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The Integration Of Cultural Historical Activity Theory (CHAT) As An Analytical Lens In Science Lesson Presentation For Effective And Quality Delivery Of Science Concept.

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Abstract: *This paper focuses on how Cultural Historical Activity Theory (CHAT) can be used in thepreparation andpresentation of science lesson during classroom teaching. CHAT is used to identify and analyze contradictions; model and implement solutions in the learning and practice of science teaching in schools.*

CHAT is the modern analyticallens that incorporates all what a lesson plan entails. The paper focuses on how contradictions were used as sources of learning and development leading to 'real life expectations'. This demonstrates and reflects on the value of an interventionist research theory and methodology employed in the study to enhance science teachers to sustain teaching that enhance quality education in all schools.

Of recent there is a decline in the pass rate of science students in the research carried out by Trend In Mathematics and Science Study {TIMSS} revealing that science and mathematics were really not doing very well globally, this might have been due to poor method of teaching, where educator are using the generic method of teaching, which seems not to be fruitful, this paper focus on the use of CHAT in lesson presentations for effective teaching and quality education.

Cultural Historical Activity Theory (CHAT) provides a methodology, examine how groups of people with different experiences and perspectives working on the same object can work on new problems and jointly develop new knowledge or tools to address the problems.

The first generation CHAT provides scant techniques involving subjects, tools and Object. Which is much similar or resembles traditional methods of teaching that inhibits the total development of students. End products of first generation CHAT theory are mostly, clerks, shopkeepers, security, drivers etc.

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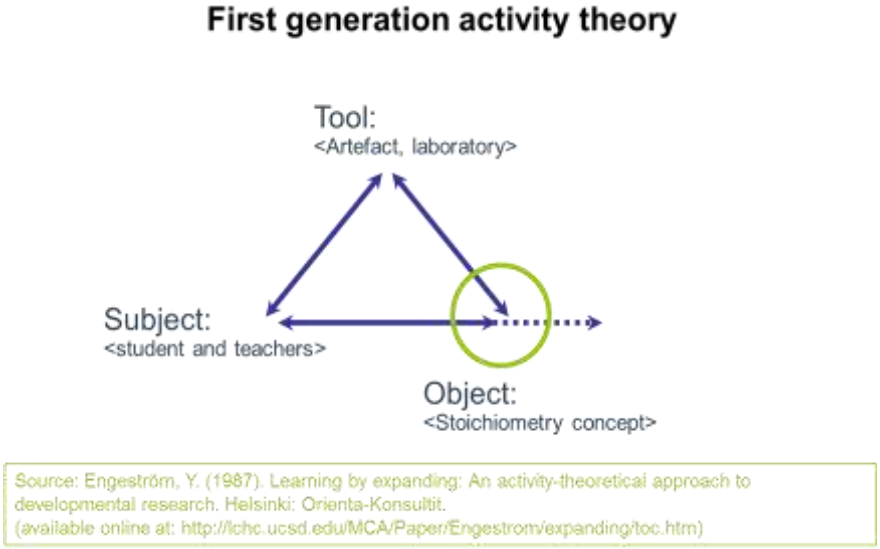

Figure 1,First generation of Activity TheoryEngeström, Y. (2001).

Learning within a CHAT perspective is seen to take place in two main ways: through internalization and externalization. Internalizationstake place when an individual makes sense of available cultural capital in his/her social relations, thinking and actions.Externalization happens when a person or a group of people creates new knowledge or solutions. Learning that encompasses both internalization and externalization, is called expansive learning (Engeström, 1999). Second and third generation CHAT provides the scope to work with local and broader contexts that have a bearing on the learning and teaching ofscience. Second generation CHAT covers rules, community and division of labour, subject, object, and mediation and tool relations (Figure 2).

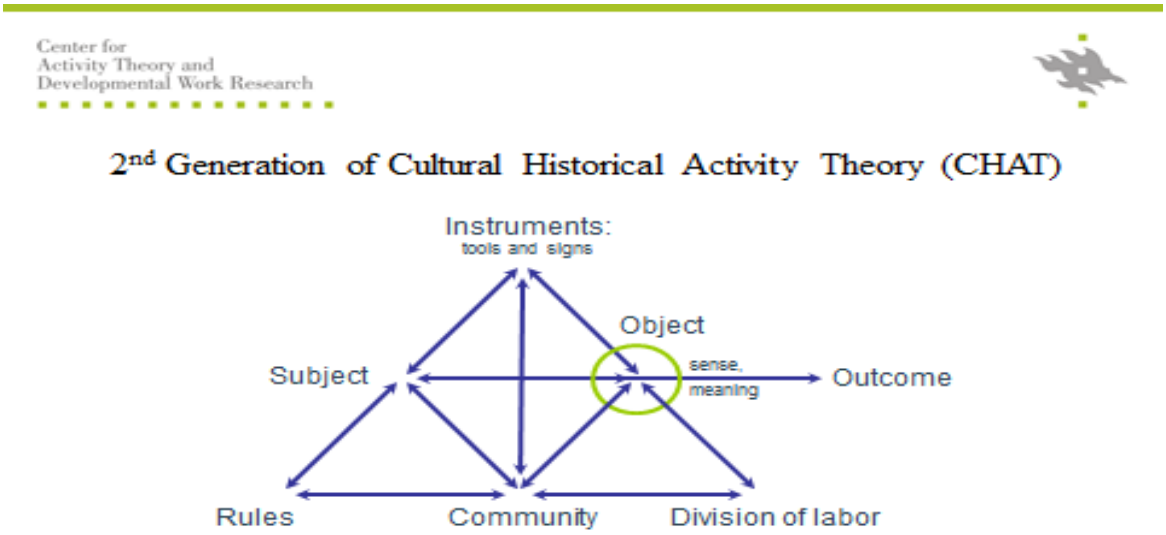

Figure 2, Second generation of Activity TheoryEngeström, Y. (2001).

The third generation covers a number of second generation activity systems that are interacting.
The common language defined by the six elements of the activity theory structure can provide a mechanism enhancing quality lesson preparation and presentation in science classroom situation.

I INTRODUCTION

The primary focus of this paperis on integration of Cultural Historical Activity Theory (CHAT) as an analytical lens in Science lesson presentation for effective and quality delivery of Science concept.

As the usage of technology increases all over the word, lessons preparation has suffered critically because most teachers and students now depend mostly on internet sources for learning and teaching science concept without editing or conceptualizing the concept to suit the learning situation on ground.

"At independence in March 1990, a new teaching and learning paradigm developed that would disassemble the previous regime's policy of segregation and inequality of access and reflect the new government's priorities of equity, access, quality, and democracy in education. The National Institution for Education and Development (NIED), one of the branches of the Ministry of Education, Culture, Youth, and Sport, was entrusted with the task of reforming and developing the curriculum, integrating the national language policy with English as the official language" (n.d)

Education and Training Sector Improvement Programme (ETSIP) 2005-2020, came up not much was known after some years, this made the Minister of Education to comment, Hon.Nangolo Mbumba (no date) "How successful we are in the education system will largely determine how successful we are in creating that better future that we long for…"If Namibia is to develop as planned for the vision 2030 we need to change the mode of teaching with emphases on the lesson presentation ,planning and teacher education programme.

Ministry of Education (MoE) enumerated why current education and training system is not able to rise to the call of vision 2030

- Shortage of qualified teachers
- Declining productivity in some sectors [e.g. education]
- Shortage of skilled workers on various level

- Low learner outcomes(MoE, n.d.)

This paper is looking into how the weaknesses enumerated by the Ministry of Education can be reduced via teaching pedagogy, the mode of lesson preparation and delivery by integrating CHAT expansive learning in our lesson preparation to enhance effective and quality education. Poverty eradication can only be enhances when there is high learner outcomes, that will feed the tertiary institution from High schools. This will also enhance increase in the number of student apprehensive for science courses.

The goals of education as stated in Towards Education for All (EFA),one of the goals by

MoE is on Quality, referring it "to the provision of good education by supplying schools with well–prepared teachers" (MoE, n.d)

The establishment of cluster-based groups for each subject orphase improves the quality of teaching by allowing teachers to share ideas, lesson plans and teaching materials.

The thematic emergence surfacing is quality; to enhance the quality of education we need changes like the integration of CHAT expansive learning into our teaching.

The MoE mission statement "The mission of the Ministry of Education is to work to realize the overall goals of our nation. The following is our mission statement:

We, in partnership with our stakeholders, are committed to providing all Namibian residents with equitable access to quality education programmes to develop the abilities of individuals to acquire the knowledge, understanding, skills, values and attitudes required throughout their lifetimes". MoE (n.d.)

II THE THEORETICAL FRAMEWORK AND CONCEPTUAL FRAMEWORK.

The theoretical framework informing this paper is the theory of constructivism

- Piaget's Cognitive Constructivism and
- Vygotsky's Social Constructivism
- CHAT as analytical lens

Imenda (2014, p.189) opined that "A theoretical frame work refers to the theory that a researcher chooses to guide him/her in his /her research. Thus a theoretical frame work is the application of a theory or a set of concept drawn from one and the same theory, to shed some light on a particular research problem". Cognitive constructivism draws on the developmental work of Piaget (1977) who alluded that learning occurs by an active construction of meaning rather than being a passive recipient of knowledge. This is a perspective based on the understanding that learners are not "account deposits" (Freira, 1993, p. 99). Instead, learners in science can effectively and efficiently construct science concepts if proper mechanisms are at their disposal.

The conceptual framework informing this study will be the pedagogical content knowledge (PCK) and social-constructivist concept. According to Imenda (2014, p189) "Conceptual frame work may be defined as an end result of bringing together a number of related concepts to explain or predict a given event, or give a broader understanding of the phenomenon of interest- or simply, of a research problem". PCK is a concept that reflects the way teachers prepare, present and formulate subject content for the maximum benefit of the students. PCK will unpack the science teachers' methodology teaching science concepts. The Vygotsky's social-constructivist concept will assist in understanding teacher–teacher and teacher – learner interactions during the teaching of science concept in class.

The concept of CHAT expansive learning will be used as an analytical tool that will explore and expand the teachers' capabilities through expansive learning, Engeström (1987) and assist in focusing or answering any emergent questions.

The PCK and SCK of teachers

Shulman (1986b) proposed three categories of content knowledge for teachers; Subject-matter content knowledge (SCK); Subject-matter / Pedagogical Content knowledge (PCK);

Curricular knowledge (p.13).

According to Shulman (1986b) to subject-matter content knowledge equates to the amount of knowledge per se in the mind of the teacher. The second category, subject-matter pedagogical content knowledge suggests 'the ways of representing and formulating the subject and make it comprehensible to others' (p. 13). The third category, curricular knowledge equates to syllabus, scheme of work, textbooks, laboratory demonstration and other mediating tools in the classroom to make it understandable to students. All these components are embraced in Cultural Historical Activity Theory (CHAT) that will be used as analytical lens.

In a nutshell, Shulman (1986, p. 9) emphasized "PCK as the most useful forms of representation of topics, the most powerful analogies, illustrations, examples, explanations and demonstrations- in a word, the ways of representing and formulating the subject to make it comprehensive to others". PCK also includes an understanding of what makes the learning of specific topics easy or difficult, the conceptions and

preconceptions that students of different ages and background bring with them to the learning of those most frequently taught topics and lessons.

Schulman summarised PCK as the concept which describes the way in which teachers present and formulate subject content in order to make it understandable and meaningful.

Van driel, Verloop and de Vos (1998, p. 676) emphasised that "PCK is the knowledge that a teacher uses to provide teacher's situations that help learners make sense of particular content".

Okanlawon (2010, p.30) proposed that the "the PCK for stoichiometry includes teachers' 'bag of tricks' and 'emotional tools' that can be used to develop students better in solving stoichiometry problem". The PCK thus integrates numerous aspects such as, instructional approaches, subject specific learning, learners' difficulties, and the nature of science, curriculum knowledge and context.

In conclusion, Shulman (1987) describes PCK as "the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the student's". (p. 15). Also Ngcoza (2007, p.53) concluded by saying that "competence in both SCK and PCK is regarded as vital in promoting meaningful learning among learners". The interest of this study is to investigate the PCK of the teachers and CHAT expansive learning into the teaching of science concept for effective and quality delivery of science concept.

The statement of the problem

The high failure rate or increase in the poor performance of learners in science subject (TIMMS, 2012) might be due to poor method of teaching of science coupled with the inadequate pedagogical content knowledge of the teacher. With the increase in the information technology in the 21st century that supposed to enhance the performances, yet decrease is the number of students apprehensive for science oriented courses, this might lead to shortage of professionals likes of medical doctors, engineers and scientists in all areas of life, including sciences teachers in our institutions. To arrest this situation before going out of hand is to study the mode of teaching science which is the intension of this paper and how science teachers prepare the lesson for effective and quality delivery. The integration of science teaching using the CHAT 2nd& 3rdgenerations and its expansive learning in their preparation might be the core antidote to bridge the gap.

III STUDY OBJECTIVE:

The objective of this study is to evaluate the effectiveness of integrating the CHAT and its expansive learning in the science lesson preparation and presentation in a classroom situation

Main questions

What causes the decrease in the number of students apprehensive for sciences subject or science oriented courses?

Sub questions

- What are the factors affecting the teaching of sciences resulting into exodus of students from science subjects?
- How can the teaching of science subjects be enhanced in schools so that more students will study science?
- Will the integration of CHAT help the science teachers in the quality and effective teaching of science in the classroom?

Conventional lesson preparation versus CHAT integrated lesson model

Conventional lesson preparation versus CHAT integrated lesson model approach is diametrically opposed to the conventional lesson preparation with the expansive learning process

MacLellan and Soden (2004, p254) opined that the pedagogical method used in traditional or convectional method of teaching is centered on "lecturing, note-taking, and memorizing information for later recognition or reproduction". This mode of teaching has been criticized by researchers in recent years, with the development of many learning theories and approaches. A major focus of science education research is to analyses different instructional methodsfor their efficiency, and to suggest improvements or new methods. This paper is looking into how CHAT and its expansive learning concept can be incorporated in the lesson preparation by science teachers. The constructivist method is based on Piaget's theory of cognitive development and tries to achieve the construction of knowledge by the students under the teacher's guidance.Admittedly, Piaget's theory was extended by Vygotsky to include the role of the social dimension to learning as opposed to the focus on an individual only. Vygotsky's Social Constructivism claims that effective learning lies in the nature of the social interaction between two or more people with different level of skills and knowledge.

IV METHODOLOGY

The methodology used is based on CHAT expansive learning that is used in working and interacting with the students in classroom and in laboratory activities:

Observations were done when grade 11A of Zebra Senior Secondary school did practical on periodic table, metals and non-metals, oxygen, Hydrogen and hydrogen sulphide gas preparations'. All the students present were grouped into 5 per group and instructional guide were given to each group. Lesson was observed and videotaped. Questions were generated by the students, when the teacher told them to work in group

V DATA ANALYSIS

- Students attendance register and test scripts were collected and recorded.

Data on lesson presentation

Lesson presented	Number of student present	Number of absentees	Total number of students
Hydrogen	24	7	31
Oxygen	22	9	31
Periodic Table	28	3	31
Metals	27	4	31
Non-metals	26	5	31
Hydrogen Sulfide	24	7	31

Data on tests given

	Number of students present		Number of students absent		Total number of students
	Passed	Failed	Passed	Failed	
Hydrogen	23	1	1	6	31
Oxygen	22	0	2	7	31
Periodic Table	25	3	0	3	31
Metals	24	3	1	3	31
Non-metals	23	3	0	5	31
Hydrogen Sulfide	22	2	1	6	31

VI FINDINGS

- Most students present when CHAT expansive learning process was used passed the test very well.
- Some of the students that were absent during presentation passed the test and subsequent tests but most of them failed as show in the table above.

Designing lesson and laboratory Activities based on CHAT:

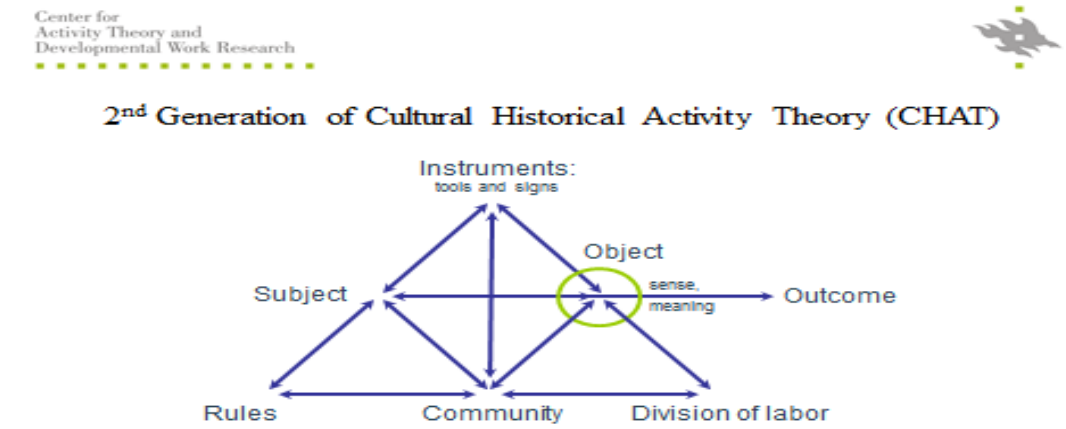

Figure 1, Second generation of Activity TheoryEngeström, Y. (2001).

The**subject**of an activity system is the person, or group of people whose perspective is thefocus of the analysis e.g. teachers, students or a group of learners.

The **object** is the goal or motive of the activity system as a whole improving student's outcomes.

Both subject and object are influenced by mediating **tools or artifacts**, the nature of the

communityto which the activity system belongs, the**rules**of normal behaviour appropriate to the system and the **division of labour**within the system, and also to the way in which labour is divided within the context of the system:"In other words, rules and the division of labor define how participants are expected tobehave and who is expected to do what in the achievement of the object of an activitysystem" (Tsui& Law, 2007: 1291).

CHAT EXPANSIVE LEARNING

The expansive learning process will answer the question 'in what ways can science teachers be supported wi**t**h the mediation of the teaching and learning of science concept?' Expansive learning encompasses collaborative learning that addresses new and emerging knowledge on science concept. Daniel, (2001, 2005) said that expansive learning involves doing, reflecting and improving the practice. Diagrammatically the expansive learning cycle is as illustrated in the diagram below and the processes answered all my questions associated with this paper.

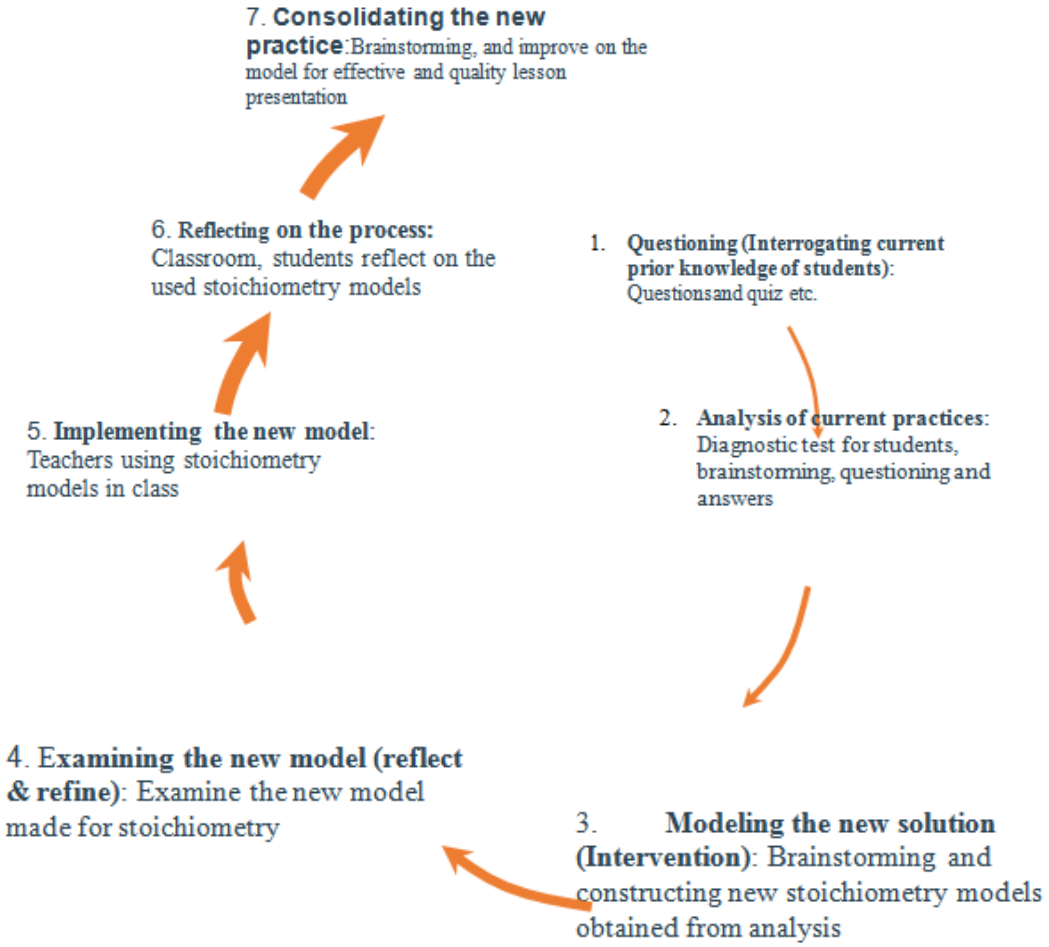

Figure 4: Engeström's cycle of expansive learning (1999)

The case of stoichiometry in physical science.

The teaching of stoichiometry in Physical Science needs the components of CHAT theory and its expansive learning toprovidestudents the opportunity to analyze activities using basic principles of CHAT. This will enhance the mediation of learning stoichiometry for quality and effective understanding of science concept.

Thestudents will analyze the activities according to Engeström's triangle and define the intermediary tools, the group work, the rules and the objects which are usually transformed into outcomes in order to create new knowledge in the context of rules that the entire community sets.Theunit of analysis is the activities involved and contradictions experienced when doing the activities. This makes moving from one activity to another flexible, getting advantage of prior knowledge to proceed to the next level of activity, the teacher scaffold the students during the practical in other to achieve the objectives.

The majority of students grow in an environment where measurement are carried out using non-calibrated apparatus like cups, tins etc.

At the beginning of the laboratory practical lesson a discussion was embarked upon about measuring things in the vicinity or environment.

Expansive learning is part of activity theory and can be considered as a kind of design methodology that aims at change. The series of learning activities in an expansive cyclewereused in the classroom and in the laboratory lesson, (Engeström's 1999, p. 383)

Questioning: students discussed about the stoichiometry, its meaning, origin, component's, associated problems and development of classroom models for effective learning of stoichiometry. This answered the question 'What are the factors affecting the teaching of sciences resulting into exodus of students from science subjects?

Analysing the situation: The analysis includes the components of stoichiometry that need to be studied prior before the other concept, like periodic table, atomic mass, molecular mass and the practical transformation of the stoichiometry to enhances effective learning and teaching of the concepts. The analysis relies on questions like "why" studying stoichiometry and how can the teaching of science subject be enhanced in schools so that more students will study science?

Modeling: Collaboratively developing a newly explanatory model that will mediate the learning of stoichiometry in aneasily understandable mode. This explicit and simplified model will offers solution to difficult stoichiometry questions.Students develop the activities for measuring moles of an element (construction of a model to measure mass of an element and determine the mole).

Examining the new model:implementation and experimentation with the model or readymade scales so that the potentials, capabilities and limitations can be discovered. Students practiced on the activities in the laboratory with the guidance of the teachers[scaffolding]

. **Implementing the model:**The practical applications of the model enhanced the teaching and learning of abstract concepts of stoichiometry

Reflecting and evaluating: Students reflect and evaluate themodels they had designed during the teaching of stoichiometry in the laboratory.The teacher should beinvolved in reflective processes themselves with the students duringreflective processes in the classroom as well as laboratory.

This will help to developreflective attitudes among the students, which will encourage a responsive interaction mode during the teaching of science. This will motivate students to participate in the science activity.

School teacher should develop a learning culture for student to make space for reflection at all time in any activity both inside and outside classroom. Time [tutorial classes] should be made available for teachers totalk with each student about the new concept they had been exposed to during the teaching of the concept stoichiometry, to share meanings and help them make stoichiometry understandable.

The analysis of the activity theory and the development of the expansive learning cycle (ELC)by Engeström offer a new methodology towards the teaching of science concepts that will motivate students and teachers to teach science effectively.

Purpose and advantages of this study

This paper focusing on integration of CHAT in lesson preparation and presentation of science concept is to confirm that scientific knowledge is a dynamic activity system.

The study creates a conducive learning environment so that teachers develop innovative activities into the teaching of sciences and helps in quality education.

CHATS will enhances student interest in science activities and be positive to science concepts that will encourage more students to venture into the study of science subjects.

Teachers learning and teaching skills will be sustained, PCK andSCK will be enhanced for effective and quality teaching

VII CONCLUSION AND RECOMMENDATION

The use ofexpansive learning cycle (ELC)into the context of sciences education will provides motivation to prospective teachers to develop innovative sciences activities and help students master science concepts.

Expansive learning cycle will assistteacher duringanalysis and designing activities within the field of science education and will achieve meaningful learning and scientific concept development.

Teachers should useexpansive learning cycle (ELC) in the scienceteaching to develop scientific knowledge as a process of internalization from the individual to the society.

Nevertheless, CHAT has much to offer science teacher, both as a method of analysis and as a

stimulus for change. The examples of CHAT lesson preparation on stoichiometry discussed in this study are an indication of the range of ways in which the method is being applied for effective and quality lesson preparation and delivery.

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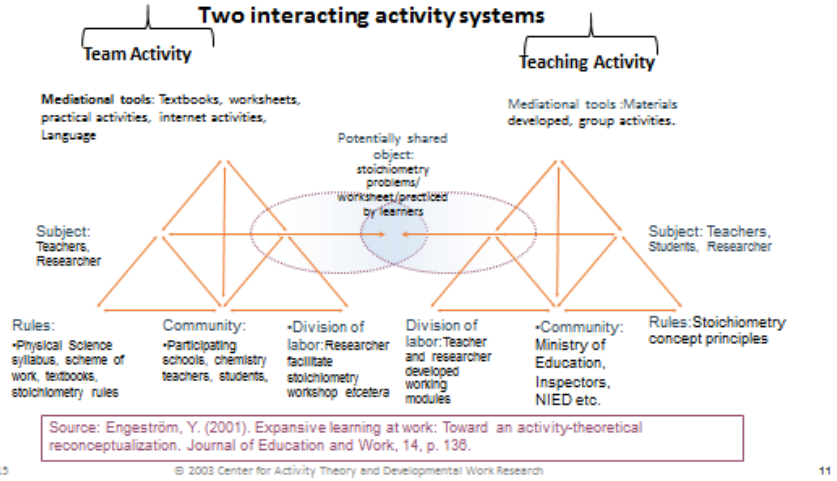
Appendices

Figure 3: The third generation activity – and this study



TRADITIONAL LESSON PLAN MODEL

TOPIC:-

PRIOR KNOWLEDGE:-

BEHAVIOURAL OBJECTIVE:- By the end of the lesson student should be able to

METHODOLOGY:-

LESSON PROCEDURE:

STEP 1

STEP 2

STEP 3

RELECTION ON LESSON PRESENTED

CHAT MODEL LESSON PLAN

Name of Lesson:

Grade Level: _____ **Subject:** _____ **Prepared By:** _____

Overview & Purpose	**Education Standards Addressed**

	Teacher Guide	**Student Guide**	
Objectives (Specify skills/information that will be learned.)			**Materials Needed** • • •
Information (Give and/or demonstrate necessary information)			
Verification (Steps to check for student understanding)			**Other Resources** (e.g. Web, books, etc.)
Activity (Describe the independent activity to reinforce this lesson)			
Summary			**Additional Notes**

Note: printable courtesy of LessonPlans4Teachers.com

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