
Title	A collective case study of IT integration in Singapore secondary schools
Author(s)	Shanti Divaharan and Lim Cher Ping
Source	<i>AARE Conference, Fremantle, Australia, 2-6 December 2001</i>

This document may be used for private study or research purpose only. This document or any part of it may not be duplicated and/or distributed without permission of the copyright owner.

The Singapore Copyright Act applies to the use of this document.

DIV01082

A collective case study of IT integration in Singapore secondary schools

Shanti Divaharan and Lim Cher Ping, Nanyang Technological University

The focus of this qualitative research is to study how Information Technology (IT) is used by teachers to support students learning effectively in Singapore secondary schools. The study would focus on the manipulation of IT as a tool, which encourages effective learning to take place with the presence of any of the core thinking skills as presented in Dimensions of Thinking framework proposed by Marzano, et.al. among Singapore secondary school students.

Activity Theory would be adopted as the theoretical framework for this study. Activity theory is a philosophical framework that provides the structure to study various human interaction and practices within the context of development. By using activity theory as a framework, it is hoped that the study would be able to observe, analyse and report on the interaction between the various factors, which influence the use of IT to support students learning.

It is hoped that once completed, the study would provide insight to educators and researchers on how IT can be successfully used to scaffold students' cognition to optimise their capacity and potential to think and become life long learners. At this stage, however, the report would focus on the methodology of the study.

A collective case study of IT integration in Singapore Secondary Schools.

Introduction

The focus of this research study is on the teacher in an Information Technology (IT)-based classroom. The study hopes to look into the factors, which facilitate the use of IT by the teacher in the classrooms to support students' learning. Consequently, the study will focus on the teacher, per se, and how the teacher manipulates the use of IT to enhance or espouse students' learning process. The study would further analyse the classroom setting and school setting, thereby attempting to identify, analyse and describe the socio-cultural factors that espouse the teacher in the use of IT to support students' learning.

Master Plan for Information Technology (IT) in Education

The Master Plan for IT in Education (MPITE) was launched in April 1997. The goal of the MPITE was to integrate IT in education as a strategy to meet the challenges of the 21st century. The skills required by our students to meet the needs of the future will centre on "thinking skills, learning skills and communication skills. IT-based teaching and learning would be one of the key strategies for equipping our young with these skills" (MOE, 1997). Briefly, the MPITE has four main goals:

1. Enhance linkages between the school and the world around it, so as to expand and enrich the learning environment.
2. Encourage creative thinking, lifelong learning and social responsibility.
3. Generate innovative processes in education.
4. Promote administrative and management excellence in the education system.

The focus and interest of this paper is on the second goal, where the study hopes to research on how IT is used as a tool in the classroom by teachers to support students' learning. It is timely to conduct the study at this point, as according to the MPITE, Phase 3 schools have already been inducted into the IT integration process. In fact, Phase 3 schools were initiated in 1999 and are due for completion by the year 2002. By 2002, all school in Singapore, all 362 schools, will be fully equipped with the necessary hardware and infrastructure which will support an IT integrated

learning environment. By December 1999, the teacher-computer ratio for Phase 3 schools was 2:1 and the pupil-computer ratio was 6.6:1 for 3 primary schools and 5:1 for 3 secondary schools. The aim of the MPITE is to eventually equip schools with hardware such that the pupil-computer ratio will be 2:1 with 30% of IT-based curriculum time.

Table 1: Master Plan for IT in Education implementation schedule

<i>Year</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>
Approval of MPITE	Ö					
Phase 1: 22 schools	Ö	Ö	Ö	Ö	Ö	Ö
Phase 2: 86 schools		Ö	Ö	Ö	Ö	Ö
Phase 3: 254 schools			Ö	Ö	Ö	Ö

However, moving beyond the hardware in place, it is far more important to focus on how the technology is being used such that effective learning takes place.

Focus of the study

Effects with technology

As Gavriel Salomon (1991) describes, "...although our attention is focused on computer technology, we are fully aware that computer technology, in and of itself, is of little interest. What is of interest and can potentially affect students' intellect are the kinds of programs and tools that can be used with this technology, as well as the kinds of activities that they can afford". Thus, this brings about the 2 kinds of cognitive effects. They are:

1. Effects with technology – obtained during intellectual partnership with the computer; and
2. Effects of technology – referring to the transferable cognitive residue that this partnership leaves behind.

This research study will focus on the effects with technology cognitive effects. In order to study the cognitive effects with the use of technology, the study must focus on the whole social and cultural milieu in which instruction takes place (Salomon, 1991). This means that it is not the technology alone that is affecting the minds but the whole culture of learning that takes place in the classroom – students' role, teachers' role, activity, lesson objectives, and many more exert their combined effect to achieve effective learning through the use of IT as a tool to support students' learning. In order to identify, analyse and describe the factors that facilitate the use of IT by the teacher to support students' learning effectively, the study has adopted the activity system framework to explain the interplay of the factors.

Effective learning – Core thinking skills

In order to identify the factors, which espouse the teacher's use of IT to support students' learning, the study needs to recognise effective learning taking place during the IT-based lesson. The study defines effective learning to taking place when the students exhibit any of the core thinking skills adapted from the framework developed by Marzano(1988) in *Dimensions of Thinking: A framework for curriculum and Instruction*. These lessons would then be analysed according to the framework provided by the activity system to identify, analyse and describe the factors, which facilitate the teachers use of IT to support students' learning. The study has adopted Marzano's framework of core thinking skills which are – focusing skills, information-gathering skills, remembering skills, organising skills,

analysing skills, generating skills, integrating skills and evaluating skills. These skills have been further elaborated in Table 2.

Table 2: Core thinking skills

<i>Main category</i>	<i>Sub-category</i>
Focusing skills	<i>Attending to selected pieces of information and ignoring others</i>
	1. Defining problems: clarifying needs, discrepancies or puzzling situations.
	2. Setting goals: Establishing direction and purpose.
Information-gathering skills	<i>Bringing to consciousness the relevant data needed for cognitive processing</i>
	3. observing: obtaining information through one or more senses.
	4. Formulating questions: seeking new information through inquiry
Remembering skills	<i>Storing and retrieving information</i>
	5. Encoding: storing information in long-term memory
	6. Recalling: retrieving information from long-term memory
Organising skills	<i>Arranging information so it can be used more effectively</i>
	7. Comparing: noting similarities and differences between or among entities.
	8. Classifying: grouping and labelling entities on the basis of their attributes.
	9. Ordering: sequencing entities according to a given criterion.
	10. Representing: changing the form but not the substance of information.
Analysing skills	<i>Clarifying existing information by examining parts and relationships.</i>
	11. Identifying attributes and components: determining characteristics or parts of something.
	12. Identifying relationships and patterns: recognising ways elements are related.
	13. Identifying main ideas: identifying the central element.

	14. Identifying errors: recognising logical fallacies and other mistakes where possible and correcting them.
Generating skills	<i>Producing new information, meaning, or ideas.</i>
	15. Inferring: going beyond available information to identify what may be reasonably true.
	16. Predicting: anticipating next events, or the outcome of a situation.
	17. Elaborating: explaining by adding details, examples, or other relevant information.
Integrating skills	<i>Connecting and combining information</i>
	18. Summarising: combining information efficiently into a cohesive statement.
	19. Restructuring: changing existing knowledge structures to incorporate new information.
Evaluating skills	<i>Assessing the reasonableness and quality of ideas.</i>
	20. Establishing criteria: setting standards for making judgements.
	21. Verifying: confirming the accuracy of claims.

(From *Dimensions of Thinking: A Framework for Curriculum and Instruction*, Marzano, R. J. & et.al. 1997)

Objectives of the study

The main objective of the study is to identify, analyse and describe the factors that facilitate the use of IT by teachers in a secondary school classroom to support students' learning.

In order to identify the factors, the study would focus on the following:

At the classroom level:

- i. The types of IT tools that the teacher has used;
- ii. The teachers' rationale for using IT as one of the tools;
- iii. How the teacher has manipulated IT as a tool;
- iv. Teacher's perception of the use of IT
- v. Formal training teacher has received in how to use IT.
- vi. Support that the teacher receives in integrating IT into the lesson.

- vii. Students' perception of the use of IT in learning;
- viii. Types of IT use by the students;
- ix. Types of support given to students during lesson; and
- x. Types of training students' receive to acquire the skill in using IT.
- xi. Types of non-IT tools, which provide support for the eventual use of IT to support students' learning.

At the department level:

- i. The vision, mission and policy of the IT department;
- ii. Support provided by the IT department to teachers;
- iii. Management of IT resources by the IT department;
- iv. Procedures, rules and guidelines set by the department; and
- v. Training and sharing sessions encouraged by the department.

At the school level:

- i. School policy, mission and vision;
- ii. Support provided by the school management (namely, vice-Principal and Principal)
- iii. Creating opportunities for the teachers to share their experiences and knowledge;
- iv. Training for the teachers;

In order to systematically identify, analyse and describe the socio-cultural milieu that surrounds an IT-based classroom lesson, the study has adopted the activity system as a theoretical framework

Theoretical framework

Activity Theory

Activity Theory is a cross-disciplinary framework for studying different forms of human practices, factoring in the process of context as developmental processes, both at the individual and social levels at the same time, including the use of artefacts. (Kuutti, 1997). Activity Theory is a research framework and a set of perspectives originating in Soviet psychology in the 1920s (Nardi, 1997). It is a powerful and clarifying descriptive tool rather than a strongly predictive theory.

Engestrom (1990) views the human activity as an interdependent system, where there is constant interaction with the socio-cultural factors surrounding the context within which a person functions. This system of human activity is made up of a subject, object of the activity and the tools that are used in the activity. This is further explained in the following diagram 1.

Diagram 1: Activity System

As Engestrom (1990) claims, human system is socially-bound and not simply the sum of individual actions. The interaction in the human system is dynamic and constantly changing and evolving. Thus, in order to capture this dynamic system, the activity system can be used as a framework to provide a reasonable description of the activity that goes on.

The production of any activity involves a subject, the object of the activity, the tools that are used in the activity and the actions and operations that affect an outcome (Nardi, 1996). Subject refers to the individual involved in the activity – for the purpose of this study, it would be the students. Object refers to the physical or mental product that is sought – in this case would be the learning outcome from the students – thinking and learning skills. Activity itself contains various artefacts that play a mediating role in order for the subject to achieve the intended object. These artifacts could be instruments, methods, people, etc. In addition, to being influenced by artifacts, activity theory takes into consideration cultural factors and developmental aspects of human mental life (Bodker, 1991; Leont'ev,1978).

The following are some of the artifacts as defined by the activity system. (i) Tools, which refer to anything used in the transformation process – computers, instructional materials used by the teachers and learning environment. (ii) Community within which the subjects work. In this case, the community would refer to the classroom within which the students function in. (iii) Division of labour, which refers to the various roles adopted by the members of the community. In this case, it would refer to the roles adopted by the students and the teachers which functioning in the community. Finally, (iv) rules and regulations form another mediation factor that govern the activity within the system. This could refer to rules in the school to computer lab rules and so on.

Activity becomes actions (with conscious effort) but once the action becomes automatic, then it becomes operations (where at this stage there is less conscious effort). It is a dynamic process (e.g. operations can be disrupted and then become actions where conscious effort is required). The focus of this study is not on operations which are automated actions. Rather, the focus of this study is on the activity that takes place in an IT-based classroom that supports effective learning among the students.

The use of the activity system as a framework for this study would help provide insight into the natural activity system that takes place in the classroom. Not only will it help to identify the factors that lead to successful IT integration, the framework will help to provide insight into the interaction that takes place between and amongst the various mediating

artefacts in the activity system which enable effective learning to take place with IT as a mediating tool. In addition, the framework also considers the historical and developmental phases of IT integration process that is unique to each school.

Methodology

It is hoped that data can be collected to observe the actual interplay of the socio-cultural factors that suggest effective learning taking place in an IT-based classroom learning environment. The data collection will be done in two phases. The first a quantitative survey followed by a qualitative method of data collection.

The first phase consists of a self-reporting questionnaire, which was sent to all the secondary schools in Singapore questioning them on their level of IT integration. The questionnaire focused on the following: school IT culture, pupil use of IT, teacher use of IT, management of IT resources and staff development. Based on the responses from the school, three secondary schools have been selected. One is an independent school, the other a government-aided school and the third, a government school. These schools would be representative of the types of secondary schools that make up the Singapore education system. An independent observer was sent to the schools to verify the self-reporting information gathered from the questionnaire. This was done to validate the information reported by the school. The second phase of data collection will be done in the following manner.

- i. About 15 Classroom observations per school will be conducted which amounts to a total of 45 observations. These observations will enable the capturing of data in a naturalistic setting with no interventions on the part of the researcher. The observations would be of any IT-based lessons irrespective of the discipline. However, the aim of the research is to capture data across as many disciplines as possible.
- ii. This will be followed by interviews with the teachers who taught these IT-based lessons. All the teachers will be interviewed so as to verify the observations made as well as to expand on why some actions took place during the course of the lessons. These interviews will serve to triangulate the information gathered from the classroom observations.
- iii. In addition, interviews will be conducted with selected students based on criterion sampling (criteria to be developed at a later stage based on classroom observations). Again, it is hoped that these interviews with the students would provide insight to the lessons that were observed and would help clarify any doubts that may arise in the course of the classroom observations.
- iv. A general questionnaire will be given to the teachers and students who were involved in the study to capture their perceptions, experiences, and opinions of IT-based lessons. Again, it is hoped that this questionnaire will capture whatever data possible to explain the activities that take place in an IT-based classroom and to answer why these activities take place.
- v. Finally, interviews will be conducted with the Principal of the school and the Head of Department for IT. These interviews together with relevant documentation would enable the gathering of data that would help trace the development of an IT-based learning environment in the school.

Significance of the study

With IT hardware and supportive infrastructure for IT-based learning to take place, the study hopes to focus on the factors that facilitate, espouse and encourage the teacher to use IT to support students' learning. By identifying, analysing and describing the factors, the study hopes to present a framework of IT integration in secondary schools that has been successful in supporting students learning effectively. This framework of IT integration with emphasis on pedagogical practices in the classroom would prove useful to educators and practitioners to encourage the use of IT in secondary schools.

References:

Bodker, S. Activity Theory as a challenge to systems design. In H.E. Nissen, H.K. Klein, & R.Hirschheim (Eds.), *Information systems research: Contemporary approaches and emerging traditions*. Amsterdam:Elsevier.

Engestrom, Y. (1990). *Learning, working and imagining: Twelve studies in activity theory*. Helsinki: Orienta-Konsultit Oy.

Kuutti, K. (1997). Activity theory as a potential framework for human-computer interaction research. In B.A. Nardi (Ed.), *Context and consciousness: Activity Theory and human-computer interaction*. Cambridge, MA: MIT Press.

Leont'ev, A.N. (1978). *Activity, consciousness and personality*. Englewood Cliffs, NJ: Prentice-Hall.

Marzano, R.J., Brandt, R.S., Hughes, C.S., Jones, B.F., Presseisen, B.Z., Rankin, S.C. & Suhor, C. (1988). *Dimensions of Thinking: A Framework for Curriculum and Instruction*. USA: Association for Supervision and Curriculum Development

Ministry of Education (1997). *Masterplan for information technology in education*. Singapore: Ministry of Education.

Nardi, B.A. (1997). Activity Theory and Human-Computer Interaction. In Bonnie, A. Nardi (1997). *Context and Consciousness: Activity Theory and Human-Computer Interaction*. MIT Press, London, England.

Nardi, B.A. (Ed.). (1997). *Context and consciousness: Activity Theory and human-computer interaction*. Cambridge, MA: MIT Press.

Salomon, G., Perkins, D.N. & Globerson, T. (1991). *Partners in Cognition: Extending Human Intelligence with Intelligent Technologies*. Educational Researcher, 20(3), 2-9.