Results at first school showed it was isolated from community and activities integrating school subjects with community human resources were designed. Findings at second school suggested that teachers failed to motivate most students due to social problems and categorization of students. Problem-Solving and development system was designed to overcome identified contradictions. Lastly, alternatives to exclusive school-subject interpretation of ICTs within test-oriented pedagogy curriculum practices at third school were replaced using mobile technologies. A lighter technological infrastructure was achieved. However, contradictions identified could not be overcome through one-time change, but required continuous internal development and learning in the school communities.*

**Keywords: Key words:** Activity theory, change laboratory, developmental work research, expansive, transformation and ethnography.

## 1 Introduction

The Government of Botswana hosted WITFOR during 2005 organized by the International Federation for Information Processing (IFIP) in Gaborone. The general theme of the forum was ICT for accelerated development and one of the sub-themes was Education. The work on this theme was based on IFIP's expert group declaration of July 2005, the Stellenbosch declaration: ICT in Education: make it work [1]. The declaration described the challenges of ICT use in education in the developing countries and gave a number of important recommendations. It highlighted the need to use ICT for integrating education to the real world. It also recommended bridging the gap between technologies as well as developing and understanding the use and the effects of ICT in education. The WITFOR Education Commission sought to pursue this trend by launching the Best project. The Botswana educational system is organized into three levels: primary, secondary with the junior and senior divisions (3 year junior and 2 year senior high), and post-secondary education of diverse types. Primary is organized into standards and currently takes seven years. The study Change Laboratory (CL) studies focused on one junior and two senior secondary schools

## 1.1 Objectives of Study

The objectives of the Best Project were identified taking into account that more systematic understanding of educational change is needed in the area of ICT [2]. They proposed that education projects should aim to coordinate the introduction of computers with national policies and programs related to changes in curriculum, pedagogy, assessment, and teacher training, and respectively, start to think in terms of combinations of input factors that can work together to influence learning. In addition, capacity building should be at the heart of the renewal of effective and high quality work in ICTs and education. The objectives of the BeST Project were discerned into four categories:

- To enhance teachers' capabilities to perform as change agents in the era of ICTs. To carry out developmental interventions in collaboration with local practitioners and academic researchers and design required pedagogical transformation and reinvent school-community relations aimed at preparing students to be competitive in the global employment market through broadening their learning perspectives using ICTs.
- To facilitate school transformations related to creative use of ICTs. The research component to focus on the pedagogical use of ICT's in schools and the advancement of collaboration between schools and the surrounding community. To extend the infrastructure of intellectual capacities for school renewal and establish innovative learning and knowledge communities that stimulate, support and advance school and community experiments and local developmental actions. To go beyond borders through the construction of genuine interaction between schools, community development and academic research in order to make possible learning and systematic knowledge creation on the ICT's use in schools and communities.
- To build collaborative human capacity infrastructure between the University of Botswana and Helsinki University. To create sustainability through collaborative effort and bilateral research and development collaboration between The Centre of Activity Theory and Developmental Work Research in the Helsinki University (recently named The Centre for Research on Activity, Development and Learning (CRADLE) and the Department of Educational Technology in the University of Botswana.
- To establish virtual ICT based tools for collaborative research and development activities and learning based on horizontal collaboration between schools and research institutes. Also to provide an open-source-based and technology-mediated learning environment for the schools.

In reaching these objectives, the project is not designed to transfer models of using ICTs from developed countries, but utilizes their experiences as resources for reflecting innovatively on the current practices and future trajectories of the development of schools in Botswana [3]. An implementation plan was made where the CL method, and its use in the development of school activity and the pedagogical use of ICT's in schools were introduced. An inter-organizational interest group, the Activity Theory Interest Group (ATIG) was involved in the negotiations to direct and guide the use of CL in schools. The Government of Botswana had previously selected ten schools to act as pilot schools of the Best project. In each school, a heterogeneous (across curriculum) group of teachers was formed to assist in the implementation of ICTs.

Excerpt 1 (Speaker from university): the best way is to go and build a net, you know, a small interest group around ourselves so at least at the end of the day we have multiplied, you know this cascading, so here the department is very committed because we are transforming it.

Excerpt 2 (Speaker from non-formal/community education): It could be nice if we have already conceptualized ourselves as one thing. I mean different individual parts of a system where we will be all contributing to the larger Botswana system posed at the university.

Inspired by the work done by WITFOR Education Commission, an international group of researchers was formed for supporting teachers' ICT competence in Southern African Developing Communities (SADC). The Academy of Finland granted a two-year research grant for a feasibility study (2007–2008). A substantial research plan was prepared in collaboration with researchers from Helsinki University and the University of Botswana through negotiations with representatives of the Ministries of Education, Communication Science, and Technology, as well as specialists in distant and non-formal learning sectors of education in Botswana. Based on this collaboration, the Academy of Finland further allotted a four-year funding (2009 – 2012) for the project.

In developing country contexts, there is a lack of research on the application of ICTs to teaching and learning in school-based settings and only few examples of investigations into how mobile technologies can be used in education [3]. Being school-based, the Best Project has significance of investigating the ways in which new forms of technology can enhance teachers' capabilities and improve knowledge and professionalism in Botswana and delineate own way to modern information society. Four interconnected developmental processes have been intertwined in the project: 1) the development of activity in ten pilot schools from which three schools were studied by using Change Laboratory method; 2) the development of a group of change agents at the University of Botswana and its capability to carry out developmental interventions in schools; 3) the development of boundary crossing collaboration and object-oriented interagency among participants (including officials responsible for school development, teacher training, and ICT implementation), and 4) the develop-

ment of collaborative activities between Finnish investigators and those of SADC region.

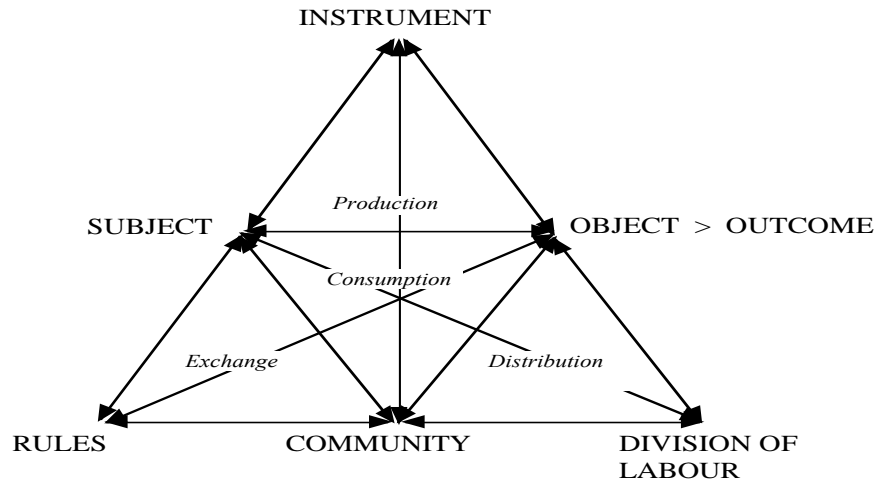
## 2 Theoretical Frameworks

The Best project is based on the expansive learning theory and Developmental Work Research, which have their foundations in Cultural-Historical Activity Theory. Activity Theory has an emphasis on semiotic and cultural mediation of human conduct, and human development [4], [5], [6]. The theory originates from psychology, but is nowadays a multidisciplinary paradigm that has gained popularity as an approach that takes into account the cultural and organizational context and also directly focuses on day-to-day practical work, thus providing an alternative socio-ecological and unifying approach [7], [8].

Vygotsky is known for formulating the general genetic law of cultural development, which has strongly affected pedagogical-philosophical views of Activity Theory. According to this formulation [4] every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first between people (inter-psychological), and then inside the child (intra-psychological)." This formulation invites the notion of mediation, which offers the way that phenomena of human conduct and people's activities are studied. Mediation has formed the basis of the method of double stimulation by which the mental functions are studied with the aid of two sets of stimuli. These two sets of stimuli fulfil different roles vis-à-vis the subject's behaviour. One set of stimuli fulfils the function of the object on which the subject's activity is directed. The second function serves as signs that facilitate the organization of this activity [4]. Vygotsky's method implies an intervention, which operates with "the second stimuli", the mediating means, by which people are solving an original task, the first stimulus. These theoretical ideas have formed the foundation which has been applied and used in significant ways in studying organisational learning, knowledge building and professional development. Currently, the framework has been used and considered valuable in studies which focus on technology-mediated and technology-enhanced activities in education.

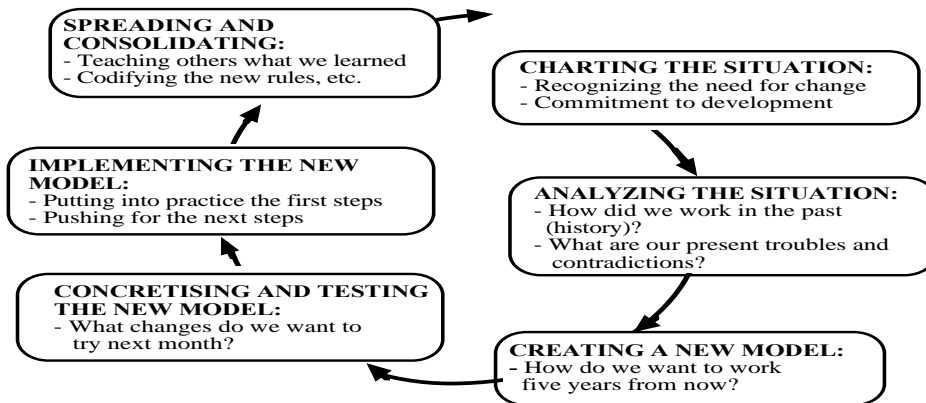
Three features of a framework found relevant for the BeST project are outlined. Firstly, for a systemic analysis, it offers a unit of analysis, which corresponds to people's activity. As such a unit, the model of activity system depicts the constituents of activity within a triangular form of activity (Figure 1). The activity system serves as a dynamic, continuously changing and developing whole of elements of activity. The model represents relationships between subject (actors), object of work/outcome and instruments used in the activity, as well as social determinants of the activity, such as community, rules and division of labour. The forms of change of an activity system are related to inner contradictions between elements of the activity. The analysis of contradictions provides some basis of an expansive re-conceptualization of the activi-

ty. Secondly, the framework entails the cycle of expansive learning, relating to how to study change as a process of professional development and capacity building.



**Fig. 1.** The model of activity system (Source: Engeström, 1987, pp. 73-82; reproduced with permission from Cambridge University Press) [9].

The expansive cycle consists of six steps that are conducted in collaboration between the practitioners of studied community or organization and academic interventionist-researchers. Each phase consists of finding answers to specific questions in the analysis and design process [9].



**Fig. 2.** The Steps of expansive cycle (Source: Adapted from Engeström et al., 1996, p. 11 [10]).

These steps can be used in the research design, where participants of the study can push the development further if they name the nature of the change with the help of the expansive cycle, recognize its inner contradictions and find ways of overcoming them. In each phase, a different challenge is faced. Thirdly, a central feature of the framework is multi-voicedness, which means horizontal and vertical dialogue as well as local experimentations for developing new practices in the context of societal and educational transformations. The dialogue in Botswana aimed at creating and conceptualising new understanding of school activity in the era of ICTs. The key participants and stakeholders shared experiences in organizing expansive learning. The BeST project concentrated on how to make capacity building with the teachers without losing the relationship between policy implementation represented by governance and educational technology skills offered by the University of Botswana.

### 3 Methodology

The research design is based on the CL intervention which is an ethnography method that enables a series of interventions to take shorter calculated periods. The CL consists of six to twelve well-prepared weekly sessions of two to three hours carried out in the school. In addition, a varying number of follow-up sessions after a period of about two month's experimentation with new solutions is recommended. CL is a novel research design for transforming work; a tool and method of crossing the boundary between academic research and practice of any field of activity. It focuses on the daily shop floor practice while still keeping the point of view analytical and systemic. The collaborative analysis and design of a new activity is aided by a set of tools that help participants of the project to share and jointly process their observations and ideas. Figure 3 visualises the CL design as wallboards that are divided horizontally into three columns, providing the research tools as well as vertically into rows representing the past, present, and future of the activity.

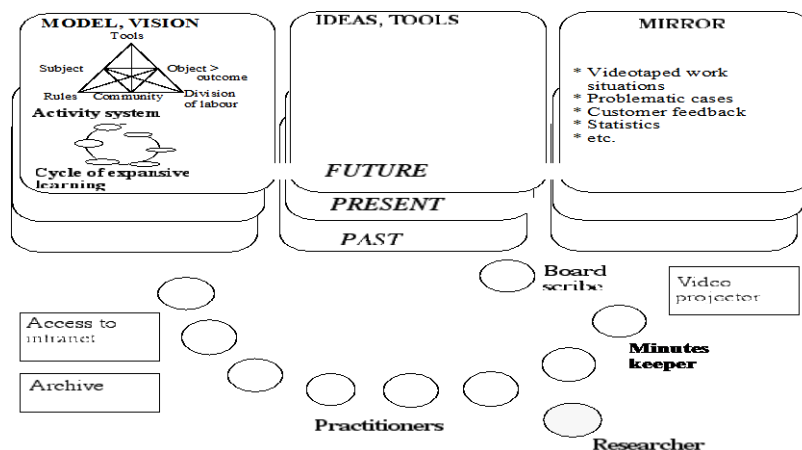


Fig. 3. Prototypic layout of change laboratory (Source: Engeström et al., 1996, p. 11 [10]).

The 'Mirror' board in the right column represents and examine concrete data concerning the activity. The mirror of the present activity includes cases that enable the analysis of changing work situations. The mirror of the past outlines data denoting historical changes in the activity. The mirror of the future represents follow-up data relating to participants' experiments with the new concepts and tools, which they have created and with which they begin to build the future form of the activity. The 'model/vision' board is used for modelling the historical forms of the activity with the help of the model of activity system. As participants progress between the mirror (based on ethnography), and the theoretical model of activity, they generate generalizations concerning transformations of the activity and its present form and contradictions. The 'ideas' and 'tools' board is reserved for representing the intermediate-level products of design of the activity discussed in the CL sessions.

The design of CL aims at creating a dynamic interplay between participants' personal involvement, commitment and research-based intellectual distancing as well as a multi-voiced dialogue. Participants move between concrete observations concerning their own practices and the more abstract system of joint activity in which they participate. The CL is informed by the expansive cycle of development with its six main phases as illustrated in figure 4, where the need for change is identified, and some analysis of the historical situation done to identify existing contradictions. Then developing a new model and testing the model regarding the changes required before implementation, to push for the anticipated changes and finally disseminating the new model.

### **3.1 Ethnography and Qualitative Research Strategy**

Change Laboratory as an ethnography and developmental work research technique, usually adopts a case study research approach that is based on qualitative research strategy. Qualitative research is also appropriate in the realm of developmental research, due to the ecological, contextual, phenomenological, historical or dynamic perspectives of its processes. Case studies have features such as, featuring smaller numbers of units (at times one), data being mostly collected in naturally occurring environments, and either being quantitative, qualitative or both, the aim being to understand and theorize through the unfolding research literature. Case studies allow for questions regarding *why and how* to be answered with an understanding of the nature and complexity of the systemic phenomena. In all three schools, ethnography studies were mainly carried out by an employed international researcher. Both the Department of Educational Technology and Ministry of Education Department of Teacher Training and Development played an active role in making preparations for the school visits for CL activities. Activity Theory Interest Group members collaborated with the international group on trips to the schools where CL activities were taking place. Some government 'Kitsong Centres' designed for ICT use by the respective communities within the three schools were also visited in the process to adopt an integrated approach.

Ethnography studies were realised in two-three week sessions using CL technique conducted by the trained practitioner at the schools. The data gathering



included video-recording of some school activities, carrying out interviews and spontaneous discussion with teachers, principals, community institutions, students and parents. The interviews were videotaped and voice recorded and observations written down into field notes. The interviews were transcribed during the same day and analysed for missing data and noting issues that the recorded data revealed. This information partly guided further data collection. Usually interviewees would mention something that would catch the researcher's interest, and the researcher would follow up until the lead was exhausted. The value of ethnography using CL technique was obvious in the international project where the participants did not share unique contexts of history, geography, language use, organizational patterns, conventions, and others.

### **3.2 Data Collection**

The Change Laboratory design requires some multiple kinds of data collection. These are above all ethnography investigations (i.e. interviewing key persons and video recorded CL sessions). To stay within the limits of funding frame of the BeST Project, only three schools from the selected ten pilot schools were covered using CL. These schools were selected to represent a variety of regional circumstances and diverse school-based resources and cultures.

*Excerpt 3 (Speaker from policy making): We looked at the five regions, and we said what are the critical challenges that we can pick from the schools and set up a national picture? But then we said that we cannot only look at the schools; we need to look at the ministry person there. These are driving forces, the people who are mandated with providing infrastructure or guidelines . . ."*

Key persons from the selected ministry groups were interviewed and video-recorded. Also looking for examples of school-based applications of ICT, the headmasters, heads of the Computer Department, computer studies teachers, and librarians at the schools were also interviewed and video-recorded. The conducted CL sessions at the three schools and meetings held were video and voice recorded. These data were important for self-reflective purposes of the CLs in progress, and also later for scientific analyses, evaluative and documenting purposes of the project.

#### **Limitations**

Due to international partners' limits to stay in Botswana, the number of sessions had to be limited without much time to follow activities in the schools after the completed set of CL sessions and therefore to support the development and experimentation of new solutions. For the same reason the time between the sessions was tightened to more than one session per week. This schedule meant that teachers had difficulties finding time to be present in every session. However, the use of the CL technique, with its structured data collection procedures provided a strong base for the processes. The funding situation also limited the degree to which follow-up activities at the project venues could be made for purposes of monitoring and support.

## 4 Outcomes of CL Intervention and Lessons Learned

The BeST Project was a multiple-case study where each school-based case resulted in CL intervention where relationships between learning, change and development are complex. The framework of expansive development of an activity implies that learning and development were related to the production of transformative knowledge about the activity. A CL intervention seldom brings up a dramatic immediate change. It rather, leads to learning that produces new concepts and practical tools and the immediate change is in opening a development process that the new tools make possible, in other words, opening a Zone of Proximal Development of the change agents. The application of the new activity takes a longer time, and calls for management of developmental activity. The change therefore does not take place in a simple linear progress. Rather, in contact with other members and organizations, the ideas should be discussed in several phases of developing the new vision, new tools with experimentations, and new rules. It is within this context that the outcomes were anticipated.

The three conducted CLs varied amongst each other, due to the region and circumstances in the school, and also how the CL was conceptualized in each school. Although the CLs resulted in different outcomes, they do not challenge each other, but rather show complementary facets of a prism that is organizing our thinking about complexity of transformations, facets which are linked to the globalized education reforms and information ecologies [10]. All three CLs have taken the first steps of explorative enterprises toward a new school infrastructure, which supports and promotes professional collaboration and partnership, and constructs links from school to the outside world. This has paved the ground in order to implement creative and efficient use of ICTs in Botswana schools and trained the participants to be change agents in their educational environments. From the outcomes of the three CLs, it is critical to solicit funding to scale up the next step of the project's strategy for redesigning school activity in Botswana and the SADC region as was initially anticipated. In the light of the identified objectives for the project, the outcomes and lessons learned from the project were as follows:

- Enhancing teachers' capabilities to perform as change agents ICT era  
Teachers were active participants and ready for making their own designs through mirror data, analyzing, and sharing practices, including double binds, which have connections to their own work experiences at the schools.  
**Lesson 1:** The need to facilitate CL environments in schools and develop teachers' activities to transform and enable boundary crossing from of old ways of working and thinking together.
- *Facilitating school transformations related to creative use of ICTs.* Extending the notion of learning technology was based on the perspective that the development of mobile technologies allows capitalizing on lighter technical infrastructures. Prevalence of mobile technologies in all spheres of life may play an important role in accelerating educational transformation.

**Lesson 2:** Rather than waiting for overall educational transformation to take place, it is essential to put efforts for creating local ecologies of technology-mediated learning and instruction, using available mobile technologies which will provide models and frameworks for going through the transformation as was done successfully at one school in the BeST project.

— *Building human collaborative capacity infrastructure between the University of Botswana and Helsinki University.* During 2010 and 2011, the University of Botswana and University of Helsinki proposed a Master's programme. Results of needs analysis survey conducted reported a dire need for a Masters' degree in educational technology. A collaborative Masters' degree programme was developed to the satisfaction of the collaborating partners. Several logistical problems regarding collaborative teaching and supervision of students that existed were also resolved before the programme was launched. The program has since been approved, but not launched due to financial situation in the institution. The Master's programme was also intended to include the SADC region.

**Lesson 3:** Establishment of collaborative Master's degree programme could provide capacity building in Activity Theoretical frameworks and the possible establishment of an Activity Theory Centre, and related virtual facilities in collaboration with Helsinki University to provide the required expertise.

— *Establishing virtual ICT based tools.* The CLs revealed the institutional tradition of organizing teaching and learning that brought about the constraints for creative use of ICTs at the pilot schools. In terms of such a contradiction, the training of a separate group of students for ICT literacy in the subject-based (computer studies) environment of testing worked against the use of teachers' increasing professional capability to improve quality of teaching (pedagogy) and learning of all students with novel ICT-based practices.

**Lesson 4:** The present project brings to light the contradictions existing between democratic policy vision in Botswana's education, and old centralized regime with a strong testing and examinations culture, originating partly from colonial history and guiding school activity.

**Lesson 5:** On the overall, it was evident that the application of new activity within schools takes a longer time, and calls for management of developmental activity.

## **5 Summary Findings, Conclusion and Recommendations**

### **5.1 Mahupu School**

The leading contradiction in the ethnographic data revealed that the school was rather isolated from the community. Teachers questioned parents for a lack of interest in the children's education, which they said was manifested by a lack of school function attendance and alcohol abuse of the parents. Parents also felt they had little control over their children and little contribution to do with their school going as shown in the excerpt:

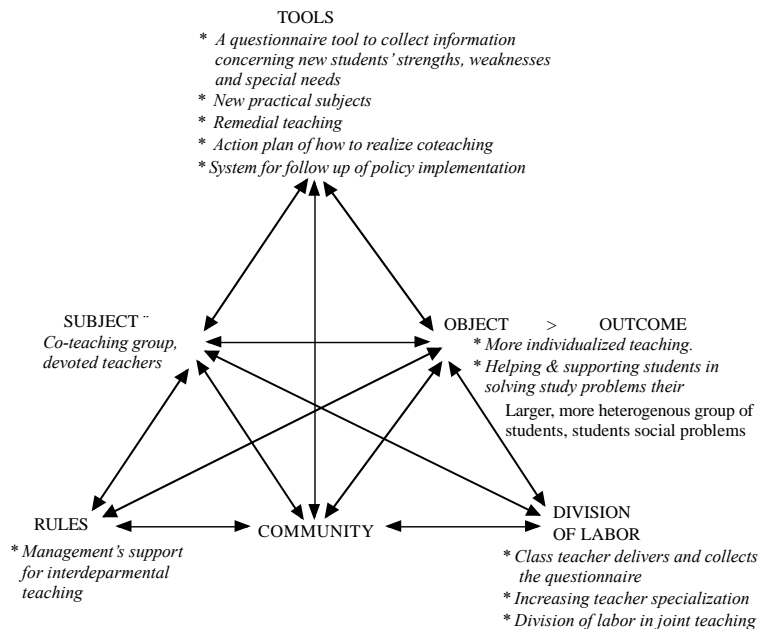
Excerpt 4 (Teacher): *It is something like she said, mind your own business. It is like parents are not very much supportive to the program for the school, so the parents live their own life there, teachers live their own life separated from the school, other people in other government departments also lived their own life and people do not come together and support one another. It is like there are some barriers in between; if the school asks for assistance from the community ... they come with a different mind to be against what the school is trying to do or to try to be on the side of the kids.*

The CL participants discussed the changes that had taken place in child rearing practices between home and school in the village and began to question the present situation. With the actions of designing school activity, CL had effect to infusing the school subjects and integrating human resources within the community. The teachers of this junior secondary school had positive attitudes toward using ICTs, but the role of new technology remained minimally touched in the presented BeST project plans.

## 5.2 Malefi Senior Secondary

Since the researcher-interventionists came from different cultures, the preliminary data collection was planned to be broad and exploratory [3]. The CL data revealed that teachers felt they were unable to motivate many of their students. Suggested causes for the lack of motivation were social problems such as alcohol abuse, drugs, and teenage pregnancies. There existed among students a growing number of orphan children that the teachers felt were not interested in school. They blamed children's social background and parents for their problems with the students [11]. The various ideas that the CL work groups produced in the seven sessions conducted are presented as elements in a model of a new form of a teachers' activity system (Figure 4). The figure is an analysis of how teachers sought to achieve more individualized teaching as a way of resolving contradictions identified in the school. Teacher work groups prepared a plan of how and when they would experiment with the new solution they had prepared. The main inner contradiction in the activity was one between the more heterogeneous student population with more social problems than earlier and the teachers' tools that were predominantly based on mass teaching that did not allow enough attention to be paid to individual students' specific needs and interests. The main tool used by teachers to manage the increasingly heterogeneous group of students and the performance criteria had been the *categorization* of students into single, double, and triple science syllabus track groups and to subsequently focus their efforts on the latter two groups [13].

Excerpt 5 (Participant): *The frustrations for the students: they hate being beaten; they seem not to like the way they have been categorized according to the sciences, that's what we picked from the audio. And they are also frustrated by the bad grades they get.*



**Fig. 4.** Ideas identified for new solutions in teachers' activity system model (Source: Virkkunen, J. and Newnham, D, 2013, P.165) [12]

The contradiction was aggravated by the demoralizing effect of the categorization on the single science students and because the variance of student's performance was increasingly due to social problems. Tabulawa [13], also observed in another school in Botswana, the apparent neglect of the cultivation of students' substantive study motivation based on their interest in the subject matter. Mirror data presented in the Change Laboratory made the teachers more conscious of this problem and stimulated them to find solutions to it.

Excerpt 6 (Student): *Especially when you are doing single sciences they just think that they have to give priority to the triple sciences and maybe double sciences, and if you say that you are single sciences, they just say hey you aggg.*

Excerpt 7 (Teacher): *It is a bit of a problem because the computer lab there is only one, and there are something like 20 computers and there are 80 students doing computer studies* Researcher: *So other students who are not doing computer studies are not having, don't have access to computers?* Teacher: *Ya they do not have.*

Participants increasingly took responsibility for developing new solutions and all groups carried out at least one experiment and the joint developmental work continued further. Group members of CL sessions, fifteen months after the CL, reported continuing the experimentation with the new tools, and that they were planning to establish a new structure to ensure that experiments would be carried out accompa-

nied with a progress report every fortnight on future and present challenges to be overcome.

The most radical of the new solutions developed was the dialogical study planning tool and process that would help the teachers deal with students' varying needs and interests including their social problems and a remarkable breaking away from the prevalent authoritarian and unidirectional teacher role. This experiment also demonstrates the ideas of re-mediation, collaborative teaching as well as the idea to add into the curriculum subjects, other than sciences, that would be relevant to the students' vocational interests, addressed directly the central contradiction in the activity system [11]. The researchers do not have follow-up data on what happened to its development after that, but clearly, the group that was developing it would have gained from an internal-to-the country support group of researchers after the first experiment. Tabulawa [14] has alleged that Botswana's Revised Policy on Education issued in 1994 is based on two contradictory concepts, one highlighting the objective of producing independent, innovative, and flexible personalities, and the other, a behaviorist model of a revision of the curriculum. This duality is seen in the development projects that the CL group formed. Dialogical study planning and collaborative teaching clearly correspond to the first line of the policy. The following two, policy implementation and development of Audio Visual (AV) teaching materials, are more in line with the latter although these teaching aids could later expand to become tools for students' inquiry.

The new system that the teachers created, can, on the one hand, be seen as an elaboration and implementation of the traditional top-down system of school development in Botswana<sup>1</sup> [15]. On the other hand, it can be seen as the development of a system of internal problem solving and development in the school, a step towards that is a prerequisite of overcoming the contradiction. However, the contradiction cannot be overcome through a one-time change, but calls for continuous internal development and learning in the school community.

### **5.3 Mater Spei College**

The school was considered by the research team to be ahead in many aspects in ICT use compared to other schools because the local mining company was sponsoring the school with computers, smart board and educational software. Anchoring on teachers' practice, the project produced an object for negotiations and for an expansive cycle of developing a school activity in an ICT era. The essence was to search for alternatives to the exclusive school-subject interpretation of ICTs within test-oriented pedagogy and, thus, challenge long-established curriculum practices. The alternative policy in the context of purposeful efforts for managing the large-scale developmental

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<sup>1</sup> According to Tabulawa (1998, pp. 250-252), the prevalent model of managing pedagogical change in schools has in Botswana been based on a top down, expert-centered, technical approach that ignores the teachers' views, experience, and voice and puts them in the role of a passive adopter and implementer of teaching strategies developed by experts without input from teachers.

cycle was found to be using mobile technology. The CL focused on using various *freeware net-based tools* in order to rely more on digitalization and mobile technology, Internet and social media such as *Facebook, Diigo, Google Maps, Google Calendar and Skype*.

*Excerpt 8 (Teacher): "I'm familiar with PowerPoint and Excel software." Teacher's expectations to CL are "to improve the use of ICT-learning, stuff in Internet that I have not used to make classes, not only websites, but some other tools."*

The use of mobile technologies not only enabled a lighter technological infrastructure, but also allowed teachers to show their competences in the creative use of ICTs. *The community of practice* at the school prospered for the rest of the study period and used an alternative approach enabling innovative use of more ubiquitous technologies where fixed laboratories were no longer a handicap. At the end of the project, participating teachers in the school were denominated as *digital ambassadors* by policy-makers for showing respect for teachers' knowledge creation potential.

## **6 Conclusion and Recommendations**

The CL process at the schools showed that focusing on the object as well as the historical changes in the activity can disclose the associated central developmental challenges and needs in the activity that the new technology could help to meet. Learning to master new technological tools, such as ICTs can open up a broad perspective of expansive development for the actors (*hybridization*). New models of teaching (*pedagogy*) are not easy to create, as they involve the questioning of current ones and making plans to changing them. The motivation for developing desired models arises from a possibility to overcome existing contradictions in the current activity. This aspect is often not taken into consideration when planning to integrate ICTs into school systems. The advantage of using the CL method is its systematic developmental procedures that guide practitioners' transformative agency to focus on the expansive development process that they undertake. Most of the time, ideas of ICT use are either beyond the realistic zone of possibilities of the expansive development of the activity, or below it and thereby providing only an alternative way of continuing the existing pedagogical approach.

The increasing collaboration between teachers and ICT professionals as well as the development of various kinds of hybrid roles of pedagogically oriented ICT specialists and ICT oriented teachers is a natural line of further development [16]. The unit of development in the pedagogical use of ICTs should thus not be considered to be a school or a network of schools, but a heterogeneous network of schools and agencies of pedagogical and technical development.

Given the lessons learned from the CL process described in this paper, it seems that a CL process within the school and the establishment of objects of joint pedagogical development in it could be a good first step for building such collaboration as was the case in the CL studies presented in this paper. While the results of a CL are initial-

ly local, their spreading, diffusion and possible utilization follow the logic of invention and innovation in an open development context. The CLs of the BeST Project worked on school-based conceptualizations and brought forth information about the micro-genesis of novel solutions and possibilities and obstacles that will be encountered during transformation processes. Small cycles may remain isolated events if they are not processed by the concentrated efforts to manage the diversity of sources in knowledge creation in the context of the overall expansive cycle of development. Several information sharing workshops for all the ten selected schools were therefore conducted to achieve this goal. However, the funding situation prohibited stake holders to follow-up on CL processes at the respective venues as was desirable.

## 6.1 Recommendations

The need to follow-up on CL activity conducted under the auspices of the BeST pilot project to develop technology-enhanced teaching and learning practices at the selected schools so as to sustain the established communities of practice and build a strong base for an *epistemic knowledge-building approach*.

Integrate the BeST Project *knowledge-building approach* with Ministry of Education & Skills development innovation system and policy development strategy so as to generate seed funding locally to scale-up the project.

Establish a longitudinal research proposal based on BeST project principles to be submitted for funding to varied local as well as international research entities (UB-Office of Research & Development, Ministry of Education & Skills Development, Southern African-Nordic Centre (SANORD) WITFOR, Higher Education Institutions Institutional Cooperation Instrument (HEI ICI) 2016-2018 etc. etc.).

Integrate developmental work research practices on technology-enhanced practices in schools within the ThutoNet education policy initiative which is a component of the national MALITLAMO ICT policy.

Forging another link with Helsinki Centre for Activity Theory in order to investigate sustained processes of knowledge advancement using novel research theories (i.e. Activity Theory) and instruments/tools (i. e. Change Laboratory and Developmental Work Research) required as benchmarks and leading to possible establishment of Activity Theory Centre at the University of Botswana as was initially envisaged.

The BeST project has therefore made a significant contribution which WITFOR should pursue further and assist in soliciting funding to support the scaling-up of the project to SADC as was initially envisaged.



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