CHAPTER 7

Report of findings: Use of technology in instruction

This chapter examines teachers' patterns of practice with technology in the four case study schools. It begins by determining the frequency of technology use as reported by teachers and students, and then looks at the typology of technology use by the teachers. Sample lessons are also described. The chapter closes with feedback from the students regarding teachers' practices of technology in the schools.

Frequency of technology use

In order to determine the frequency of technology use in the case study schools, all 40 teachers in the sample at the end of the research time frame were asked to self-report their intensity of use in the second SoCQ administered in August 2001 (Appendix 2bii). The results were then tabulated and represented in Table 18 on the following page.

Table 18 shows clearly that the majority of the teachers (44%) reported using technology one to four times a month. Another 38% said they integrated technology into instruction one to four times a week. Only 8% claimed to use technology every day while 10% admitted they seldom used technology, not even once a month.
Table 18: Teachers' self-reported frequency of technology use in August 2001

<table>
<thead>
<tr>
<th>Teachers' self-reported frequency of technology use in classroom instruction</th>
<th>Number of responses</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>T</td>
<td>G</td>
</tr>
<tr>
<td>Every day</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-4 times a week</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1-4 times a month</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Very seldom (not even once a month)</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>6</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

*One of the teachers was promoted to the post of full-time IT coordinator and had no teaching periods towards the end of the research time frame.*

When this frequency of usage was collapsed into three main categories – namely high, mid and low level users – and the results tabulated, the picture that emerged (as shown in Table 19 below) was a preponderance of mid-level users (82%) with only 8% high-level users and 10% low-level users.

Table 19: Category of technology use (based on teachers' self-reports) in August 2001

<table>
<thead>
<tr>
<th>Category of use</th>
<th>Frequency / intensity of use</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level users</td>
<td>Every day</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Mid level users</td>
<td>At least once a month</td>
<td>32</td>
<td>82</td>
</tr>
<tr>
<td>Low level users</td>
<td>Not even once a month</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>39</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The teachers’ self-reports confirmed reports made by 233 students in August 2000 (tabulated in Table 20 below) which indicated that in August 2000, there were 17% low-level technology users, 83% of mid-level users and NO high-level users.

**Table 20**: Frequency of technology use (as reported by students)

<table>
<thead>
<tr>
<th>Category of use</th>
<th>Frequency / intensity of use</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level users</td>
<td>Every day</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mid level users</td>
<td>At least once a month</td>
<td>193</td>
<td>83</td>
</tr>
<tr>
<td>Low level users</td>
<td>Not even once a month</td>
<td>40</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>233</td>
<td>100</td>
</tr>
</tbody>
</table>

In other words, feedback from both students and teachers tallied, indicating that from August 2000 through August 2001, the majority of the teachers were mid-level users of technology. The next section attempts to put together a typology of the teachers’ usage of technology in the case study schools.

**Typology of technology use**

To come up with a typology of technology use, the teachers were asked to specify their mode of technology use in the addendum of the second SoCQ administered in August 2001 (Appendix 2bii). The results were then tabulated and ranked in descending order of frequency cited, as shown in Table 21 on the following page.
Table 21: Teachers’ ranked, self-reported typology of technology use

<table>
<thead>
<tr>
<th>Rank</th>
<th>Profile of use</th>
<th>Citation of Use (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Electronic presentations</td>
<td>92</td>
</tr>
<tr>
<td>2.</td>
<td>Internet</td>
<td>74</td>
</tr>
<tr>
<td>3.</td>
<td>Word processing</td>
<td>67</td>
</tr>
<tr>
<td>4.</td>
<td>Email</td>
<td>56</td>
</tr>
<tr>
<td>5.</td>
<td>Drills and practice (CDs)</td>
<td>41</td>
</tr>
<tr>
<td>6.</td>
<td>Desktop publishing</td>
<td>41</td>
</tr>
<tr>
<td>7.</td>
<td>Computer games</td>
<td>41</td>
</tr>
<tr>
<td>8.</td>
<td>Simulations</td>
<td>38</td>
</tr>
<tr>
<td>9.</td>
<td>Web-based instruction</td>
<td>38</td>
</tr>
<tr>
<td>10.</td>
<td>Tutorials</td>
<td>33</td>
</tr>
<tr>
<td>11.</td>
<td>IT as white board</td>
<td>33</td>
</tr>
<tr>
<td>12.</td>
<td>Spreadsheets</td>
<td>33</td>
</tr>
<tr>
<td>13.</td>
<td>Problem-solving projects</td>
<td>28</td>
</tr>
<tr>
<td>14.</td>
<td>Database</td>
<td>13</td>
</tr>
<tr>
<td>15.</td>
<td>Collaborative projects with other schools</td>
<td>13</td>
</tr>
<tr>
<td>16.</td>
<td>Video conferencing</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 21 above shows that the most common mode of technology use within the research time frame was electronic presentations (cited by 92% of the teachers), followed by Internet use (74%), word processing (67%) and email (56%). Drills and practices, desktop publishing and computer games tied for fifth place (41%) while simulations and web-based instruction ranked eighth (38%). Sharing tenth place was use of technology as a white board, tutorials and spreadsheets (33%). Then came the use of technology for problem-based projects (28%). And finally, bringing up the end of the list were database and collaborative projects (13%) and video conferencing (5%).
Patterns of practice

This section attempts to weave for the reader a pattern of teachers' practices with technology in the case study schools by describing actual lessons observed. These descriptions focus on four main uses of technology – as a productivity tool, teaching tool, networking tool and mind tool. It is important to bear in mind that the lessons described are not benchmark practices of technology but mere documentations of what was observed in real-life classrooms. However, it is hoped that their descriptions will stimulate reflection on the issue and pave the way for the notion of optimal uses to be crystallised later.

Technology as a productivity tool

Electronic presentations. As indicated clearly in Table 21, much of the teachers' practices with technology during the research time frame revolved around its use as a productivity tool. About 92% of the teachers reported frequent use of electronic presentations software, in particular, Powerpoint:

Students are quite used to this kind of thing. They're very interested. The good ones are good. One girl actually got pictures from the Internet and put it into her powerpoint presentation. She put in a lot of effort, the response was very good...

(R:29.8.00.2)

Witness the following Bahasa Malaysia lesson conducted in a simulation room at Temasik. The number of students was 25. ‘T’ refers to the teacher and ‘S’ the students:
(The simulation room, painted a calm shade of blue, was fully air-conditioned and well equipped. White boards lined two walls. Shelves held the students’ folios and task sheets. There was even a self-access corner and a cupboard for dictionaries. A 29-inch television set took pride of place at the front, presiding over the four stand-alone computers, the mobile COW (computer-on-wheels) and OHP. Tables and chairs were arranged in six clusters to facilitate group activities. The teacher started the lesson by asking the students the date.)

S: August 1.
T: Yes, August. What does August remind you of?
S: Merdeka! (Independence)
S: Holidays! (chorus of answers).
T: How old are you now?
S: Born in 1987.
T: Then how do you know about Merdeka?
(There was a show of hands).
S: Books!
S: Sudirman’s songs.
S: Internet!
T: Yes, yes... now I’m going to give you a task sheet about Merdeka – there are pantun, syair and peristiwa. Read them carefully and prepare a presentation on the computer on its meaning; include your reflection.
(The teacher gave more instructions. As she finished talking, the boys broke into groups and rushed to the computers. A few went to the adjoining room which was empty. They were enthusiastic and at ease with the computers. A boy opened a Word program and started clicking, drawing circles. His friends gathered round and offered advice.)
S: Make it a dull colour.
S: No, make it blue.
(In another corner, several boys read through the pantun as their leader keyed it into the computer, prompted on by another boy who heaped advice upon him.)
S: Take tools, change font, make it bigger.
(As he finished, his friends clapped – the slide was really quite well done.)
S: Click auto shapes.
S: What are you doing?
S: Give me, give me... let me show my professionalism. (He clicked on the rotating tool and tilted the arrow on the computer screen. The teacher walked from group to group. The students were hard at work – every group had one or two boys working at the computer while the others sat at the table and looked up the meanings of words.)
S: Let me and Faizal do on the computer.
(Tasks were delegated via the game ‘scissors, paper, stone’.)
S: Ok, we start from this one. (A boy read the poem aloud.)
S: Ah, I know... independence is the result of other people's efforts.
S: \textit{Canik!} (Beautiful!)
S: Ok, write down.
(A question sailed across the room.)
S: What's \textit{panji}?
S: Read the sentence.
S: Spell it.
S: P-a-n-j-i.
S: There's a dictionary next door. \textit{Ambil!} (Take!)
T: Remember, one representative to read.
(The boys selected their representatives.)
S: Me.
S: Me.
S: Let's '\textit{junken}' (toss for it).
S: Whoever can read better okay?
S: How to do shading?
S: Go to tools.
(The teacher helped a group struggling with the word \textit{berkorban}. She pointed out that sacrifice did not necessarily entail death and threw them a question.)
T: What can youths sacrifice? How do they sacrifice?
S: When we sing \textit{Negaraku} (national anthem).
(The others laughed. At the end of the period, teacher gathered the students round the TV set for the presentation.)
S: Us first!
(As the group went to the front of the class, the others dragged their chairs nearer.)
S: I'll handle the PC, you do the talking.
(As the boy Daniel started speaking, there was a good-natured jeer from the others.)
S: Why like this? Why are the words so light?
S: Slide show \textit{lah}.
S: Sorry, used Word.
S: Powerpoint \textit{lah}!
S: \textit{Aiya}... didn't say so earlier. We did in Word.
(Daniel explained what was written on the computer screen as the others watched eagerly.)
T: Do you understand?
S: Yes.
T: Okay Ahmad, what do you understand by what was presented?
(Ahmad stood up and summarised.)
T: John, you explain what you understand.
(John talked about the torture experienced by people during the Japanese Occupation: "Tongue cut out, eyes come out", he mimed the action to the word.)
T: What other effects?
S: Money hard to get.
S: Economy.
T: Look at their presentation. Can you comment?
S: No flag.
S: Programme not suitable. Use powerpoint lah – so many slides.
S: Compare before and after Independence.
S: No conclusion.
T: How about the colour?
S: Cannot read.
S: Increase the font size.
T: Any other comments?
S: Grammar wrong.
(The students listened as teacher went through weaknesses in the content and presentation format)
S: Teacher, we want to make corrections.
T: Ok, hand up tomorrow.
(A student asked if he could put in sound effects so that students need not speak during presentation but the teacher reminded him that the computers in the simulation room had no speakers.)
S: Teacher, comment.
(The teacher offered suggestions for every presentation. When one student said, “See, I told you”, the teacher reminded the class that everyone had to accept criticism and comments positively. Lesson ended on a happy note as students hurried out after saving their work on diskettes.)

(Note: The above lesson was a typical example of the use of electronic presentations in the classroom. Such lessons were frequently observed throughout the research time frame. As there was no content inherent in electronic presentations, this use of technology has tremendous potential for developing leadership and creativity by serving as a scaffold for learning. This use of technology also encouraged the development of management skills as students negotiated and delegated tasks and duties, and voiced ideas and reacted to proposals. Notice how comments from friends often became prompts to modify, express and defend ideas. And more importantly, the students had fun...
in the process. Unfortunately, more sophisticated uses of electronic presentations like graphing software were not observed in the schools within the research time frame.

Word processing. As indicated in Table 21, word processing was carried out by 67% of the teachers and ranked third in the teachers' typology of technology use. Field observations showed both teachers and students engaged in word processing tasks frequently. At Temasik, students often stayed back in the Multimedia Room till late evening to use the word processors. Likewise, the students at Gemilang, Rajawali and Sendayan. The following is a description of a lesson in which Ling integrated word processing skills to hone writing skills:

(The lesson was held in a classroom with six clusters of tables and chairs, each holding a computer linked to a 29-inch TV mounted on the wall in the front. As there were only 14 students, they worked in pairs and three's. There was also a computer on the teacher's table. Ling's objective was to hone writing skills via text reconstruction exercises she had developed from the template 'Hot Potatoes'. She began by asking the students their experiences with Internet Relay Chats. After ensuring that they knew what 'ICQ' and 'chats' meant, she asked them to read a newspaper article about con men who had preyed on unsuspecting Internet surfers. She explained the meanings of words, and proceeded to test the students' comprehension of the passage by asking questions).

T: Whom did she meet?
   What did she do?
   What is the meaning of the word 'seduce'?
   What do you know about the man?
S: He is a con man.
T: How do you know that? Which word says that?
(This started a discussion on adjectives which led to a discussion on moral values.)
T: Why did the girl fall in love with him?
   If you were the girl, what would you do?
(Ling then asked the students to access a file which had a summary of the newspaper article but with key words blanked out. She gave instructions.)
T: The aim of this exercise is to develop your writing skills. Study the passage carefully and fill in the blanks. Read the passage again and again,
look for contextual clues to help you. Try to recall information from the passage. Then type in the word you think best fits the blank. You can ask the computer for clues.

(Initially, the students keyed in words at random, beginning with common articles like 'a', 'an', 'the' but as more blanks were filled and the passage began to make sense, they were observed scrutinising the passage in order to select words based on context. The students became totally absorbed in selecting words and identifying sentence structures. Suddenly, there was a whoop of joy.)

S: We're first, we're first (Quickly checked scores on the computer).

(When all the students had completed the exercise, they were asked to write a short essay on the steps to take to protect themselves on the Internet, using ideas from the passage. The students worked in pairs, one keying in sentences whilst the other contributed ideas and edited as words appeared on the computer screen).

S: Careful! Don't tell your real name on computer.

S: You forgot 'the'. (She inserted the word.)

S: Don't trust a man.

S: Not man lah — don’t trust strangers.

S: Talk to your parents before meeting someone on the Net.

S: Talk or tell?

(A moment's hesitation, then the word 'talk' was replaced with 'tell'. The students worked at their essay while the teacher walked round. At the end of the lesson, they saved the work on a diskette and submitted it to the teacher).

[Note: Most teachers readily acknowledge the value of word processing in increasing the productivity of students involved in the writing process. In traditional writing classes, students sit and think about a topic, pen an outline and then try to develop it. Writing and editing is tedious, slow and often messy, with words, phrases, whole lines and even paragraphs crossed out and inserts in all directions. Some students end up writing several drafts and spending hours on their work.

Word processing removes some of this drudgery by reducing the amount of time required. As a student put it: "I don't have to waste my time writing and I could do my work faster" (ISS:G14). Word processing also makes work neater, more legible and better organised, and this facilitates the flow of ideas.]
It also develops higher order thinking skills as illustrated in the lesson described above which showed students learning FROM as well as interacting AROUND it. The students had to scan the passage to catch the drift of its meaning, hypothesise on possible words to fill in the blanks and make choices. Immediate feedback forced them to reanalyse options and consider alternatives when these choices were rejected. This constant cycle of analysing contextual clues, synthesising information and choosing alternatives honed logical and critical thinking as well as writing skills, and enhances the technology as a tool for instruction.

Desktop publishing. Within the research time frame, about 41% (as shown in Table 21) of the teachers participated in desktop publishing activities in the schools. Students were observed selecting and preparing articles for their school magazines and bulletins, a process which required them to analyse and break down problems into small parts, make decisions as well as design creatively with technology. Although time-consuming, this practice of technology was described as mentally challenging and rewarding by the majority of the students interviewed.

Technology as a teaching tool

The white board. After the smart school software was installed in the school computers, technology was increasingly used as a teaching tool. The simplest example of this typology of use was when technology became simply a white board, a means to display information, a screen which students learnt from rather than learn with. The
following lesson – a Geography lesson at Rajawali – best illustrates this mode of technology use.

The 20 students were seated in six groups with a computer per group. The teacher’s computer was linked to an LCD panel which projected the screen onto the white board in front of the class room. The teacher started by showing a slide presentation depicting symbols used to represent land use such as rubber, paddy, swamps, etc. She then asked them to access a file on the computers.

A grid table flashed on. It was divided into three columns headed ‘topography’, ‘soil type’ and ‘vegetation type’ and was attractively laid out, with each column filled in a different colour. The teacher read aloud the information in the table and explained the characteristics of land use associated with each topography type. She used the computer like a whiteboard and then set the students a task – they had to come up with a mind map or concept map on the computer, explaining the importance of natural resources to a country’s economy.

The students soon settled down to the task at hand. They chose a leader to deliver the presentation. Then, some started sketching out the mind map while others looked up facts in the textbooks.

There was an air of light-heartedness as the students moved around and jostled at each other’s work. Jokes were bandied about and occasional bursts of laughter filled the air, but overall, the atmosphere was orderly.

The teacher walked round the classroom, helping students where necessary. Later, they took turns to make their presentations. At the end of each presentation, feedback was given and changes to the mind map made.

The teacher then summarised the main points of the lesson, again referring to the grid on the LCD screen. She collected the diskettes from the students so that hard copies of their mind maps might be printed and distributed for future reference.

[Note: The emphasis in the above lesson was on using the computer as an electronic whiteboard. Although this mode of technology use may be considered trivial by some people as the computer could easily have been replaced by a blackboard or OHP without adversely affecting the impact of the lesson, the technology nevertheless served an important purpose – it captured the students’ attention and turned the lesson into something high tech and ‘cool’. The technique of getting students to come up with mind]
maps was frequently observed within the research time frame. While there was merit in training students to create mind maps and thereby hone thinking skills (Gordon & Gill, 1989), no concept mapping software like MindMan, VisiMap, Inspiration and Activity Map were used by the students who depended on limited word processing software. However, what makes the above lesson really commendable was the fact that Geography was not earmarked for technology integration in the first phase of the technology implementation initiative and thus, the teacher’s efforts were entirely her initiative.

Drills and practice. Computer-based drill and practice exercises were frequently used by the teachers to reinforce skills after a topic had been taught, especially in Mathematics. Below is an illustration of a lesson incorporating drill and practice exercises:

The teacher had taught the topic on percentages a week earlier and wanted to reinforce the students’ mastery of the topic. Upon looking through the software in the school’s resource room, she chanced upon a relevant CD and decided to integrate it into the next double period lesson, held in the classroom. As there were six computers to 17 students, they worked in groups of three.

The lesson started with a brief recapitulation of the previous lesson. The students were asked to review the page entitled Imbasan Sejarah (flashback to history) and then tested via simple, knowledge-level questions. The teacher directed their attention to the graphical representation of ‘25%’ on a pie chart and explained what it meant. Later, students accessed the drill and practice exercises in their groups, writing down their answers – with the correct working – on separate sheets of paper. Soon, the students were working earnestly together. They discussed the mathematical problems and worked out the solutions.

S: Click on the answer lah.

The girl seated nearest to the computer clicked on the answer. There was a jubilant cry when they saw that their answer matched that on the screen.

S: Saya tak dapat, macam mana? (I don’t get it. How did you do it?)

The first boy looked over quickly at the paper with the working and spotted the student’s mistake.
S: Ini salah, bodoh! (This is wrong, stupid!)
The computer screen showed a score and advised them to move on to the next page where another short exercise followed. The students worked through the problems quickly as the teacher walked around, checking on the groups as they worked. She noticed a student having problems, glanced at his working and pointed out his mistake.
T: Itulah yang salah tadi (That’s where you went wrong just now).
As the exercises were self-paced, some groups finished earlier. They checked their scores on the computers and moved on. Group Anggerik completed both the drills on the computers ahead of the others.
S: Habis, cikgu! (We’ve finished, teacher!)
T: Self access.
The student leader walked over to the self-access corner and picked up the task sheets for the day. She distributed copies to her group members who started working on them individually. When the bell rang to signal the end of the lesson, the teacher collected the answer sheets from the students.
T: Those of you who have not done the task sheets, please collect them from the self access corner and do them for homework. Any problems?
No, then, you may go for rehat (break).

[Note: Most teachers appeared comfortable with drill and practice software, especially ‘wraparound’ software which ran parallel to curriculum and textbooks (Snyder, 1986). The students seemed to enjoy this mode of technology use because information was presented in a linear fashion and thus, easy to follow. Unfortunately, the exercises did not really accommodate individual differences as all students followed the same path of learning.

Drill and practice exercises have often been criticized for promoting rote learning and low level thinking skills (O’Brien, 1994; Salomon, 1985), and for fostering automaticity in students and trivializing subject matter (Vockell and Schwartz, 1992). They have also been slammed as boring (Geisert & Futrell, 2000). Several teachers at Rajawali agreed that such exercises were “dry” (R:27.8.00.1), especially since these exercises were based on behaviourist principles which emphasized skill reinforcement]
rather than new learning. Classroom interactions tended to follow a fixed sequence, that is, the computer initiates, the student replies, the computer evaluates and then the cycle starts again. Although about 41% of the teachers reported engaging in drill and practice exercises, many said they were not particularly enamoured of this use of technology.]

Tutorials. Tutorials differ from drill and practice exercises as they are based on cognitive rather than behaviourist principles. They diagnose students’ skills before presenting information and testing their understanding, and follow this up with instruction to correct errors. In other words, the students learn from the computers. Witness the following Science lesson conducted by Chin at Gemilang.

(The students filed excitedly into the computer lab which was equipped with 20 Internet-ready computers. As there were 31 students, they paired off).
T: Every student must have a piece of paper. You may now log on.
(As the students excitedly logged on, an LCD panel projected the screen from the teacher’s computer onto the wall in front of the classroom. Using that as a white board, the teacher gave instructions on how to access the Smart School Programme.
T: After you enter (the menu for) Science Form I, wait. Be patient! Wait for your friends. (The students chattered excitedly.)
T: Access the topic ‘Heat’.
Any problems, put up your hand. You may use headphones.
(Immediately, a hand shot up – a student could not launch the program on his computer.)
You must all do the pre test.
(Some students wrote the answers on pieces of paper while others keyed the answers directly into the computer. A student moved the keyboard so as to get more space. Chin copied out several questions on the white board and directed the students to look for the answers as they went through the tutorials.
Question 1: What is heat?
Question 2: What’s temperature?
Question 3: List four types of thermometers
Question 4: Write a summary of what you have learnt
A student nudged her partner.

S: Salin nota tu, nanti cari jawapan (copy the notes, look for answers later.)
T: Don't worry about copying the notes. Try to answer the questions.
S: Bising ni. (This is too loud.) The boy gestured to the headphone. Unfortunately, no one could figure out how to reduce the volume of the sound.
S: Dapat ini, sekarang mana pula? (Got that, now what?)
S: Teacher, teacher, is thermometer mercury a type of thermometer?
T: What does the computer say?
S: Teacher, what's my password?
(There was a loud "clang!!" whenever someone clicked the right answer. The computer's response to wrong answers was even more jarring — "like an alien", a student noted. A student grabbed the headphone from his partner. They had to share as they worked in pairs.)
S: Aiyo, (the computer) so slow one.
(The tutorial taught students the correct way to read temperature. A thermometer was pictured, immersed in a beaker of water and heated gradually; the students had to record the temperature on the computer screen before and after the heating process. Several students finished answering the questions and asked for permission to access their email. A boy started exploring other sites.)
T: Those who have finished, send me an email and tell me your reflections on what you have learnt today.
A student was observed sending her email to the teacher: “Teacher (sic) you balas (reply) me, U know, please balas me” (G:2.5.01.4).
T: Boleh log off. (You may log off.) Just then, the bell rang.

[Note: Two points emerged clearly from the above lesson. Firstly, the students exerted less control over their learning as in the archetypal tutorial. Despite having their entry level skills determined at the start of the lesson, they went through the same tutorial, regardless of their entry level skills. Secondly, the computer controlled the amount of instruction, moving the students through the tutorial much like they would have been moved through a textbook with a human teacher. There were few opportunities for students to explore the software which followed a typically linear sequence.
Consequently, there were limited opportunities to construct meaning. Instead, students merely digested inert information and selected from the interpretations posted on the]
software. A further point to note about tutorials is that although only 33% of the teachers have adopted this pattern of practice (as shown in Table 21), this mode of technology use is likely to increase in the near future once the smart school software is fully ready.)

Technology as a networking tool

Asynchronous communication: Email. Email was the most common form of asynchronous (delayed) communication observed in the schools within the research time frame. About 56% of the teachers (Table 21) reported using this means of communication to liaise with students. Anna mentioned that her students regularly emailed greeting cards to her during festive seasons. At Sendayan, a teacher interacted with her students regularly via email: "I ask students to do refleksi (reflections) in email and send to me. Then I'll send back to them" (S:7.3.00.3). She explained that email helped her to know her students better and this transferred into better rapport in the classroom. Another time, when a teacher from Sendayan had to take emergency leave to care for her husband stricken with dengue fever, she emailed daily instructions to her students regarding class assignments (S:17.2.00.2).

A check on email exchanges showed that the majority dealt with the supervision of project work, calls to hand in assignments, scheduling of meetings, etc. There were no tutorial exchanges conducted via email within the research time frame. But the email did offer students personal access to the teacher and allowed them to vent their feelings on personal matters, thereby enhancing rapport and paving the way for more egalitarian participation in the classroom.
However, not all teachers liked using email. One described how she felt email to be an invasion of her privacy:

I see technology as blurring the line between my workplace and my home. For example, I'm supposed to email my students when I'm at home. I'm supposed to relate to them and I have to set them homework. I don't like that, I don't like that and I see that happening increasingly not only in my workplace but also in all our lives. That means, blurring of lines between what I consider my work and what I consider my private life... I love my work here but I won't love my work if it's an invasion. I'm not unhappy about the changes. I realize they're necessary. I'm going to a part of the world and the computer is going to be there and I can't run away from it but I want to have control. I'm not willing to think about technology the way the sellers of technology want us to embrace it...

(S:27.6.00.1)

Thus, it would appear that the easy accessibility offered by email was a double-edged sword. Apart from email, other forms of asynchronous communications such as bulletin boards and list serves were not observed used by the teachers within the research time frame. However, teachers like Ling subscribed to list serves for personal updates on lesson plans.

Synchronous communication: Video conferencing. A video conferencing session involving four schools in Malaysia and a school in New Zealand was held in September 2000. Four students from Rajawali participated in the conference. As this was a pioneer effort, the teachers helped the students prepare the script for the conference. Students and teachers were observed, staying back after school almost every day for about a week, discussing, writing, taking snapshots of the wetlands and scanning pictures into the computer.
Obvious benefits were derived from the video conferencing session. One was the sense of unity and teamwork the students experienced as they collaborated on the project. Feedback from the students included “We enjoyed (the) teamwork” and “I learnt to cooperate with the other members and I learn to control my temper” (R:8.9.00.1). A student mentioned developing interpersonal skills and tolerance when working with team members:

I practised some people skills, like when someone says ‘I can’t come, well, I stay in... (far from the school) and I can come and I don’t understand at first (why others couldn’t come) but I learn to be more patient... (R:8.9.00.1)

Another student credited the project with increasing her general knowledge – “I learnt from the conference...” (R:8.9.00.1). She expressed a sense of pride: “I feel glad I could participate in an international show... at least, I’m exposed to what’s happening about Christchurch” (R:8.9.00.2). A side benefit was the enhancement of ties between the school, the students and their parents:

When teacher told me, I felt like it’s nothing much. But my dad saw the Principal and she told my father I had been chosen and my father was very proud. I could see it in his eyes. I was so happy because he was happy. Other then my exams, I never see him so happy, he was so proud and he started to tell everyone about it... (R:8.9.00.2)

The project also provided an opportunity for the students to get to know their teachers better:
I also learn to know my teachers better... she doesn’t teach me, I never knew her but she was in charge of all this, I learn she was a nice person when we work together. I learnt how she felt about the project, but more about her. She was really concerned because we had such a short period, a very caring teacher. I feel good...

(R:8.9.00.2)

Even students who were not techno-savvy became more comfortable with technology after participating in the conference. One student said:

At first, exams were coming soon and I thought it would interrupt my studies. I wanted to drop out but my teachers and friends persuaded me. I learnt all this technology stuff... wasn’t interested much at first, so I watched. Feel closer to computers now. And I think it’s cool. You get to know other people better, closer ties to other countries you wouldn’t know. It’s cool because you get to see people on the screen and it’s different, one thing we learnt is to speak with confidence in public. This will stick in my mind.

(R:8.9.00.2)

On a more cautious note however, it must be pointed out that many teachers had doubts about the viability of using video-conferencing as a teaching resource due to the high costs incurred and the cumbersome user interface. A review of research into some of these initiatives confirmed this (Maddux, 1989). Riel and Levin (1990) stressed the need for active commitment by an enthusiastic project manager before video conferencing can be truly effective. Turnbull and Beavers (1989) highlighted the problem of compatibility of interacting communities. Keep (1991) felt that much energy was required just to sustain student interest. In short, the consensus seems to be that this use of technology can only be effective if it is embedded in a larger framework of cross-site communication and concerns.
Besides video conferencing, the students at Temasik also reported networking with friends in chat rooms and over the ICQ, especially when working on collaborative projects. A student was observed at home, discussing the features for a super bike he had designed with other members of his group who sent ideas and suggestions online, via downloaded files.

**Technology as cognitive / mind tools**

**Problem-based projects.** Throughout the research time frame, students were observed to be engaged in various problem-based projects. Utilising technology to get students to solve authentic problems is actually harnessing the potential of technology to act as a mind tool. Jonassen (1996) defined mind tools as "computer-based tools and learning environment... developed to function as intellectual partners with the learner in order to facilitate critical thinking and higher order learning".

In other words, mind tools are computer-based learning environments that amplify cognitive functioning by providing scaffolds to higher order, critical thinking. Given the information explosion today which sees knowledge doubling every three years (Salisbury, 1996), technology definitely gives students an edge by enabling them to tap global sources of information and engage in conversations with external partners and online experts. Witness the following Science research project conducted at Sendayan:

(The students collaborated to produce a folio on different aspects of the topic 'Reproduction'. They worked at the project on their own time and were given one month to produce the folio. The culmination of the project was a presentation, held in one of the simulation rooms which housed 16 computers and a LCD.)
A group leader introduced the members of her group and began her presentation prepared on Powerpoint, with 3-D pictures downloaded from the Internet. She used a marker to indicate the location of the bladder, urethra, vagina, etc., and showed the front and side views of the human reproductive system. Interactive elements were introduced as the students were virtually shown the impact of conception on various parts of the reproductive system. They watched in rapt attention as the group representative explained.

When she had finished, another member of the group took over and talked about the menstrual cycle. She presented an interactive pie chart on the components of vaginal discharge and showed the effects of an imbalance in these components on the human body. “Wow!” was one girl’s reaction. Giggles were heard when the topic touched on personal hygiene. A hand was raised – the student wanted to know the difference between menstruation and period, and when one should consult a gynaecologist.

The next group had researched the first trimester of a pregnancy. The students listened spellbound as the leader presented her findings of the development of an embryo. There was even an ultrasound scan of a foetus in various stages of development and a slide presentation of a woman in various stages of labour, complete with sound effects and a running commentary.

As another team member talked about amniocentesis, the students were observed listening intently. When the presentation touched on the topic of breast-feeding, the students complained that the words on the slide were too small.

At the end of the presentation, the teacher commended the students on their efforts and highlighted some of the weaknesses and strong points of the presentation.

[Note: This lesson demonstrated clearly how interactive multimedia can take a lesson outside the walls of the classroom as the students learnt so much more – and vividly too – than they would have if the lesson had been conducted the traditional way. Thus, the power of the Internet to “shrink the world and bring knowledge, experience and information...” (LaQuey and Ryer, 1993) to the students was seen. Unfortunately, the full potential of the use of technology as a mind tool was not tapped in this project due to time constraints and inequitable access to technology. Nevertheless, the lesson did illustrate some of the potential possibilities offered by technology.]
Several interesting observations were noted from following the students around on this project. Firstly, field observations showed the students working mainly on their own at their delegated tasks, with limited communication between students or teacher.

Secondly, whatever communication that did take place between students and teacher was centered mainly on the product — the folio — rather than on the research process. In fact, the teacher played a really minimal role in the discovery process, coming in only at the end as a commentator on the product. Clearly, more efforts to ‘share’ the project from conception to conclusion are needed if benefits are to be optimised.

Thirdly, the success of the research project was found to vary greatly, depending on the ability, background and experience of the students. In groups where students were bright and techno-savvy, the technology worked effectively as a mind tool, sharpening research and thinking skills. However, a particular group of weak students was observed mindlessly downloading a virtual smorgasbord of information which they just cut and pasted into the folio.

And finally, although several students managed to successfully pursue divergent strands of information offered by the Web, there was insufficient guidance from the teacher to help students manipulate data effectively.

Simulations. Very few lessons with computer simulations were observed within the research time frame, perhaps due to the high cost of acquiring good simulation software. However, when properly carried out, this mode of technology use is not only
highly effective but also provides tremendous user satisfaction. Witness the following

Science lesson conducted in a science lab with one computer at Temasik:

(It was a double period. The subject was Science, Form One and the topic was the atomic structure of matter. The Science teacher had already spent four lessons explaining the atomic structure of solids, liquids and gases and explained the differences between an element, a mixture and a compound. However, she sensed that some of the students had not fully grasped the concept and were unable to visualize the arrangement of the atoms in such structures. So, she decided to show a simulation to deepen the students' comprehension.)

The group of 30 boys sat on the floor of the science lab, gathered round a single computer. The software started by showing the difference in the arrangement of atoms in solids, liquids and gases, and then simulated what happened to the atoms when certain variables were manipulated – for instance, when heat was applied or temperature reduced.

There were cries of “oohs” and “ahhs” as students tried to outguess the computer in determining what the changed state was.

The students were then asked to nominate a leader from their groups to represent them in a quiz.

Five group leaders were chosen. They sat near to the computer as they had to manipulate the mouse.

The first group leader clicked onto the first question. A simulated arrangement of atoms (in the form of coloured balls) flashed onto the computer screen – the group had to determine whether the atomic structure depicted was that of a solid, liquid or gas. The representative clicked on the answer “Solid” and was rewarded with 10 points by the computer.

A change in atomic structure was then simulated and the group had to again determine the change in state.

The screen then showed an arrangement of different coloured balls and asked the students to determine if the simulated atomic structure depicted an element, mixture or compound.

The group representative was responsible for clicking on the answer. When his answer was wrong, the question was opened to the other members in his group. However, no marks were awarded save for correct-on-first-attempt answers.

Only after all the questions related to the simulation were answered could the second group representative take over and move on to the next set of questions.

At the end of two rounds, the scores were tabulated and the winning group was given a rousing cheer.
[Note: The above lesson is testimony to the fact that even single computer classrooms can be effective. The development of higher order thinking skills was clearly emphasized in the lesson as students analysed and applied knowledge to new situations and hypothesised on what might happen under certain circumstances, in this case, when variables were manipulated. Both teacher and students appeared pleased with the outcomes of the lesson – the boys lauded the interactive approach while the teacher was pleased with the enhanced learning outcomes resulting from use of the simulation software].

Summary

To summarise, this section examined teachers’ patterns of practice with the technology in the school milieu by describing actual lessons observed. The objective was to come up with a typology of technology use commonly adopted by teachers in the case study schools within the research time frame. The resultant typology which emerged from field observations categorises teachers’ practices of technology into four groups – as a productivity tool, teaching tool, networking or communications tool and mind tool. This is graphically represented as in Figure 14 on the following page.

The next section compares the perceptions of both teachers and students regarding the effectiveness of technology-integrated instruction.
Figure 14: Typology of teachers' technological practices
The effectiveness of technology-integrated instruction

The teachers’ perceptions

To find out how teachers perceived the effectiveness of different modes of technology use within the research time frame, the teachers were asked to rank their practices of technology according to perceptions of effectiveness. This feedback was analysed and the results tabulated as in Table 22 below.

Table 22: Teachers’ perceptions of the effectiveness of modes of technology use

<table>
<thead>
<tr>
<th>Pattern of practice</th>
<th>Total number of ‘effective’ citations</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>19 (N)</td>
<td>1</td>
</tr>
<tr>
<td>Powerpoint presentations</td>
<td>13 (%)</td>
<td>2</td>
</tr>
<tr>
<td>Desktop publishing</td>
<td>5 (%)</td>
<td>3</td>
</tr>
<tr>
<td>Simulations</td>
<td>3 (%)</td>
<td>4</td>
</tr>
<tr>
<td>Drills and practices (CDs)</td>
<td>3 (%)</td>
<td>4</td>
</tr>
<tr>
<td>Word processing</td>
<td>2 (%)</td>
<td>6</td>
</tr>
<tr>
<td>Computer games</td>
<td>2 (%)</td>
<td>6</td>
</tr>
<tr>
<td>Email</td>
<td>1 (%)</td>
<td>8</td>
</tr>
</tbody>
</table>

As Table 22 above shows, the modes of technology use ranked by teachers in descending order of effectiveness were the Internet, powerpoint, desktop publishing, simulations and drills and practice CDs, word processing and computer games, and lastly, email.
However, Table 22 seems to suggest that the teachers do not generally perceive the use of technology in schools as effective, at least not within the research timeframe. Even the top-ranked mode of technology use in terms of effectiveness—the Internet—was perceived as effective by only 48% of the teachers. PowerPoint presentations were rated effective by one third (33%) of the teachers while desktop publishing gathered 13% of the votes. Subsequent modes of technology use received the thumbs up from only a minority of teachers—simulations and drill and practice software (8% each), word processing and computer games (5% each) and email (3%).

Anna explained why she did not find the Release One of the English software effective:

(The) Form One software is very simple, one sentence fillers, one word fillers, you'll laugh. May help weaker students but for the boys here, I think not much of a challenge. The Form Five topics are more interesting. And we have to proceed along the exercises accordingly, we cannot jump and it's quite boring. Maybe the second software'll be better. The first one is boring. We went through it like students and felt bored. Most of the teachers felt it was too simple for urban school students. It's linear, cannot branch or jump topic, we have to follow; the Form Five software is okay, we have to know and understand the text, comprehend it before answering the questions but the Form One software is just too simple...

(T:18.8.01.4-5)

Over at Gemilang, Chin also found the Science smart school software disappointing. She described the students' responses to the software:

After about an hour, they got bored and asked for permission to go to the Internet, I gather they were bored.

(G:23.4.01.2)
She elaborated:

One same sentence (for) several pictures, for example, heat from the sun supports life; six pictures and the picture takes a long time to come out, but fact is too simple (and) picture served no purpose (only) aesthetic, new. Students, they just sit and enjoy. They said the music is so stupid, not “black metal” [laughs]...  

(G:2.8.01.1)

The layout and graphics of the software also came in for criticism:

The graphics are quite attractive but the sounds are very disturbing. Is there anyway we can shut off the sounds or not? I think there are hot spots – a row of five to six buttons and the minute we touch on (sic) it, it goes crannkkk! It’s irritating!  

(G:23.4.01.2)

However, she realised that the smart school software was new and that it should, given time, improve: “Give them three years, (things) should be much better…” (G:2.8.01.1).

The dismal placing of email was due to the fact that some of the students’ English proficiency was horrendously low and teachers did not know how to use email to enhance learning outcomes. A teacher showed the following email sent to her by a student at the end of an English lesson and moaned that she did not know where to begin to help her students:

ok u ada dapat kad tak i send you
ok u boleh send balik
(ok, did you get the card I sent you)  
(ok, you can send back a card)  

(G:23.4.01.1)
The students' perceptions

The students' perceptions of technology use have been tabulated in Table 16 on page 189. To recapitulate, Table 16 shows clearly that although 61% of the students perceived technology in the classroom as 'enjoyable', only 8% believed it to be effective. Another 11% of the students were unsure how they felt about technology-integrated instruction while 3% insisted it was a waste of time. In other words, the students had very mixed reactions to the use of technology in instruction, and a seemingly low opinion of its effectiveness.

Given the exam-oriented nature of our education system, these mixed reactions were hardly surprising. Interviews with the students cast more light on their responses. A student who found technology-based lessons enjoyable explained that the technology livened up otherwise dull lessons:

I like to use the Microsoft Powerpoint which we may design our page plus animation on our presentation...

(ISI:S7)

Another student said that he enjoyed technology-integrated lessons because it offered opportunities for group work:

I feel that using the computer in school is better because it encourages teamwork in groups. It also increases our creativity using the software in the computer. Learning in groups also encourages friendship in groups. Learning in groups help people overcome their weaknesses by learning from others. Aside from that, we can grow closer to our friends and teachers.

(T:18.8.00.1)
However, the students' low opinion of technology's effectiveness as a tool for instruction was interesting. To gauge if the students understood the impact that technology would probably have on them in the near future, they were asked if they perceived technology as relevant to future careers. The majority of the students (92%) perceived technology as relevant, a minority (5%) felt it was irrelevant while 3% admitted that they did not know (shown in Table 23 below).

<table>
<thead>
<tr>
<th>Responses of students</th>
<th>Number of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, it's not relevant</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Yes, it's relevant</td>
<td>213</td>
<td>92</td>
</tr>
<tr>
<td>I don't know</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Total (N)</td>
<td>233</td>
<td>100</td>
</tr>
</tbody>
</table>

Interestingly, despite the large number of students (92%) who perceived technology as relevant to future careers, only 72% (as indicated in Table 24 on the following page) wanted their teachers to integrate technology into lessons in the classroom. About 17% of the students preferred teachers to stick to traditional modes of instruction while 11% wanted teachers to combine both instructional modes.
Table 24: Students’ preferred mode of instructional strategies

<table>
<thead>
<tr>
<th>Students’ preferred instructional strategies</th>
<th>Number of students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional mode</td>
<td>39</td>
<td>17</td>
</tr>
<tr>
<td>Technology-integrated mode</td>
<td>168</td>
<td>72</td>
</tr>
<tr>
<td>Both</td>
<td>26</td>
<td>11</td>
</tr>
<tr>
<td>Total (N)</td>
<td>233</td>
<td>100</td>
</tr>
</tbody>
</table>

Summary

To sum up, research findings suggest that although teachers have started integrating technology into classroom instruction and the typology of technology use which emerged (Table 21) shows electronic presentations at the top of the list, the teachers and students do not, as yet, appear to have faith in the effectiveness of technology. Despite this however, 92% of the students perceived technology as relevant to future careers and 72% wanted teachers to integrate it into classroom instruction.

A further observation was noted during field work. In schools where students’ responses to technology were positive, the teachers appeared more motivated to innovate, often thinking up ways to incorporate marks for technology projects into assessment grades. This encouraged students to devote more time to technology projects and eventually paved the way for a cycle of inter-sustaining reinforcement to be set into motion (as depicted in Figure 15 on the following page) where the students’ positive reactions to technology spurred teachers to greater efforts and this in turn, encouraged students to spend even more time on technology.
The converse happened when the students' responses to technology were negative as teachers then reduced efforts to integrate technology into class assessment, and this ultimately caused students to turn away from and to reject technology.

Figure 15: The cycle of inter-sustaining reinforcement in technology adoption
Conclusion

To conclude, this chapter examined technology use in the four case study schools within the research time frame. It investigated the frequency of use as reported by teachers and students and found that most teachers were mid-level technology users who integrated technology into instruction at least once a month.

It also looked at the typology of technology use in the schools and found that electronic presentations, the Internet, word processing and email were among the most commonly adopted practices, with video conferencing bringing up the end of the list.

An attempt was also made to provide thick descriptions of some of the teachers’ practices with technology, drawing on actual lessons of different subjects taught at differing levels of technological infrastructure. Field observations revealed that most of the teachers still stuck to traditional classroom patterns of instruction even when technology was adopted.

And finally, the chapter investigated teachers’ and students’ perceptions of the effectiveness of the innovation. Findings suggest that only about half the case study teachers perceived the use of technology as effective and that the modes of technology use ranked in descending order of effectiveness were the Internet, powerpoint, desk-top publishing, simulations, drills and practice software, word processing, computer games and email.

Surprisingly, only 8% of the 233 students interviewed perceived technology as effective in enhancing teaching. Despite this however, the majority (92%) believed technology to be relevant to their future careers and 72% were in favour of teachers
adopting technology-integrated pedagogies rather than sticking to the traditional mode of instruction.

The next chapter attempts to put all the major findings of this research study into a theoretical model to explain teachers’ acceptance and use of technology in the classroom, and to examine some of the issues raised and implications which arose.