Paper Presentation

A Case Study of The Integration of ICT in Teaching and Learning in A Smart School in Sabah

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Abstract

This research investigates teachers' views of their use of ICT in teaching and learning (T&LICT). The objective of this research was to study in depth the thoughts, beliefs and opinions of the teachers' attempt towards pedagogical improvement as part of the Smart School Project. Specifically this research examines and describes the teachers' implementation of T&LICT in the classroom in terms of the instructional practice, the instructional roles and the instructional environment. A case study research methodology is employed. The case is Sekolah Menengah Bestari (a psuedonym), which is a Smart School in Sabah. Analysis of data from 52 survey questionnaires complemented the qualitative data from the 13 interviews and 3 observations, as well as document analysis. Findings indicated that hardware and software technology infrastructure were available to support the T&LICT implementation. Nevertheless, the teachers felt it was not enough to implement T&LICT effectively. It was estimated that about half of Sekolah Menengah Bestari staff, mainly Bestari and ETeMS teachers, implemented T&LICT. Findings indicated that teacher practices were little changed. IT was used mainly to support the existing teacher-directed and teacher-centered approach. The role of the teacher extended to that of facilitating without releasing control of lesson to the students.

in relation to the integration of ICT in teaching and learning (T&LICT) is aimed at addressing the need to create a knowledge society and a technology literate workforce for the twenty-first century. Schools have a need to adopt an information-literacy curriculum; and students have a need to develop their ICT and thinking skills and take the responsibility for their own learning. Such needs would be met within a technology-enabled teaching and learning environment that emphasizes student self-direction and self-regulation. The Smart School Project is an example of a major educational change initiative to improve classroom teaching and learning practice within such an environment (Smart School Project Team, 1997). Technology, especially the computer, is seen as a critical tool to support this change in instruction by allowing and supporting inquiry and exploration by students.

1.1 Research Objectives and Research Questions

The objective of this study is to explore the views of teachersô from a Smart School in Sabah regarding how they have integrated ICT in teaching and learning. The T&LICT scenario shall be discussed in terms of its implementation fit to the desired Smart School T&LICT practice and the implementation intensity, which includes the density and the frequency of the practice. The implementation density refers to the quantity of T&LICT use by teachers in the school, the frequency of T&LICT refers to how often teachers integrate T&LICT in their lessons. The T&LICT scenario shall be viewed from three aspects: the instructional practice, the instructional roles and the instructional environment within which T&LICT took place. From the analysis of the T&LICT scenario, the development phase of the implementation shall be gauged.

e T&LICT in the classrooms ?

2. What is the development phase of T&LICT implementation in Sekolah Menengah Bestari?

1.2 Importance of the Research

This research seeks to understand the nature of the change viewed from the teachersô perspective. An analysis of the existing situation in the *Sekolah Menengah Bestari* classrooms will provide a rich description and in-depth understanding of the dynamics of the implementation of change within an organization. It is expected that all schools in Malaysia will have assimilated the Smart School practice by the year 2010 (Bernama, 2005). Knowledge of the T&LICT scenario in *Sekolah Menengah Bestari* may provide useful insights to future implementers.

1.3 Limitations of the Research

This is a snapshot case study which examines and provides a cross-sectional description of the implementation phase in the change process. Findings are drawn from data collected from interviews, documents, observations and questionnaires. The localized nature of the conclusions drawn from individualsô responses should be emphasized here. Such conclusions should be an accurate reflection of the nature and the state of the ICT integration in the school. However, caution should be exercised in extrapolating to conclude the same results for other groups not included in the study. Findings shall neither be generalized to describe the setting and conditions of the whole process of change, nor applied without modification to other cases.

on the teachersô perspective, and cautions against stakeholdersô perspectives not explicitly discussed by respondents. The researcher is also aware that the various teacher characteristics or individual differences which might influence the respondentôs perceptions.

This research is not a study of all the aspects of change with regards to the Smart School Project. It focuses on examining the views of teachers who are endeavoring to integrate T&LICT. It is an in-depth examination of the teachersô perspective pertaining to three aspects of teaching and learning in the classrooms, that is, the instructional practice, the instructional roles, and the instructional environment.

2.0 Review of Related Literature

Literature will inform the teacher developmental phases of technology integration. A discussion about teaching and learning using ICT as innovative practice will provide a background for pedagogical issues associated with the Smart School.

2.1 The Developmental Phases of ICT Integration in Teaching and Learning

The Apple Computer of Tomorrow (ACOT) research (1995) summarizes the developmental phases ACOT teachers go through as they gradually replace their traditional beliefs and practices with new ones. The report represents the teachersô development as five phases: *Entry, Adoption, Adaptation, Appropriation, and Invention*. During the *Entry* phase, the teacher learns the basics of using the new technology, after which he is ready to *Adopt* the new technology to support traditional instruction. In the *Adaptation* phase, the teacher seeks to integrate new technology into traditional classroom practice. Here, they often focus on increased student productivity

processors, spread-sheets, and graphics tools. During teacher is able to progress to focus on cooperative, project-based, and interdisciplinary workð incorporating the technology as needed and as one of many tools. Finally, in the *Invention* phase, the teacher discovers new uses for technology tools, for example, developing spreadsheet macros for teaching algebra or designing projects that combine multiple technologies. In this model, the teachersô traditional text-based curriculum delivered in a lecture-recitation-seatwork mode is first strengthened through the use of technology and then gradually replaced by far more dynamic learning experiences for students.

This study was carried out when *Sekolah Menengah Bestari* was at the implementation stage of T&LICT in the process of change. Ideally, T&LICT in *Sekolah Menengah Bestari* would achieve the stages of ñappropriationò and ñinventionò where the focus is on the studentôs use of technology as tool for cooperative work and constructivist learning.

2.2 Change towards T&LICT in the Smart School

The Malaysian Smart School was visualized as "a learning institution that has been systemically re-invented in terms of learning-teaching practices and school management in order to prepare children for the Information Age" (Smart School Project Team, 1997, p. 10). The Smart School pedagogy that integrates ICT would see a paradigm shift from the directed to the constructivist teaching and learning. Learning in Smart Schools would focus on enhancing mental development through thinking skills.

Practices

nly a one-way transfer of information from the teacher to the student, the constructivist approach to teaching and learning focuses on learning through posing problems, exploring possible answers, and developing products and presentations. The stress is more on group work than individualized work. Instead of traditional teaching and assessment methods like lectures, skill worksheets, activities, and tests with specific expected responses, the emphasis is on alternative learning and assessment methods like exploration of open-ended questions and scenarios, doing research and developing products; assessment by student portfolios, performance checklists, and tests with open-ended questions; and descriptive narratives written by teachers (Robyler, 2002, p. 56). The teacher would need to diversify teaching and learning strategies in order to meet the studentôs needs.

2.4 Changing Instructional Roles

ICT facilitates active learning. It enables the individual learning approach through self-accessed, self-paced and self-directed learning. Consequently, the teacher has to change his role from ña *sage on the stage*ò to ña *guide by the side*ò. The advocated role of the teacher is as a facilitator. There is a shift from a predominantly óteacher-controlledô paradigm (Figure 1) to that of empowering students to be more active and more independent learners.

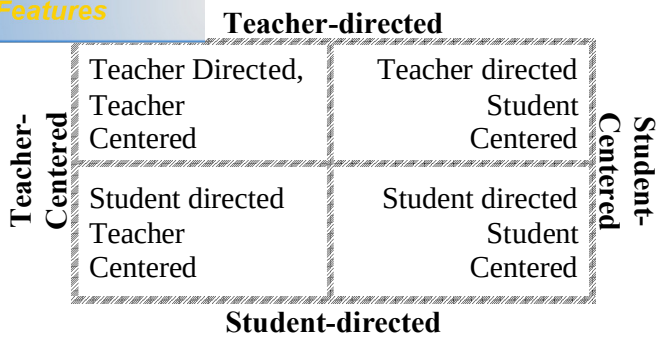

Figure 1: A teaching and learning grid

2.5 Changing Instructional Environment

Traditional classroom practices might have a tendency to foster dependence, passivity and a "tell me what to do and think" attitude (Barrell, 1993). The ICT-integrated classroom environment would see more involved individualistic participation from its learners, and the whole school would generate a culture that is ñinformed, active and thoughtfulò (Perkins, 1992, p. 3). The Malaysian Ministry of Education aims to ensure active use of ICT by the students in teaching and learning in order that they can i) speedily master ICT skills, ii) involve themselves in active learning, iii) create a culture of productive ICT use, and in the process iv) challenge their minds (Bahagian Teknologi Pendidikan, 2004, p. 23). Computer-based teaching-learning materials developed for Bahasa Melayu, English, Mathematics, and Science at both primary and secondary levels would allow shift towards more active and self-directed learning by students and an increase in teachersô time spent as facilitators of learning.

School-wide networks will facilitate access to information and learning resources, preparation of lesson plans, delivery of assigned lessons to students, delivery of

ork, communication with their peers and supervisors

asks.

2.6 A Framework of T&LICT situations and Teacher Development Phases

A simple framework demonstrates the various teaching and learning situations that highlight the roles of significant players.

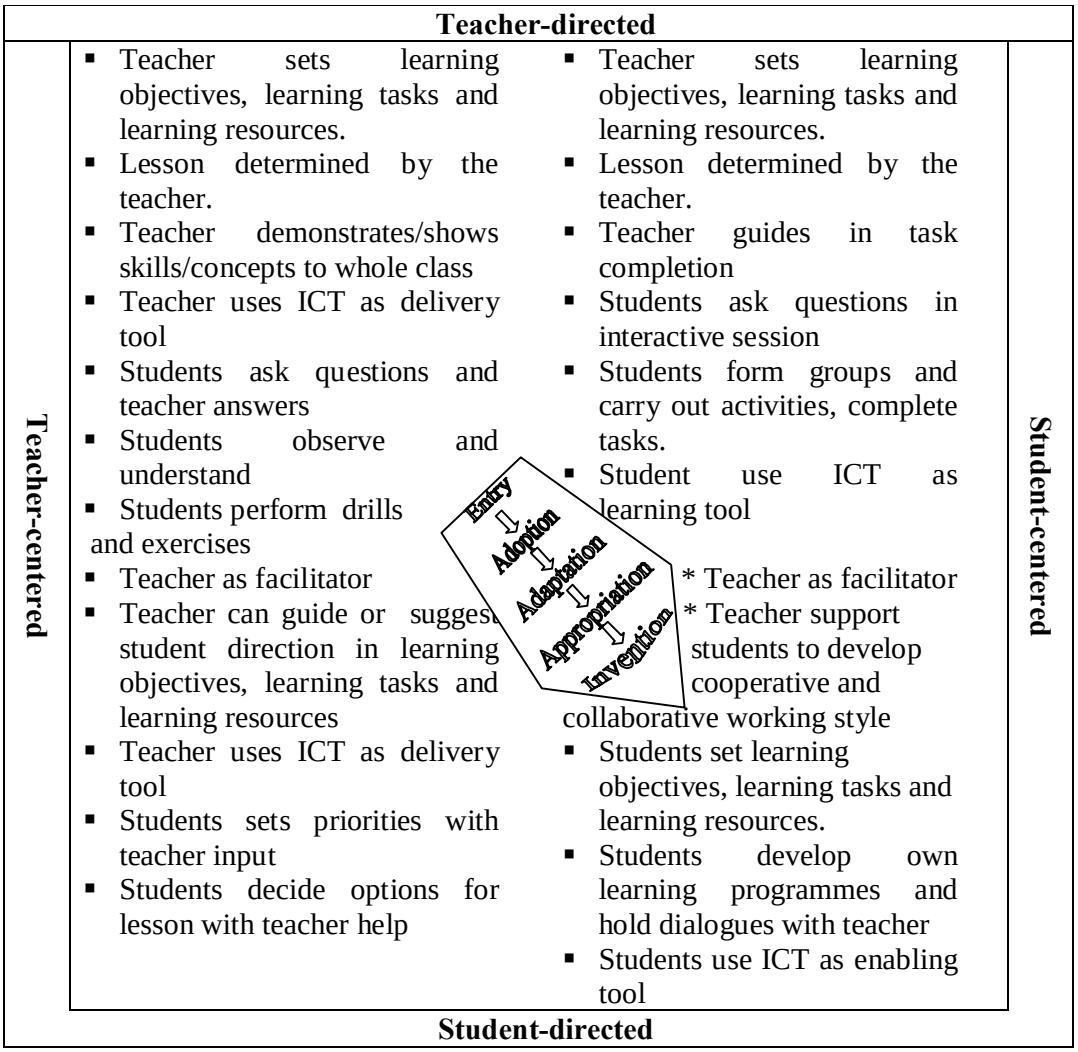

Figure 2: T&LICT situations and Teacher Development Phases
Adapted from: Teaching & Learning - Guiding Principles - Pedagogy, Smart School Conceptual Blueprint, 1997

The terms óteacher-centeredô, óteacher-directedô, óstudent-centeredô and óstudent-directedô highlighted the actor who is most active and responsible for making decisions

the T&LICT learning process. These terms do not es but rather opposite extremes along a continuum of teaching and learning strategies and teacher-student roles.

The ACOT (1995) model of the five teacher development phases is conceptualized to fit within this typology of roles and teaching and learning situations. Generally, during the *entry* phase into technology integration, the teaching and learning situation is teacher-centered and teacher-directed. Upon *adoption* and *adaptation* of technology integrated strategies, teaching and learning tended to be both student-centered and teacher-directed. As technology integration progresses into the *appropriation* and *invention* phases, the focus on the teacher gradually gave way to student-centered and student-directed instruction.

Student-directed learning would allow constructivist knowledge building rather than passive acquisition. This is the ideal T&LICT situation. It is indicated in lower right quadrant in Figure 2. It exhibits features of an educational paradigm that is emerging globally (Pelgrum & Law, 2005). The teacher has arrived at the *invention* phase of teaching and learning situation decisions and arrangements pertaining to the learning process (Figure 2, lower right quadrant). Such a situation allows the student to engage in relating new ideas and explanations to the studentôs own prior beliefs.

3.0 Methodology

To ascertain how the teachers have implemented T&LICT as part of their teaching and learning repertoire, a case study research design is employed. A Smart School was chosen as a case for this study. Data was obtained via the interview, observation,

llection techniques. Descriptive statistics from the rt the qualitative data and to provide further details to the analysis. A total of 52 respondents returned the questionnaire, of which 13 were male teachers and 39 were female teachers (Table 1). .

Table 1: Respondents' Gender Profile

	No. of Respondents	*Percent (%)*
Male	13	25
Female	39	75
Total	52	100

During the preliminary analysis, the significance of the role played by teachers involved in the ôEnglish for the Teaching of Mathematics and Scienceô (ETeMS) Project was observed. Laptop computers were issued to these teachers throughout the nation. This made them teachers with IT accessibility. The ETeMS teachers were also *Bestari* teachers. Their involvement under the ETeMS Project meant added significance towards T&LICT implementation. Among the 52 questionnaire respondents, 19 were ETeMS teachers, 4 were teaching *Bahasa Melayu* and the remaining 29 respondents taught other subjects (Table 2)

Table 2: Respondents' Profile: ETeMS, Non-*Bestari* and *Bahasa Melayu* teachers

Subject Teachers	*Frequency*	*Percent (%)*
EteMS subject teachers	19	36.5
Non-Bestari subject teachers	29	55.8
Bahasa Melayu teachers	4	7.7
Total	52	100.0

Out of the 52 questionnaire respondents, 13 teachers who had implemented T&LICT were interviewed and three observations of T&LICT integration were made. The findings of this study draws deeply from the teachersô thoughts, beliefs and views to provide a rich and thick description in the analysis. Examining the teachersô thoughts

ights into what occurs in classrooms and provides as of change taking place. In Cubanôs words (1993, p. 256), "*The knowledge, beliefs, and attitudes that teachers have…shape what they choose to do in their classrooms and explain the core of instructional practices that have endured over time*".

The researcher adopted the required protocols for human subject research. The instrument was piloted on respondents similar to those who will be included in the actual research sample. Data collection process was carried out over a period of two months. During the period of data collection process, the researcher was especially mindful of ethical behavior towards the respondents and informants. The researcher followed informed-consent rules which ensured that individuals were voluntarily participating in the research with full knowledge of relevant risks and benefits. The researcher respected the confidentiality and privacy of informants by letting them know how their data will be used, and secured their consent. Ongoing inductive analysis led the research process, and the data collected were reduced, displayed and discussed, and conclusions were drawn and verified (both through computer program analysis and researcher analysis) according to the data analysis process of Miles and Huberman (1994). Questionnaire data was analysed descriptively using the SPSS. A computer program, Atlas-ti 5, assisted in the coding, and the retrieval of codes, as well as theory development of the interview and observation data. The researcher selected what was most interesting and appropriate for presentation in the study in the form of tables and graphs. Direct quotations from the informants would be referred to by their pseudonyms followed by the line number(s) where the quotes occurred in the primary document. For example the reference ñLaim, 23:24ò indicated a direct quote from

mant) and the quoted text could be located from line 23

ment that consisted of transcribed interview text with Laim. Findings were intended to elicit the T&LICT scenario and to discuss the conditions that influence the implementation of T&LICT.

4.0 The Findings: The Integration of ICT in teaching and learning (T&LICT) in Sekolah Menengah Bestari

Sections 4.1, 4.2 and 4.3 shall answer the research question ñHow do teachers integrate T&LICT in the classrooms ?ò and section 4.4 shall answer the research question ñWhat is the development phase of T&LICT implementation in Sekolah Menengah Bestari?ò

4.1 The Instructional Practice

4.1.1 The T&LICT Implementers

When informants were asked their opinion of, ñ*How many teachers in this school are implementing T&LICT*?ò most thought that the number of teachers in *Sekolah Menengah Bestari* who have implemented T&LICT hovered around 50% of the teacher population.

> *40 - 50%. (Sable, 145:146)*
> *About half (Azura, 59:60)*
> *Maybe not up to half the school (Nelia, 140:140)*
> *About 50% of the teachers in this school (Gray, 61:61)*
> *Maybe half of the teachers in this school (Iona, 48:151)*
> *Bestari teachers using ICT not quite reach 50%; those non-Bestari teachers very seldom use (Bron, 47:47)*
> *Less than 50% (Jade, 42:42)*
> *Probably 50%. (ITC, 326:326)*
> *About 40 out of 90 teachers in the whole school (Raed, 163:164)*
> *Maybe less than half (Flavian, 104:104)*
> *Maybe we can count almost 50% have already tried (Laim, 226:226)*

Data from the questionnaire verified that 53.8% (N = 28) have either not used computers at all in their teaching or only just started teaching with computers (Table 6.10).

s for this situation were that:

> *ne to prepare for T&LICT, and teachers have other responsibilities..there are not enough computer labs; there is one Bestari lab and others for TMK..if good class in computer labs ok, but with notorious students the computer labs might be vandalized, for example. .. What is tested is different from what is available in the courseware… Courseware more suitable for remedial and enrichment (Sable, 147:153)*

Informants thought that T&LICT was implemented more by the *Bestari* subject teachers (Sable, 145:146; Laim, 215:217; Azura, 59:60; Flavian, 107:107; Lavender, 11:11; Ping, 13:13; Iona, 148:151; Nelia, 140:140) than other teachers (Bron, 47:47; Azura, 59:60). This corroborated with data from the questionnaires which indicated that all the *Bestari* subject teachers had implemented T&LICT, whereas about half of the non-*Bestari* teachers have not used ICT (Table 3).

Table 3: Years of using ICT by Subject Teachers

Years using ICT	***ETEMS subject teachers***	**%**	***not* Bestari *Subject teachers***	**%**	***BM teachers***	**%**	***Total***	**Total %**
0	0	*0.0*	15	*51.7*	0	*0*	15	*28.8*
1	6	*31.6*	6	*20.7*	1	*25*	13	*25.0*
2	4	*21.1*	1	*3.4*	2	*50*	7	*13.5*
3	3	*15.8*	2	*6.9*	0	*0*	5	*9.6*
4	1	*5.3*	1	*3.4*	0	*0*	2	*3.8*
5	3	*15.8*	2	*6.9*	0	*0*	5	*9.6*
6	2	*10.5*	2	*6.9*	1	*25*	5	*9.6*
Total	19	*100.0*	29	*100.0*	4	*100*	52	*100.0*

nts were asked, ñ*How often do you use ICT in your teaching*?ò to elicit the frequency of their T&LICT practice. Data from the interview seemed to indicate that the use of ICT in teaching and learning and its frequency of use varied with subject teachers and according to computer facilities accessibility.

Among the *Bestari* teachers, it appeared that science teachers, and to a lesser extent, Mathematics teachers, were the more frequent implementers of T&LICT (Flavian, 104:104; Nelia, 140:140; Iona, 148:151; Ping, 13:13, Azura, 59:60), and Sable (145:146) who teaches English Language herself admitted ñ*mainly science teachers, and once in a while, English teachers once in a while*ò. Ionaôs (150:151) opinion was that, *"The BM and English teachers not so much as the Maths and Science teachers."*

According to Gray (67:69), ñ. *Mathematics I seldom teach with IT. Not used to using the courseware – not being supplied with the CDs*.ò Sable (145:146), who taught English Language, also admitted that mainly science teachers, and once in a while, English teachers used IT to teach. *Bahasa Melayu* teachers comparatively used T&LICT less frequently (ITC,175). Flavian (29:29), who taught *Bahasa Melayu* and PJK also admitted that he rarely used the learning courseware.

The frequency of use was also determined by time factor and the demands to complete the syllabus. According to Raed,

> *During normal teaching time not so easy to spare time. At the beginning of the year, almost every day, almost every lesson. Starting from after the mid-year break, I found that I am far behind of the syllabus to complete. Using ICT takes up a lot of time. For example, to teach the first chapter "Lines and Angles" for Form 3, it took me 1 plus months to complete the topic. So I make my decision not teach less using ICT.*

nce of operating the trolleys was also a deterrent to in the classrooms. As ITC observed,

> *Those classes with trolleys, some teachers also quite reluctant to bring the trolley out. To them it is quite tedious. If I were the teacher, I think I would prefer to do the traditional teaching. Saves all the time. Very recently, the teacher he took all the effort to bring out the trolley and set up every thing. And then the last part he noticed one of the cable is not there. So it is quite upset.*

In the questionnaire, respondents were asked ñ*How often do you use T&LICT?*ò. 15 (28.8%) of the respondents never used ICT to teach (Table 4). All of them were non-*Bestari* subject teachers.

Table 4: Frequency of the use of ICT by subject teachers

Frequency of use	Bestari *teachers*	%	*Non-* Bestari *teachers*	%	*Total*	%
Not using	0	*0.0*	15	*51.7*	15	*28.8*
Once or twice a semester	13	*56.5*	11	*37.9*	24	*46.2*
Once or twice a month	6	*26.1*	1	*3.4*	7	*13.5*
Once or twice a week	2	*8.7*	1	*3.4*	3	*5.8*
Almost every day	2	*8.7*	1	*3.4*	3	*5.8*
Total	23	*100.0*	29	*100.0*	52	*100.0*

They also made up 51.7% of the non-*Bestari* teacher respondents. 24 (46.2%) respondents used ICT for teaching only once or twice a semester. They make up about two-third (64.9%; 24 out of 37) of the respondent who used ICT. More than half (56.5%; 13 out of 24) of them were *Bestari* teachers. 89.6% (26 out of 29) of the non-*Bestari* teachers were either implementing T&LICT once or twice a semester, or not at all. About 26% of *Bestari* teachers implemented T&LICT once or twice a month. Less than 20% of the *Bestari* teacher respondents used ICT weekly.

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tegies in Sekolah Menengah Bestari are derived from classroom observation notes supplemented with additional information from the other informants. Lesson observations were made on classes conducted by Gray, Lavender and Sable who taught the *Bestari* subjects.

It was observed that the lessons that integrated ICT were teacher directed strategies. Prior planning and pre-teaching preparations were necessary for a T&LICT lesson. The teachers made decisions on the topic, materials and strategy. It was noted that prior to her lesson, Lavender had decided on her delivery strategy and the materials to be used for her Form Four *Bahasa Melayu* class. Gray and Sable had also planned their content and delivery strategies prior to the lesson.

The set induction and input stage also followed similar practice. Gray started the lesson by demonstrating an experiment. Lavender instructed the students seating two to three in a group to read the text she has preloaded into the teacher terminal. Sable showed two pictures of weather on the projection screen, one clear and another hazy, and then she asked the students questions about pollution to generate ideas.

The normal practice during the lesson development phase was the focus on input by the teacher. At this stage, the lesson was devoted to the discussion of content (Lavender:Obs). The input normally came from the teacher, usually in the form of a Power Point presentation, or contents from a CD courseware, or demonstration. The students listened and read the text on the computer terminal, and answered the questions directed to them. This stage of the lesson was teacher-centered.

l Learning Strategies Used by Respondents

; strategies?	*N*	*Mean*	*Std. Dev.*
Directive : direct instruction	52	4.06	.461
Individual learning (self-accessed, self-paced, self-directed)	52	2.69	.579
Cooperative/Collaborative Learning (group work)	52	3.60	.603
Distance Learning (e-mail, video conferencing)	51	1.00	.000
Experiential Learning (simulation software and virtual reality)	52	3.71	.997
Research, Reference, and Data Search	50	2.58	.835
Electronic Assessment (On-line assessment)	50	1.50	.863
Drill and Practice	50	3.86	.881
Chalk and talk	50	3.48	.863
Valid N (list wise)	50		

1 = never 2 = seldom 3 = sometimes 4 = often 5 = almost all the time

Sable thought that teaching activity using ICT was ñnot so much different from the usual teachingò (Sable, 93:93). According to Azura (68:68), ñnot use IT to teach and using IT to teach, the strategies are the same. But use IT to teach not as much explanation by the teacherò. This was supported by data from the questionnaire (Table 5), which indicated that teachers often employed direct instruction and sometimes did group work, drill and use of software. Teachers seldom implemented individual learning.

Some teachers still preferred the traditional method of drill and practice (mean = 3.86, SD = 0.88) and chalk and talk (mean = 3.48, SD = 0.86). There were certain issues that made teachers prefer teaching in class. ITC said,

> *The teachers prefer to teach in the class rather than come to the lab. They prefer the traditional teaching. Even though we have teachers who have attended ETeMS courses, they come back and still use the traditional method, even though with all the training all the courses provided. Many of the teachers have their own laptops, but still prefer to teach using chalk and talk. Probably to them it is a bit tedious to carry the laptop with them.* (ITC, 262:268)

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The teacher directed instructional practices determined the teachersô roles. Data from the questionnaire (Table 6) reported that the teachers seldom allowed students to decide on the tasks and resources for teaching and learning (mean = 2.75), and on the objectives for teaching and learning (mean = 2.21), but sometimes facilitated learning, not just teaching (mean = 3.44), and also sometimes guided students in their tasks (mean = 3.90).

Table 6: Role as a teacher

In your class, do you……..?	*N*	*Mean*	*Std. Deviation*
allow students to decide on the tasks and resources for T&L	52	2.75	.905
allow students to decide on the objectives for T&L	52	2.21	.871
facilitate learning, not just teaching	52	3.44	.698
guide students in their tasks	52	3.90	.569
Valid N (list wise)	52		
1 = never 2 = seldom 3 = sometimes 4 = often 5 = almost all the time			

The teachers perceived that they played the role of a facilitator. The belief about their role as a facilitator was basically that of going round the class from group to group monitoring their task progress and mediating where it was deemed necessary and guiding the students in their tasks. For example, what Raed (111:112) did was, ñ*As a teacher, I facilitate the students to understand more, and do translation. I help the students by walking around.*"

4.2.2 The Studentsô Role

ñ*The role of the student is to complete the work directed by the teacher*ò (Flavian, 92:92). This statement reflected the views of teachers regarding their expectation of

following notes were made during an observation of

> *The students are generally working on their task. They accessed the text in the computer and were reading the passage while completing their task. Students know their roles and task within the bilik simulasi. Student appeared to accept teacher's decision and follow instructions.* (Lavender:Obs).

Group work and discussion appeared to be the preferred teaching-learning strategy used by teachers. They expected the students to complete their task within their groups.

> *The students shared computers and worked in pairs or threes. They were working on the same piece of work and levels, as directed by the teacher. Students use the computers to do their work.* (Lavender:Obs).

Data from questionnaire (Table 7) indicated that the respondents thought the students were sometimes active learners (mean = 3.12) and were sometimes able to cooperate and collaborate in group work and projects (mean = 3.25). However, respondents felt that the students were seldom self-accessed, self-paced and self-directed (mean = 2.85) and independent learners (mean = 2.87).

Table 7: Student Roles in Teaching and Learning

Are your students ……?	*N*	*Mean*	*Std. Dev.*
self-access, self-paced and self-directed learners	52	2.85	.802
Independent learners	52	2.87	.742
Active learners	52	3.12	.832
Able to cooperate and collaborate in group work and projects	52	3.25	.653
Valid N (list wise)	52		
1 = never 2 = seldom 3 = sometimes 4 = often 5 = almost all the time			

had more chances to use the computer in the *bilik* There were 20 computers in the *bilik simulasi* for students although not all were fully functional.

It was felt that ICT facilities in the *bilik simulasi* were not optimized for constructivist learning.

> *Students worked on the exercises in the TLM on "Description of Places". This is basically an interactive drill and practice software with some preliminary tutorial input. Students are not producing any original work.* (Sable:Obs)

In the classroom the computer was usually used by the teacher (Laim, 255:255). The students had little chances of using the computer.

> *During exercise in answering questions, the students come to the front and key in the answers on the teacher's computer. There is no other way of access to computer usage in the classroom. In the classroom the teacher uses the computer; the students do not.* (Ping, 52:53, Laim, 255:255)

The studentsô limited access to ICT in the classrooms meant that they had little opportunities to develop their ICT skills. According to some teachers:

> *The students need to be given a briefing on teaching using IT. We need students to be skilled in computer (Gray, 157:158)*
>
> *Student's knowledge in using IT is low. Teachers had to teach them how to use the computer at the same time teacing the topic (Jade, 102:103).*
>
> *The rate of students using computer is very low, because the student here is quite poor.* (Laim, 180:181).

4.3 The Instructional Environment

4.3.1 ICT Infrastructure

The *Bilik Simulasi* was allocated only for the use of the teaching and learning of the four *Bestari* subjects, namely, English, *Bahasa Melayu*, Science and Mathematics from

137; Ping, 126:126; Lavender, 39:39). This restricted

nodate the whole school requirements.

> *We have only one lab and then with so many classes, and that will have time table for the classes* (ITC, 55:56).

Under the ETeMS Project, laptop computers with LCD projectors and teaching-learning materials were widely distributed by PPK to the ETeMS teachers. The English Language department had four units of laptops, Mathematics, 8 units and Science, 7 units. No laptop computer was issued to *Bahasa Melayu* teachers, or other subject teachers. The teachers were encouraged to implement T&LICT in the classrooms. The mobile classroom trolleys with electrical fixtures were available for laptop support in all classes in Form 1 and Form

4.3.2 Where T&LICT was implemented

Bahasa Melayu teachersô implementation of T&LICT was located only in the *Bilik simulasi*. Flavian (11:11) ñ*used IT for BM in bilik simulasi, but not in the classroom".* ETeMS teachers implemented T&LICT in the *Bilik simulasi* and classrooms; Mathematics and Science teachers sometimes use the laboratory.

> *I teach in the bilik simulasi and also have a computer to teach physics and mathematics (Gray, 67:67)*
> *I used IT to teach in the classroom a few times (Jade, 74:74).*
> *I use IT in the classroom and in the Bilik simulasi (Ping, 52:52).*
> *My English Lesson can be in the Bilik simulasi and also in the classroom (Sable, 83:83).*
> *Form 1, form 2, form 3 Science, usually they have lesson in the lab (Laim, 267:268).*
> *I teach in the lab (Gray, 67:67).*
> *I entered the Bilik Simulasi (Lavender,12:12.)*

Some teachers who have their own computers preferred to use the classroom rather than the *bilik simulasi*. For example, Jade felt that classroom teaching eased student

ng to ITC,

ey are quite reluctant to bring the students..
Maths teachers prefer to teach in the class (11: 11).
Mathematics teachers usually bring the students for revision(16:17)
Teachers prefer teaching in classroom. Easier to control the students (5:6).
Some teachers they prefer to bring their students to the science lab by using the notebook and LCD and explain instead of bringing the students here (32:34).
We have all the facilities needed to bring the LCD to the classroom and do their teaching in the classroom (124:125)

In the questionnaire, respondents were asked, ñ*Does your class resemble the following arrangement?*ò Data from respondents indicated that teachers sometimes used to teach the class in group arrangements with no computers (mean = 3.15) and in whole class arrangements (mean = 3.02). They seldom taught in group arrangements with one computer (mean = 2.46) and in a whole class arrangement using one computer (mean = 2.52). Teachers almost never taught in a class where there were computers per group (mean = 1.87) or computers for every student (mean = 1.50).

It appeared that ETeMS teachers often used the whole class method with one computer (Table 8) for delivery of instruction (mean = 4.32); and sometimes used the group method with one computer (mean = 3.84).

Table 8: How Subject Teachers Manage Classroom Arrangement

	ETeMS subject N = 19	not *Bestari* subject N = 29	BM N = 4	Overall N = 52
group with no computer	2.63	4.07	3.75	3.15
group with 1 computer	3.84	1.76	1.07	2.46
1 computer per group	2.79	1.34	1.25	1.87
1 computer per person	1.74	1.21	2.00	1.50
whole class	2.11	3.24	3.25	3.02

		not *Bestari* subject N = 29	BM N = 4	Overall N = 52
arrangement whole class with 1 computer	4.32	1.52	1.25	2.52

1 = never 2 = seldom 3 = sometimes 4 = often 5 = almost all the time

However, they seldom had the opportunity to provide access to computer for every student (mean = 1.74). Non-*Bestari* teachers, on the other hand, often taught in groups (mean = 4.07) and sometimes taught with whole class arrangement (mean = 3.24), but almost never used computer in any arrangement for teaching and learning (means = 1.76, 1.34, 1.21, 1.52). *Bahasa Melayu* teachers only have access to computers in the *bilik simulasi*. They sometimes taught in groups (mean = 3.75) or as a whole class (mean = 3.25); they seldom had the opportunity to allow students one computer each (mean = 2.00).

Respondents were asked where they implemented T&LICT in which they may make multiple selections (Table 9). ETeMS teachers responded that they used to teach in the computer laboratory, *bilik simulasi* and classroom; *Bahasa Melayu* teachers taught in the *bilik simulasi* and classroom. Fifteen of the non-*Bestari* teachers had not implemented T&LICT anywhere; others have taught in the above mentioned places and elsewhere.

Table 9: Where T&LICT is used by Subject Teachers

Where use T&LICT	*ETeMS teachers*	*non*-Bestari *teachers*	*BM teachers*
nowhere		15	
computer laboratory	9	5	
Bilik *Bestari*	12	11	2
classroom	10	5	4
other places		3	

ources

the *Bestari* subjects (Laim, 184:184; Lavender, 11:11) in the form of Smart School TLM. The ETeMS project provided stand alone CDs (Laim, 190:191; Raed, 29:29). There were also CD courseware for Agama Islam (ITC, 332:333) and Science for Form six (Laim, 26:26). There were also stand alone courseware CD supplied by BTP as well as CDs that came with textbooks (Azura, 35:37; ITC, 40:41; Sable, 38:40; Laim, 190:190).

Table 10 shows the teaching and learning resources used by the teachers.

Table 10: Teaching and Learning Resources Used by Teachers

Do you use the following resources during T&L?	*N*	*Mean*	*Std. Dev.*
Application software (example Data processing, word processing, graphic presentation)	52	2.48	1.13
CD-ROM Interactive learning courseware ï Bahagian Teknologi Pelajaran	52	2.19	1.14
Teaching-Learning Modules ï Smart School Integrated Solutions (SSIS)	52	2.00	.97
CD-ROM Interactive learning courseware ï Commercial	52	1.71	.78
Internet	52	2.48	.98
E-mail	52	1.73	.91
Workbooks and worksheets	52	3.58	1.05
Textbooks	52	3.85	.85
Computers and LCD Projector	52	2.73	1.14
Chalk & Board	52	3.58	.94
television and video player	52	1.62	.75
audio cassette player	52	1.69	.83
3-dimensional objects	52	1.98	1.06
Valid N (list wise)	52		

Data from the respondents indicated that chalk and board (mean = 3.58), textbooks (mean = 3.85) and workbooks (mean = 3.58) were the more preferred resources used compared to digital based resources.

resources used between *Bestari* teachers (ETeMS and *non-Bestari* teachers. Textbooks, workbooks and worksheets and chalk and board were the teaching and learning resources more regularly used by *non-Bestari* teachers than the *Bestari* teachers.

Table 11: Teaching and Learning Resources Used by Different Subject Teachers

Resources Used	*ETeMS and BM subjects*	non-Bestari *subjects*
application software	3.07	2.10
CDRI BTP	2.77	1.72
TLM SSIS	2.61	1.59
CDRI Commercial	1.82	1.59
Internet	2.94	2.28
E mail	1.85	1.59
workbooks & worksheets	3.41	3.62
textbooks	3.72	3.83
computers & LCD	3.18	2.41
chalk & board	3.51	3.62
TV & video	1.79	1.59
audio player	1.92	1.55
3-D objects	2.13	1.79

1 = never 2 = seldom 3 = sometimes 4 = often 5 = almost all the time

The non-*Bestari* teacher respondents seldom or never used the ICT based resources. These include computers and LCD projectors (mean = 2.41), application software (mean = 2.1), CDRI (means = 1.72, 1.59), Internet (mean = 2.28), TLM (mean = 1.59), e-mail (mean = 1.59) and audio visual aids (means = 1.59, 1.55, 1.79). They were comparatively used more by the *Bestari* teachers than non-*Bestari* teachers (Figure 3).

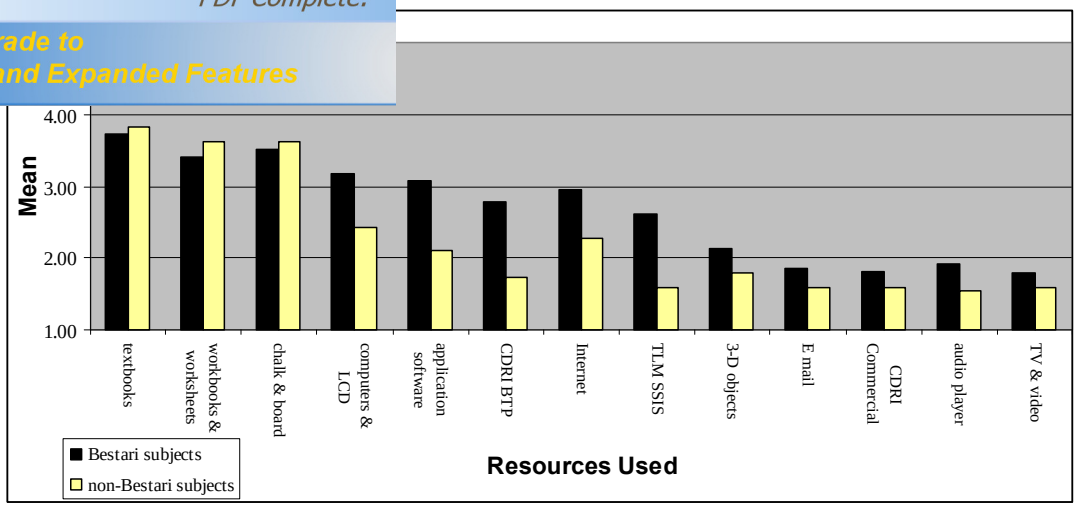

Figure 3: Teaching and Learning Resources Used by Different Subject Teachers

Informants found the TLM useful: ñ*...in the Bestari program they got all these courseware that can use to teach the students*ò (Laim, 22:23), and ñ*we find the stand alone CD helpful*ò (Laim, 192:192). This is especially so for certain topics in subjects like Science, ñ*...like myosis, mytosis probably more interesting we use the courseware*ò (ITC,159:160). The CD courseware also has assessment, quiz (Laim, 121:125) so much so that ñ*now we are actually using the courseware as ABM to teach biology*ò (Laim, 27:27).

> *The software from Kementerian is useful. It is quite good. The animation is very nice. I think it is enough, because if we too much animation, it becomes boring for the students. Cannot depend all on animation* (Laim, 163:165).

Sable (38:40) found it convenient to use the CD that came bundled with textbook. She projected the contents on the screen and students go through the textbook. In that way, they were paying attention to the CD and at the same time answering the questions in the text book.

Furthermore there is the

> *ing the CD is 3-D. Sometimes when you talk*
> *dents cannot imagine what the concept is all*
> *ourseware, because they design the courseware 3-d with animation, so the students can really have a clear vision of it, because if we don't the animation, quite hard to make students to imagine about the concepts. So actually that one make our job easier*ò (Laim, 76:80).

The BTP and TSS produced learning materials appeared to be suitable for modes such as drill and practice, simulations, instructional games and electronic book. Lavender (26:26) used the TLM to give exercises to the students. Raed found the courseware in the CD

> *...complete already, including all the induction set, and the objective. Everything in side there. When we put on the CD on the screen, basically we don't do much. Let the CD talk everything and then the only thing that I do in the class is to facilitate the students to understand more* (Raed, 108:112).

> *In that courseware there is an audio, there is visual as well. In this courseware also they show what will they learn that day, the objective of the lesson of the day. They give the scenario of the lesson, everything, the examples. That's the whole thing. After giving all the examples, the CD also give one particular exercise for the students to try* (Raed, 142:145).

4.4 The Development Phase of T&LICT in *Sekolah Menengah Bestari*

From the analysis of the instructional practice, the instructional roles and the instructional environment, it appeared that *Sekolah Menengah Bestari*ôs T&LICT situation may not yet able to fully meet the three thrusts of computer in education laid out by the MOE, which are: ICT as an enabler, ICT as a subject matter and as a learning tool, and ICT as a tool to increase productivity and efficiency (Chan, 2002).

The use of ICT in *Sekolah Menengah Bestari* has not yet reached the stage as an enabler in bridging the digital divide for a number of reasons. First, data indicated that technology facilities in *Sekolah Menengah Bestari* were not enough for optimal student

artially due to inadequate technology resources, the

CT implementation by the teachers was low. Thirdly, the teacher-centered, teacher directed T&LICT implementation strategies could not allow the students to develop the requisite levels of ICT literacy skills

MOEôs second aim for ICT as a subject matter and as a learning tool was only partially achieved in *Sekolah Menengah Bestari*. Computer in Education was offered as a subject to interested Form 4 and Form 5 students. A computer laboratory was allocated for this subject. In the *bilik simulasi* the computers were available to the students for accessing information, communication and for productive purposes. However, usage was restricted to the Bahasa Melayu, English Language, Mathematics and Science subjects only. The students used the computer as a tool to access the TLM, complete their tasks and sent it through the system to the teacher who would also check it on-line. Sometimes, they sourced for materials from the internet. In the laboratory and classrooms however, students rarely had the opportunity to use the computer for productive purposes. They had little access to computer, except for the occasional incidences when they came up to the front and pressed the answer key or typed in the answers to the questions being discussed. Hence it appeared that ICT was used enough to automate and mechanize certain work processes but not to the level of using ICT as a learning tool for ó*appropriation*ô and ó*invention*ô (ACOT, 1995). The students also had little opportunity to make use of ICT as a tool to increase productivity and efficiency, which is the third thrust of the MOEôs objective for ICT.

nersô implementation ómisfitô meant that they had not

ses that matched the prescribed constructivist T&LICT practice (Figure 4) in its ñ*appropriation*ò and the ñ*invention*ò phases (ACOT, 1995).

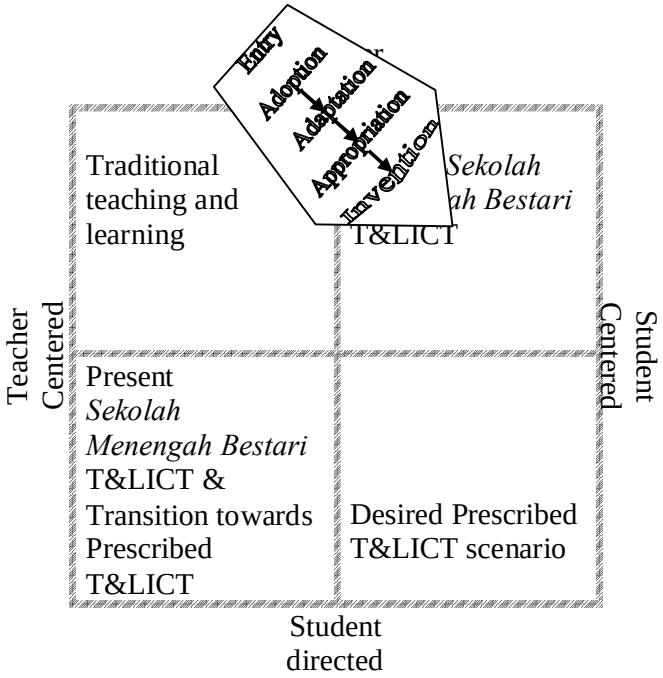

Figure 4: The Development Phase of T&LICT in *Sekolah Menengah Bestari*

Applying the above T&LICT development grid into the case of *Sekolah Menengah Bestari*, the entry level in T&LICT here reflect the start of the Smart School pioneer school project in 1999 with all its teething problems. The teacher at the entry phase is loosely regarded as operating in a traditional teaching and learning situation (upper left quadrant), then taking off towards adoption of T&LICT and employing student-centered strategies while retaining teacher control (upper right quadrant). The teaching and learning situation in *Sekolah Menengah Bestari* in the context of T&LICT at the time of data collection appeared to reflect the situation in the upper right quadrant (Figure 4) which puts it still at the adoption and adaptation phases of technology integration.

by the students to learn technology skills and as a tool for delivery of instruction by the teachers. As teachers and students adapted to the changing classroom teaching and learning environment, it was hoped that student activity and productivity would increase. The stages of appropriation and invention would be the situation hoped for in T&LICT in the Smart School classroom context. The use of computers would be mainly for students to enhance the learning content. It was mentioned in Chapter 1 that ICT could be used not only to support learning about ICT, but also to support learning with ICT and learning through ICT (Pelgrum & Law, 2003). In the case of *Sekolah Menengah Bestari*, students and teachers were still using ICT to learn about ICT and learn with ICT but have yet to reach the stage of learning through ICT.

The researcher had pondered on this issue during the visit to *Sekolah Menengah Bestari*.

> *The question is whether the change sequence and change scenario was a natural requisite progression of the change process, or, if change agents were cognizant of the nature of change and were equipped with the requisite knowledge and skills for T&LICT, would it be possible for them to deliberately act to make the paradigm shift from stage "entry" into "appropriation" and "invention", bypassing the "adoption" and "adaptation stages"? If that were possible, a lot of time and resources (materials and manpower) would have been saved. I feel that if such a consideration were possible, it would bear heavy implications on the quality and type of training and preparation for T&LICT, as well as the mental readiness of change agents to make the leap. As it was, the CRFP for Smart Schools had advocated the use of T&LICT as envisioned in the appropriation and invention stages. Nevertheless, between the conceptualization and the implementation, the progression of change in T&LICT could not seem to make the leap. Instead, it had moved its paradigm to the next quadrant instead (Notes: V 4).*

sue of concern. Figure 4 conceptualized a graphic opment stages towards a desired T&LICT scenario in the Smart School. The concern was whether and when the T&LICT practice would progress from the adoption stage towards *appropriation* and *invention*, or whether it would be *stuck* (Hopkins et al., 1994) at the *adaptation* stage.

The second collaborative survey on Smart Schools in 2001 reported that the use of technology as an enabler was not optimized because teachers possessed low ICT literacy (KPM, 2001, p. 518). In this present research, and six years into its implementation, the teachers in this school still appeared unconcerned with best technology integration practices, but rather believed that they have understood the requisite skills and strategies for T&LICT. Teachers and students were not yet co-learners, and the balance of power has not yet changed. The teachersô instructional beliefs that did not match innovation goals (Handal, 2003) apparently resulted in the low ñ*take-up*ò in T&LICT implementation.

It is not the technology itself but how the technology is used by teachers that may or may not improve student learning. Woo (2003, p. 248) noted the (Smart Schools) teachersô concerns with the lack of exemplary uses of technology as the primary obstacle to technology adoption. They ñ*worried whether they were able to adapt technology to suit students' needs, they worried whether they were doing the right thing and repeatedly asked for exemplary practices or optimal uses to benchmark against*ò (Woo, 2003, p. 248).

hase of development, there is a need to inform teachers th computers. Equally important is the task to educate them about computers. The benefits of using computers in education can only be accurately assessed by teachers when new information technologies are critically understood in terms of their role within, and impact on, society. The Smart School training curriculum for teachers (1997, 2000, 2002, 2005) designed by the Teacher Training Division followed closely the requirements to train teachers to handle the desired T&LICT scenario.

However, more need to be understood about how their training influenced the teachersô acquisition of requisite knowledge and skills in order to understand how the leap towards the appropriation and invention stage could become feasible. Understanding their beliefs and resultant actions would allow change planners and policy implementers to approach change to fit their mental models.

In this present study, the implementation of T&LICT through the Smart School Project is already into its sixth year and yet the practice was still experiencing low take-up. The teachersô ólow take-upô in implementation and implementation ómisfitô indicated that they had not yet reached the development phases that matched the prescribed constructivist T&LICT practice. The teaching and learning situation in *Sekolah Menengah Bestari* in the context of T&LICT at the time of data collection appeared to reflect the adoption and adaptation phases of technology integration. The reasons for this situation could be explained by the conditions in *Sekolah Menengah Bestari*.

lt within *Sekolah Menengah Bestari*ôs teaching and learning environment, and there had been progressively more users among the teachers. Most were optimistic about the future development of T&LICT for the school. As ITC commented, ñ*Even the veteran teachers are trying to learn the computers to set questions .... It is quite positive*.ò The teachers saw the relative advantage (Rogers, 1995) in T&LICT. They thought that T&LICT benefited the students. They felt that it would make the lesson more interesting and motivating. The perceived relative advantage of T&LICT encouraged participation.

5.1 Low take-up in T&LICT Implementation

Findings indicated that although the teachersô reception of the T&LICT innovation was positive, there was ólow take-upô (Handal, 2003) in its implementation, evidenced by its mediocre density and low frequency of use.

Nevertheless, not all teachers in the school implemented T&LICT. Only an estimated 50% of the teachers in *Sekolah Menengah Bestari* implemented T&LICT. There was a lack of uniform participation. All the *Bestari* subject teachers had implemented T&LICT, whereas about half of the non-*Bestari* teachers have not used ICT. This was due to the inequitable resource allocation and mediocre T&LICT knowledge and skills. The *Bestari* teachers had ready access to ICT facilities and infrastructure whereas the latter were not accorded the same benefit. Dissatisfaction with the discriminate allocation of computer facilities could also partially explain the mediocre density of T&LICT implementation. Another reason for the lack of uniform participation is that the *Bestari* teachers were comparatively more proficient in ICT than the non-*Bestari*

had more opportunities for extensive in-service teacher l and the ETeMS training programmes than the non-*Bestari* teachers.

As mentioned above, the density of T&LICT use was mediocre; from such mediocre use, the low frequency of use exacerbated the situation. It was found that about two-thirds of the estimated 50% users implemented T&LICT only once or twice a semester. Less than 20% of the *Bestari* teacher respondents implemented ICT weekly. *Sekolah Menengah Bestari* teachersô perceived mediocre knowledge and skills affected their frequency of T&LICT implementation. Most informants admitted that they were weak in IT skills. The fear of failure in using the technology in front of their students could be a barrier (Hannafin & Savenye, 1993) to its increased use. Other researches (Ting, 1998; Arafah, 2000, Woo, 2003) have also highlighted inadequate knowledge and skills as a cause for such concern. Arafah (p. 399) said that the success factors for integrating ICT is both attitudinal as well as skills related.

Analysis of findings revealed that the frequency of use of ICT in teaching and learning was also affected by problems faced with the availability of resources, and the availability of time. The other non-*Bestari* teachers who were keen would take the effort to do so about once or twice a semester when they could get access to the facilities.

Insufficient technology-enabled rooms also meant that many classes had to share the facilities. This and the perceived inadequacy of technical support affected the frequency of use. The problem of unstable power supply to the school was also a serious deterrent. Although ICT teaching and learning resources were available to all

er subject teachers, it was generally perceived as not

uests for additional hardware, courseware and teaching and learning materials and support. This affected the frequency and density of T&LICT implementation.

The perceived insufficient availability of time is also a condition that adversely affected the frequency of T&LICT implementation. The perceived lack of time was due to a number of reasons. Preparing and implementing T&LICT required time. Teachers felt that they were not allowed enough time to plan, prepare and implement T&LICT lessons for a sustainable length of time. Implementing T&LICT was viewed as time consuming; it took more time to complete the curriculum content. The teachers were bound by the priority to complete the syllabus in time for examinations. Getting the classroom or *bilik simulasi* ready also used up the lesson time. Additionally, time that could be used to prepare for T&LICT was taken up for other duties like class relief. As a result, T&LICT was relegated to being practised only ñif there is timeò.

In *Sekolah Menengah Bestari*, the teachers were slow to take up T&LICT also because of examination-oriented goals. They were bound by the priority to complete the syllabus in time for examinations.

> *There is always not enough time to implement T&LICT. We have to finish our topics for the exam. (Ping, 145:145)..*
>
> *If we are talking about the Bestari way where the students learn on their own, shouldn't be exam-centered. In Bestari, students supposed to learn on their own. So some students may be fast, and some may be slow. So if exam-centered, some students may not be able to catch up. That is why most of the Maths teachers reluctant to use courseware because they have to cover the syllabus (ITC, 337:341).*

d the low take-up in T&LICT implementation. Looi of Smart School teachers were moderate. Her finding was supported by others as well (Low, 1999; Muhammad Hassan, 1997; Foong, 1999). Wooôs (2003, p. 244) research study examined the teachersô levels of technology use. She found that the diffusion of innovation in technology integration was ñ*very slow and stretches over a long period*ò. According to her, a time frame of less than two yearsô implementation was insufficient to capture higher levels of technology use among the teachers (Woo, 2003, p. 244). In this present study, the implementation of T&LICT through the Smart School Project is already into its sixth year and yet the practice was still experiencing low take-up. The reasons for this situation could be explained by the conditions in *Sekolah Menengah Bestari*.

5.2 Implementation 'Misfit'

Analysis of findings revealed that *Sekolah Menengah Bestari* teacherôs instructional strategies did not fit the desired T&LICT practices that prescribed constructivist approaches discussed in the literature review. In fact, the teachersô T&LICT strategies did not vary much from the traditional modes. As Sable said, teaching activity using ICT was ñ*not so much different from the usual teaching*ò (Sable, 093:093). The strategies were teacher directed and teacher-centered.

Computers were used more as a supplement to the existing curriculum and the traditional mode of teaching and learning. It was not much used as tools integrated into the learning of traditional subject matters. ICT was used mainly by the teacher for delivery of input content especially in the classrooms. T&LICT techniques commonly used by teachers were Power Point presentation, or showing content materials from the

BTP or PPK, or less often, commercially produced

ndicator that the learning process was still largely determined and controlled by the teacher

Insufficient ICT facilities in the classrooms affected the implementation fit of the teachersô T&LICT instruction. Teachers who brought their laptop computers into the class controlled the equipment and directed the lesson progress because only on computer was available. There was little opportunity for constructivist teaching and learning. The most convenient teaching and learning strategy to utilize a lone computer in the classrooms was the directed approach.

Because T&LICT was viewed as time consuming; most teachers revert to the traditional classroom teaching and learning strategy which was seen as less time consuming and as a more efficient method for syllabus completion. Azura said, ñ*No time to prepare, so use chalk and talk*ò (Azura, 54:54). Such a perception thwarted the sustained use of ICT in teaching and learning ñ*Once in a while teaching and learning with ICT Ok. But difficult to teach everyday*ò (Azura, 56:60).

Of noteworthy concern here is that due to additional time loaded onto teachers who were implementing T&LICT, they made do with a superficial implementation, delivering lessons that integrate ICT but with no adjustments to pedagogy, because there was not enough time provided to understand and adapt to the characteristics and requirements of the innovative strategies (Ellsworth, 2000, p. 70). The situation of not enough time for T&LICT lesson preparation and implementation therefore adversely affected the density, the fit, and frequency of its implementation.

ffected the implementation fit of the T&LICT practice. On the one hand the teachers were aware of the importance of student-centered, student-directed learning, and had positive attitudes about the advantages of T&LICT. They realized that the intention of T&LICT was that there would be more emphasis on independent and self-directed modes of learning. On the other hand, such awareness was not translated into the action because the extent of their knowledge and skills only allowed them to employ T&LICT strategies that further supported teacher control and teacher directed repertoire. The disparity between their existing skills and knowledge and the repertoire of knowledge and skills required to implement the Smart School T&LICT resulted in the implementation ómisfitô. Consequently lesson tended to be teacher-centered and teacher-directed rather than constructivist. Teacher control and teacher direction were dominant. Group work was the most popular concession to student-centered activity

This was a parallel finding with the ACOT (Dwyer et al., 1995) study. It was found that while teachers were personally dedicated to the investigation of the potential of modern technology, they were, however, held in check by the principles of 19th century instruction.

In the earliest stages of its implementation, ACOT teachers demonstrated little penchant for significant change and in fact, were using their technological resources to replicate traditional instructional and learning activities (Dwyer et al., 1995).

161) reported that while the teachers in their study had to use IT in their teaching, their practices were little changed. IT in the Hong Kong situation was also used mainly to support the existing teacher-centered approach. Fox and Henriôs finding was similar to the findings in this study. Other findings of the slow development towards constructivist practices were reported in other technology innovations research (Dwyer et al., 1995; Handal, 2003).

Whether or not they were confronted by large numbers of computers, teachers arrived at their classrooms with deeply-rooted beliefs about schooling that will help them weather the storm of demands they face. Their beliefs were informed by personal experiences and knowledge and skills about schooling and instruction which influenced their existing beliefs about teaching. Such thoughts and beliefs were shaped in part by the training they underwent, and subsequently by experiences gained through practice. Furthermore, although teachers may be provided similar input and training on teaching and learning; however, each teacher might act differently based on their perceived understanding and belief about the knowledge acquired and how it was fitted into the existing knowledge schema.

Furthermore, the educational software distributed by BTP could have reinforced the implementation ómis-fitô. The BTP and TSS produced learning materials for modes such as drill and practice, simulations, instructional games and electronic book. This requires the computer to play the traditional role acting like a tutor delivering instructions, reinforcing practice and providing feedback (Rusimi & Syed Putra, 2004). Such prescribed pedagogies to support these learning softwares could have contributed to the protracted use of the traditional modes of teaching within a technology-enabled environment.

ped what they chose to do in their classrooms and explained ñ*the core of instructional practices that have endured over time*ò (Cubanô 1993, p. 256). The ACOT Research quoted a study by Damarin in 1988 (Dwyer et al., 1995, p.5) of the projectôs first year at one of the sites that also admitted a failure to move forward instructionally due to some of the constraints under which the teachers labored, such as a district plan that reflected state-mandates and standardized testing.

The teachers had long experience and finely-tuned methods of working within these constraints and maximizing their effectiveness in that context; they had little incentive or direction for making changes which might jeopardize performance on existing criteria. Although the district planners sought (and achieved) a plan which serves as a model for equitable implementation of a radically different instructional environment, they did not seek to create new approaches to instructional excellence (Dwyer et al., 1995, p.5).

In terms of instructional roles, it was expected that the introduction of ICT would generate active learning and enable the individual learning approach through self-accessed, self-paced and self-directed learning (Smart School Project Team, 1997). The philosophy of the Smart School pedagogy rests on constructivist teaching and learning. This is best realized when teachers facilitate the studentsô independent learning style.

Sekolah Menengah Bestari teachersô facilitation style was mediative in nature. Their normal practice was by walking around the class guiding the students while they do

d referring students to their workbook and reference alked around to check on studentôs work and gave help where needed.

Interestingly, Pangôs (2005) research on a Smart School in Sabah also reported meditative strategy as among the three teaching and learning strategies used, the other two being generative strategy, and collaborative strategy (p. 277).

In carrying out the meditative style of facilitation, *Sekolah Menengah Bestari* teachers believed that they had shifted their role paradigm to that of a facilitator. But the meditative strategy is not enough in order for the teacher to function as an effective facilitator. In fact, the teacher still assumed the directed role as transmitter of knowledge and acted as an expert source. In order to create the opportunity for constructivist learning, the teacher should develop questioning skills and guide the students towards thoughtful problem solving and generating their own knowledge. Students should not depend on the teacher for direction. In fact, in constructivist teaching and learning, the teacher plays the role as assistant while students explore topics (Robyler, 2002). Such teacher facilitator behavior was not conclusively observed in the teacher practice and roles in this study. The higher levels of facilitator skills were not among the teachersô repertoire of mediocre knowledge and skills about T&LICT practices.

Because teacher roles did not change much from its traditional mode, the change in studentsô roles was consequently minimal. Because teaching and learning was teacher-directed, it seldom gave the students opportunity for student-directed and constructivist

asi where the students had access to the computers and rs was directed by the teacher. Students had limited access to ICT in the classroom or laboratory setting. Student-centered activities were mainly manifested in group work to complete tasks given by the teacher.

It appeared that *Sekolah Menengah Bestari* teachers would find sustaining its T&LICT implementation challenging. The sustainability of T&LICT implementation should be manifested in the use of ICT as a common tool for the teachers in teaching and learning and for the enhancement of studentsô independent learning styles.

Limited facilities made it difficult to accommodate the constructivist strategies. Because only the teacher had laptop, ETeMS teachers often used the whole class method with one computer for delivery of instruction; and sometimes used the group method with one computer (Table 6.19). However, they seldom had the opportunity to provide access to computer for every student. This affected the implementation fit to the desired T&LICT practices.

The educational software distributed by BTP could have reinforced the implementation ómis-fitô. The BTP and TSS produced learning materials for modes such as drill and practice, simulations, instructional games and electronic book.

> *In that courseware there is an audio, there is visual as well. In this courseware also they show what will they learn that day, the objective of the lesson of the day. They give the scenario of the lesson, everything, the examples. That's the whole thing. After giving all the examples, the CD also give one particular exercise for the students to try* (Raed, 142:145).

lay the traditional role acting like a tutor delivering and providing feedback (Rusimi & Syed Putra, 2004). Such prescribed pedagogies to support these learning softwares could have contributed to the protracted use of the traditional modes of teaching within a technology-enabled environment.

6.0 Implications and Recommendations

Although the Smart School is curriculum driven, technology nevertheless plays a crucial role as a prime enabler. The importance of T&LICT in the Smart School pedagogy is undeniable. Even at the lowest level of technology deployed to Smart Schools, the teaching-learning benefits would exceed the current traditional strategies (CFRP, 1997).

T&LICT would make the nationôs goals of producing a technology literate, critically thinking individual prepared to participate fully in the global economy of the 21st century (CFRP, 1997) more achievable. It would also develop the self-esteem that students feel in the achievement and exercise of new skills in a collaborative and constructivist setting (Freeman and Gilleran, 2001, p. 13).

However, in order for *Sekolah Menengah Bestari* to contribute towards achieving the national objective, the T&LICT scenario and conditions in the school needed to be more dynamic than its current mediocre level.

Studies (Pelgrum, 2001) have reported teachersô lack of ICT knowledge and skills to be a major obstacle to implementation and consequently pointed to the need for further

ore the training and re-training of teachers should of T&LICT strategies so that teachersô skills and knowledge of T&LICT are not limited to the teacher-directed, student-centered repertoire. Ultimately, the use of ICT should shift from its function as a tool for delivery to that of a tool for production.

Bajunid mentioned the need to ñ*learn, unlearn and relearn in order to function effectively in all the domains of life*ò (Bajunid, 2001, pp. 118-119). Teachers need to unlearn their previous beliefs and dispel their inner conflicts about classroom teaching and learning in order that their mindset may allow for a paradigm shift rather than accommodation to the innovation. Teachers need to learn to facilitate effectively and to allow students to take charge of their own learning. It is also suggested that teachers be exposed to a more comprehensive training of T&LICT and teacher roles so that their implementation may match the innovation goals.

The need to learn, unlearn and relearn also addresses the motivation and attitude of the teachers. Teacher belief and teacher attitude is a factor for consideration in change implementation. There is concern that the change effort would plateau at the adoption stage because the teachers believed they have already implemented T&LICT. Since teachersô beliefs affect instruction, and instruction affects student learning (Elizabeth, 2003; Hanushek, 2002; Ishak, 2003; Rivers & Sanders, 2002), it is very important that prior to the educational innovation, teachersô instructional beliefs are explored, identified and dealt with, to inform planning and implementation. This does not mean abandoning beliefs but gradually replacing them with more relevant beliefs shaped by more comprehensive training and exposure to a wider repertoire of T&LICT strategies.

ll, the other primary conditions needed to be given technology tools is necessary components for the successful integration of technology into the classroom as well as to have positive attitude from those who implement any technology. McDowell and Hannafin (2004) think that barriers external to the teacher such as not having access to computers or training, or not having enough time to plan prevent teachers from integrating technology. Time and resources should be made available to facilitate participation. Incentives can be explored as a means of encouraging commitment to T&LICT.

The assessment policy appeared to act as a barrier to the adoption and integration of ICT in schools. There was a need to integrate assessment and instruction so that they support T&LICT. Fox and Henri (2005) suggested that a shift to learner centered approaches to teaching and learning was dependent not on the introduction of IT but on changing the curriculum and the examination-orientated educational culture. For example, the shift of emphasis from examination to more authentic assessment tools like performance assessment, investigative research, open-response questions, portfolios and self-assessment would reflect more the constructivist employment of ICT in learning.

It was observed that the educational software provided by BTP and TSS and its prescribed pedagogies could have partially explained the continued use of the traditional modes of teaching. More study needed to be conducted on the structuredness of the Smart School courseware design and its implications for teaching and learning. At the same time, increased flexibility in the courseware use that allow for more self-directed and independent learning should be explored.

ively involved. It has been suggested (Bozeman & Spuck, 1991; Thomas & Knezek, 1991; Bennett, 1996; Bennett, 1995) that the success of ICT efforts depends in part on the principals themselves being knowledgeable users of technology. Bozeman & Spuck (1991) say that, "*The importance of training of school administrators in the effective use of technology is not in question. The problem is that few practicing school administrators are adequately trained*". (p.525)

Beyond the role as a technology expert, the style of principal leadership necessary for effective and sustained change is transformational leadership. The degree to which leaders are able to manage change, develop consensus, and sustain commitment will determine the success (or failure) of any reform effort. Dufour and Berkey (1995) noted that the principalôs leadership is vital not in leading the ICT initiative per se, but rather in drawing together and fostering the collaborative effort of interested parties that will likely lead to successful ICT integration efforts. Such leadership would generate participation and commitment. Sergiovanni (1998) noted that, "*a key part of this practice is the ability of the leader to mobilize people and community to face their problems, and to make progress in solving them.*" (p.42)

This was a case study of one Smart School, focusing on T&LICT as a technology innovation. As such, findings should not be generalized and extrapolated to other Smart Schools in Sabah or the rest of Malaysia. However, it is possible that such findings might resonate in other such schools as well. Findings should serve to advise *Sekolah Menengah Bestari* teachers of the need to increase their repertoire of T&LICT. Findings should inform the policy makers of a detailed situation in a representative

policy for the school should consider such factors as oriented curriculum and the need for updating ICT facilities.

Finally, with more funding, resources and time, this research could be expanded into a nation-wide project to include a wider cross-section of Smart Schools in Malaysia. Findings of such large scale venture would be able to conclude more confidently about the T&LICT situations in Malaysia. Future studies on teacher beliefs about T&LICT and their roles in T&LICT can be conducted on a larger scale modeled on this research.

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