CHAPTER 6

Report of findings: Technology diffusion

The diffusion of an innovation refers to its spread. Before an innovation can be fully institutionalised, it has to be diffused so that the majority in an institution accepts it. This means that if we wish to successfully implement technology-integrated instruction in schools, it is not sufficient for a mere core group of teachers to adopt it; efforts must be made to diffuse the innovation to others so that it will be more widely accepted in the school milieu.

This chapter investigates whether or not the teachers specially trained in the 14 Weeks' In-Service Training Programme for Teachers of Smart Schools acted as diffusion agents in the school milieu. It also describes the evolutionary phases teachers went through as they slowly moved through the diffusion process, and the problems they encountered. And finally, the chapter explores some of the factors that might account for variations in the teachers' responses towards technology, especially among those serving in the same physical and technological setting.

Passing the baton: Diffusion efforts

Research findings suggest that efforts to promote technology diffusion are generally more successful if there are teachers acting as technology champions to initiate other teachers into either novice, or continued, technology use in the schools (Carstens, 1995).
Field observations showed that most of the teachers who had attended the 14 Weeks' In-Service Training Programme for Teachers of Smart Schools readily involved themselves in this aspect. These teachers formed an early 'critical mass' of technology users (Markus, 1987) who devoted time to help other teachers acquire technology skills as well as strove to improve technological facilities in the school milieu. A teacher at Rajawali even loaned the school her computer modem, scanner and printer.

In order to determine the extent of the case study teachers' involvement in diffusion efforts, the teachers were asked, in an addendum attached to the second SoCQ administered in August 2001 (Appendix 2bii) to list down the number of times they had conducted or assisted in technology-related staff development activities. The results are tabulated as in Table 14 below.

Table 14: Teachers’ involvement in diffusion efforts

<table>
<thead>
<tr>
<th>Involvement in technology-based staff development activities</th>
<th>Number of responses from teachers in schools</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rajawali</td>
<td>Temasik</td>
<td>Gemilang</td>
</tr>
<tr>
<td>Not at all</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-2 times</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3-5 times</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>More than 5 times</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>
As indicated clearly in Table 14, almost all the teachers who had attended the 14 Weeks’ In-Service Training Programme for Teachers of Smart Schools appeared to have conducted technology-related staff development programmes in their respective schools, either directly or indirectly.

About 25% of the teachers reported having conducted technology-related training sessions at least once within the research time frame, 27.5% at least three times, and 37.5% more than five times. This means that a total of 90% of the teachers had participated in staff development initiatives to diffuse the innovation of technology-integrated instruction. As one of the teachers put it:

In-house (activities) is running well, I cannot remember all the details but I remember I did (conduct in-house training)... All of us did...

T:10.8.00.2)

Ling for instance, was observed conducting three multimedia workshops, on March 1, July 17 and August 21 in the year 2000 alone. She adopted a minimalist approach, teaching basic skills and encouraging teachers to use pre-prepared templates:

I taught teachers how to use Hot Potatoes, templates, content-free. We don’t have to create our own templates, so we can fill in (the content) quickly...

(R:2.5.00.7)

Similarly, at Temasik, the case study teachers were observed participating in at least 10 in-house training sessions, both at school and state level, within the research time frame. At Gemilang, staff development activities were conducted every alternate Saturday morning. Sendayan, too, had regular in-house activities which were temporarily
put on hold when the school made arrangements to move to its new premises. When the
10% of teachers who had reported no involvement in any technology-related staff
development activities were interviewed, they explained that they were merely awaiting
their turns.

To conclude, questionnaires, interviews and field observations showed that the
majority of the teachers who had attended the 14 Weeks In-Service Training Programme
for Teachers of Smart Schools participated in diffusing technology-related skills to their
colleagues in the case study schools within the research time frame. Those who were
techno-savvy conducted the training whilst those who were less technologically
competent helped with the organizational aspects. In the words of one of the teachers
who fell under the latter category,

I have been giving in-house training to others – all the half-cooked
teachers training the others, the reluctant training the rebellious…

(G:21.4.00.1)

The diffusion process

Evolution, not revolution

Recent diffusion research described the technology adoption-diffusion process as
"evolutionary rather than revolutionary" (Meyrowitz, 1995) and suggested that it was
slow, better "...measured in years or decades rather than months" (Gilbert, 1996).

The SoCQ supported this, showing the teachers in the case study schools
struggling with different concerns over time. Field observations also highlighted the
evolutionary nature of the technology adoption-diffusion process, showing teachers
gradually becoming more comfortable with the technology, more proficient in its use and more innovative in integrating it into lessons as time went by. Interestingly, instead of a linear progression, the adoption-diffusion process seemed to comprise peaks, troughs and plateaux as teachers’ enthusiasm and efforts surged, ebbed and consolidated in turn. Consequently, five distinct stages or phases were identified.

**Stages of instructional evolution**

**Entry: Preparatory use.** When field work commenced in January 2000, most of the teachers were in the entry stage of the instructional evolution cycle, that is, they were preparing to use the technology. Although fully aware of the innovation, they reacted differently to it. Some were wary and uncertain; others plainly excited! The former adopted a ‘wait-and-see’ attitude towards technology while the latter were caught up in frenzied preparations — unpacking boxes, untangling cables, formatting disks, checking out computers and generally trying to establish order in the new layouts in classrooms and labs. This stage also saw many instances of “fire-lighting” (Passey & Ridgway, 1994) when technology lovers tried to convince fence-sitters of the benefits of technology use.

**Early adoption: Novice use.** After the initial excitement heralding the arrival of the computers had somewhat abated, the teachers were observed experimenting with the technology. They struggled with new hardware and software, technical glitches and discipline problems. Mistakes and blunders were made but the teachers persisted in their efforts. However, technology use was disjointed as teachers concentrated on problems
related to classroom management rather than on instructional innovation. Despite some spill-over novelty effect, the morale of teachers was observed dipping when teething problems associated with novice use of technology escalated.

Crisis: Learning to get by. As most teachers seemed to encounter problems grappling with the innovation after the honeymoon euphoria of initial novice use had settled a little, this phase is best described as the 'crisis' or 'learning to get by' phase. In order to cope with the multitude of problems at this stage, various strategies were devised by the teachers.

For instance, students were trained to troubleshoot and to handle technical glitches. At Temasik, the Cyber Brigade became so good at this that teachers even sent their personal computers to the students for repair. Another coping strategy was the setting up of a bank of backup lesson plans in case of power failure. At Gemilang, Chin even threatened to withdraw computer privileges when students misbehaved. All these strategies met with varying degrees of success.

The teachers' experiences during this stage were crucial to determining whether or not they continued with their efforts at integrating technology. When their coping strategies failed, teachers were discouraged and the adoption-diffusion process entered implementation dips or troughs as teachers retreated from technology use, usually for short spells. These dips were especially prominent in the middle of the year 2000 due to perceived lack of top-down support and disenchantment with the technology: "Mula-mula rebut guna IT (Initially, we fought to use the technology) but now (usage) dropped because of empty promises" (R:12.6.00.4).
However, in instances when the crises were satisfactorily resolved, both the coping strategies and new instructional pedagogies were internalised into the teachers’ repertoires of skills.

**Adaptation: Routine use.** Once the storms and stress of the ‘crisis’ stage were over, teachers usually found themselves coming to new terms with the technology. The pace of use increased as routines with technology were set up although teaching remained essentially teacher-centered. A teacher noted:

> You can actually see the students, really like the lessons and using the technology. They become so creative and they’re so motivated and enthusiastic…

(S:18.2.00.1)

Thus, this stage was characterised by increased satisfaction for students,

> Children look forward to (technology)... they are happy. They are very enthusiastic, so much so they cannot stop. Keep saying, “No, no, we are not ready (to hand in work), we want to do better”. I think it helps them with leadership skills and increases their motivation...

(T:14.9.00.8)

as well as for teachers:

> The advantage is the motivation… the students get so motivated… you need a lot of time to get a little skill but once you get the skill, you can use it in so many ways… if you have a very sleepy boy in the class, put him in front of the computer, he wakes up, what he does is another thing but he does wake up…

(R:21.8.00.9)
Invention: Creative use. The final phase in the instructional evolution cycle is the invention stage when teachers moved away from routine use to more creative and innovative ways of technology integration. Just as in the 100th monkey phenomenon (a Japanese folklore which described how sweet potato became the staple diet of monkeys only after 100 monkeys had nibbled at it over many years), teachers who reached this stage experienced a turning point in their beliefs and attitudes towards technology, almost a psychological threshold so to speak, and became imbued with new mastery over the technology.

Sandholtz et al. (1997) described this stage as appropriation, when teachers used technology effortlessly to collaborate in new ways which made classrooms ‘buzz’ and come alive. Unfortunately, however, no teacher was observed comfortably settled down at this stage within the research time frame although there were times when Ling and Shah hovered here in the later part of the research time frame.

Summary

To sum up, most of the teachers seemed to have contributed positively to the diffusion of technology in the case study schools. The teachers actively participated in conducting technology-based staff development activities and were observed going through distinct phases in the diffusion process, encountering and resolving problems at every stage but more so at the ‘crisis’ stage. Successful resolution of problems led to internalisation of practices while unsuccessful resolution resulted in rejection of the innovation. This cycle of instructional evolution is represented diagrammatically as in Figure 12 on the following page.
Figure 12: Stages of instructional evolution
Problems and crises – Obstacles to technology diffusion

As no study on technology adoption and diffusion would be complete without an attempt to allow the respondents to share with the reader the experiences they went through, the problems they encountered, the pain they experienced and the pride they felt as they confronted the innovation in the school, this section makes way for the respondents’ voices to be heard. To ensure that the voices offered as broad a perspective as possible, the voices of school principals and students were captured as well as those of teachers.

The voices of the teachers were captured via interviews and an addendum distributed in the second SoCQ (Appendix 2bii) towards the end of the research time frame, which required them to list down perceived problems or obstacles to technology adoption. The results (tabulated in Table 15 on the following page) indicated that the teachers perceived various problems as obstacles to technology diffusion in the case study schools. When ranked in descending order of frequency cited, the main problems were time constraints (cited by 80% of the teachers), lack of exemplary practices of technology (68%), student indiscipline (50%), lack of IT skills (40%), limited access to technology (35%), doubts about the efficacy of technology (35%), lack of confidence (25%), lack of collegial support (15%) and lack of support from the school administration (8%). These problems were encountered by the majority of the teachers during the research time frame but the list was not exhaustive as other less prevalent problems were also encountered in isolated cases. These will surface in the course of the discussion. Let us now hear the respondents speak.
Table 15: Teachers’ perceived problems of technology-integrated instruction

<table>
<thead>
<tr>
<th>PROBLEMS PERCEIVED</th>
<th>CITATIONS BY TEACHERS (N = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
</tr>
<tr>
<td>Lack of time</td>
<td>6</td>
</tr>
<tr>
<td>Lack of examples on how to integrate technology into the subject taught</td>
<td>4</td>
</tr>
<tr>
<td>Student discipline problems</td>
<td>5</td>
</tr>
<tr>
<td>Lack of IT skills</td>
<td>2</td>
</tr>
<tr>
<td>Lack of access to technology</td>
<td>1</td>
</tr>
<tr>
<td>Doubts about the efficacy of technology-integrated instruction</td>
<td>2</td>
</tr>
<tr>
<td>Lack of confidence to implement technology-integrated instruction</td>
<td>1</td>
</tr>
<tr>
<td>Lack of support from colleagues</td>
<td>1</td>
</tr>
<tr>
<td>Lack of support from school administration</td>
<td>1</td>
</tr>
</tbody>
</table>

The teachers’ voices

Time constraints

Time constraints was the most pressing problem cited by teachers as they confronted the innovation in the classroom. This is consistent with other research studies which identified time as the critical factor affecting teachers’ decisions regarding technology integration (Wang & Chan, 1995).

One teacher explained:
But (technology) takes so much time... sometimes you get so much more done if you just use chalk and talk...

(T:14.9.00.9)

Another described how she had difficulty covering her syllabus after she began integrating technology into instruction:

We tried (integrating technology) this year... (we were) left behind, one-and-a-half chapters behind... it’s related to technology because we’re following group paced (which requires) more time for exploration...

(T:21.2.00.2)

At Temasik, Anna observed:

(technology) ... drag the lesson too long... (because students are) very competitive (and) want to produce excellent work

(T:28.7.00.2)

Time constraints were also experienced at Sendayan. A teacher voiced her frustration and concern:

We started fully with the IT and the new (smart) syllabus and all that and sad to say, we couldn’t finish the syllabus. We couldn’t finish the syllabus and it’s two-and-a-half topics (left behind). Altogether, we had six topics to finish in Form One and two and a half topics were not finished. We just couldn’t finish... it’s that slow... a lot of things to cover (we) tried our level best to finish and we couldn’t. And the Form 2 syllabus is worse, it’s the longest (syllabus) of the three years, so now, the major topic (in Form Two) and another two topics (from Form One) have to be covered this year. So, it’s going to affect the Form 2 syllabus now...

(S:30.3.00.3)

This problem was aggravated by the fact that some teachers did not have personal computers and could not prepare instructional materials at home:
I have the idea, it’s just that I don’t have the time to implement it, time meaning I have 10 classes, so I don’t have time during school time to prepare... I still don’t have any Internet (at home), so I can only prepare in school... when are free (sic), have relief classes; stay back in the afternoon and sit down a moment, start co- curriculum... We are busy...

(G:12.4.00.1)

And even when computers were available in schools, teachers were not given release time to access the technology:

(I) can use the Internet in the teachers’ room, it’s free, but I seldom go because I have work to do...

(G:13.6.00.3)

The picture which emerged from field observations was that of a group of extremely over-worked and tired teachers in the case study schools, the majority of whom were functioning in survival mode. Comments like “I’m tired out” (G:13.6.00.5); “I’ve no time... it’s just do this, this and this” (G:12.6.00.2); “...I’ve stopped using technology for the time being. Time’s the problem. Rushing, rushing, rushing to finish the syllabus” (S:16.3.00.1) and “Too much exams... no time for technology” (R:18.4.00.3) were commonly heard.

The problem of time constraints was exacerbated by the fact that teachers shouldered a myriad of responsibilities besides teaching. At Rajawali for instance, teachers stayed back almost every day of the week – Monday was Staff Development Day, Tuesday was Academic Day; Wednesday was Weekly Meeting Day and Thursday was Co-Curriculum Day.
As a teacher put it: "...time is a big problem, where got time for technology?"

(R:25.4.00.2). Clearly, time constraints was a serious factor acting against the diffusion process.

**Lack of exemplary practices of technology**

The next problem that emerged clearly from the teachers’ voices was the lack of practical, exemplary practices of technology that could be implemented in the classroom. Interviews with the teachers revealed that many did not really know how to effectively integrate technology into their respective subjects. Mei voiced her problem:

I really don’t know how (to integrate technology into classroom instruction), only can (ask students to) find list of this and that only, for example, Trigonometry, other than that, I also don’t know...

(S:20.4.00.1)

Chin was equally frank. She admitted: "Honestly, I still don’t know how to plan using a lesson on Internet" (G:3.7.01.1). Her colleague ruefully agreed:

We don’t have enough computer-based lesson plans. I don’t really know how to use computers to teach...

(G:13.6.00.8)

Several teachers even took the MOE to task, pointing out that the *14 Weeks’ In-Service Training Programme for Teachers of Smart Schools* should have provided teachers with more exemplary practices of technology which they could emulate when teaching their respective subjects. Instead, the teachers complained that many course facilitators did not even bother to use the technology themselves during the training programme:
(the course was) disappointing... I was expecting the lecturers are practising the bestari (smart school) ways and I can emulate (them).... I'm disappointed, they not practising what they teach, they have no examples of bestari work, they are not bestari ...

(S:19.8.99.1)

Ling too talked about the dichotomy between the ideal state that was propounded during training and the harsh realities found in the school milieu:

The course was very ideal but when we come back to the school, we land with a bump, you know, on this earth. It's not that well equipped and we face constraints like exams, and there's nothing we can do about it... so we try to, what do you call it, compromise lah...

(R:29.8.00.3)

The teachers' desire for exemplary practices of technology-integrated instruction to benchmark against has been highlighted in various research studies (Gilbert, 1996; Lee, 2000). Gilbert's (1996) study, for instance, confirmed that teachers were more likely to embrace technology if there were good practices for them to emulate. Watson (1993) also blamed the lack of exemplary models for uncreative uses of technology which "complement rather than change" existing pedagogical practices in most schools.

The need for exemplary practices in the case study schools was best summed up by a teacher who said succinctly:

I've learnt the how, but not the actually using it in the classroom. I know what it is, what it can do but how do I use it, teach, that would be the next step...

(S:27.6.00.4)
Student indiscipline

The third most commonly voiced problem was student indiscipline. Most teachers readily acknowledge that there is a greater element of disruptive potential inherent in technology-integrated instruction than in traditional instruction because computers divert the teachers' attention from students at least part of the time and require the teacher to surrender, at least for short periods, control of the classroom. A teacher summed up this dilemma when she said:

It (the technology) is nice and interesting but difficult to handle the class because in my class of 30 students, when they sit in groups of 3 or 4, one person would be doing the work, the others would be chit chatting or else, very busy distracting their friends, do this and do that... the class become very noisy and when they find something, they become very excited and they call their friends and they'll be jumping from one station to another station, you know, from one PC to another looking at friends' work... after one class, you'll find yourself very exhausted...

(G:12.4.00.1)

Another teacher added: "If they listen (and) do this when I say 'do this', (it'll be) ok... but they don't listen" (G:13.6.00.5). At Gemilang, Chin readily admitted to difficulty in controlling her students whenever she tried to integrate technology into her teaching:

...it's much easier to have them in class to do work (or) have them in the lab to do experiments rather than handle class in the multimedia room, I find that very difficult, to manage the lesson and to organise the students would take most of the time...

(G:12.4.00.2)

Again, some teachers levelled criticism at the 14 Weeks In-Service Training Programme for Teachers of Smart Schools for not providing them with sufficient input on techniques of managing technology-based classrooms:
In the course, we were taught to do the package, when there’s no CD, we use the PC to learn Excel, Powerpoint applications, the IT part. We were not taught how to control the class. But we were not taught to control group by group, six groups, different pace. My class... one very fast, one very slow, four about the same. At the same time, the four groups will be calling ‘Cikgu! Cikgu!’ (Teacher! Teacher!)... (I) don’t know how to handle... (ii) all the pupils go through the same lesson structure, easier to control class and preparing materials...

(R:19.6.00.2-3)

To sum up, the teachers were reluctant to integrate technology into classroom instruction when they perceived that problems with student discipline might jeopardise the smooth progress of their lessons. As Mei put it:

Discipline is important. I see the students first, their discipline first. If I see that they are like very wild like that, I won’t bring them (into rooms with computers)...

(S: 7.3.00.3)

**Inadequate IT skills**

Given the steep slope of the technology learning curve, it is hardly surprising that 40% of the teachers (as shown in Table 15) perceived their technology skills as lacking and voiced this as an obstacle to technology diffusion. A teacher expressed her frustrations:

(I’m) not skilled, (I) need help from others... If only we have an assistant...

(G:13.6.00.7)
Another teacher elaborated on the problem, emphasizing the need for teachers to have adequate technical back-up support in the classroom to ensure that lessons were not needlessly disrupted:

We don’t have a technician. We teachers are not technicians when it comes to all this, yet to a certain extent, we can handle it you know but certain things like fixing the Internet so that it’s online to six or seven computers, we try and cannot get through, we need a technician, isn’t it? We need a good technician to handle the whole thing. We can’t be all prepared to go to the classroom and something goes wrong and we cannot have the lesson on... I cannot be spending time to check out the problem... I always have this problem. I want to try things out but something goes wrong and I can’t... If only a technician is here, how wonderful it is.

(S:30.3.00.3)

The teachers’ anxiety over their low technology competencies was further compounded by the fact that so many things had the potential to go wrong in technology-based lessons:

Technology lesson, I feel like a lot of problems. PCs cannot use, no sound card, no video card. Simple problems but I cannot take. We need some good technicians. I’m wasting my time because it’s not running smoothly.

(S:23.5.00.1)

Lack of access to technology

Many teachers also encountered problems with access to the technological infrastructure in the case study schools. Although pilot smart schools were scheduled to have better IT facilities than other schools, these amenities were not completely put in place or made fully available for much of the year 2000. The lack of hardware meant that
computers had to be shared and this posed problems to teachers attempting to integrate technology into classroom instruction:

Teachers fighting to use the room and they cannot get the room because of time table clashes and that's the time they want to use it so there are constraints to abilities (sic) to use the room. I wish we can have more so that teachers can have more access. We have to slot our times so there's a lot of pre-planning and adjustment necessary...

(T:14.9.00.8)

Another teacher grumbled:

Only one PC, not enough. Maybe there's LCD somewhere but I have to look for it, borrow it, waste time lah, students crowd round one PC, difficult...

(T:8.8.00.2).

At times, the lack of access to hardware even resulted in ill will among teachers, especially when some of them had to go through bureaucratic red tape just to access the technology: "...sign this form, sign that form, ah, forget it!" (G:15.2.00.1). Underlying the issue of access were more complex issues of trust and equity which sometimes led to, and created, tension and resentment among the staff:

Nothing can go wrong with... (the IT coordinator) where she's (HM) concerned... He has so much power... If he's not around, the room is closed...

(G:13.6.00.5)
The end result was bottled-up anger which led to occasional outbursts of frustration—
"You know-lah; it's his room. He's in charge..." (S:13.4.00.5) — and even rejection of
the technology:

We will use technology in the end when he's (the IT coordinator)
not so sensitive but at the moment, it's his baby...

(G:25.1.00.1)

[Note: The tension over access to technology was particularly prevalent in schools
which adopted the lab model of technology use — namely Temasik and Gemilang — but
less obvious in the two-level 'A' smart schools which adopted the classroom model. This
raises an interesting issue — perhaps the diffusion of technology-integrated instruction
might be easier if computers were made easily available in classrooms rather than in
labs.]

Doubts about the efficacy of computers in instruction

The teachers' voices also revealed that many of them were plagued by doubts and
uncertainty concerning the efficacy of computers in instruction. One teacher questioned
the wisdom of introducing an extra element — technology — into lessons when students
lacked even basic language skills:

The weak students, even if they surf, don't know what to look for,
what to pick out, what’s relevant, what’s not (relevant), waste of
time to surf the Net, they don't know the language (well)... I was
teaching question tags... drills and drills but still they cannot do it.
(I) taught again and again — is, are, isn't he, aren't he... (I even)
speak (in) Malay to them... but even then, they cannot answer
questions, so tell me, how can I just let them surf the Net?

(G:13.6.00.4)
Chin also noted that her students did not seem to derive any benefit from the integration of technology into lessons:

I'll achieve more if I stay in the class. (Technology) just make the subject more interesting. (Students) don't have the initiative to understand the subject. 'Macam tengok wayang' (like watching a show)...

(G:11.4.00.3)

Chin's experience was not an isolated one. Teachers at Rajawali had similar tales to relate:

When (students) use the computer, they are like more like playing, they don't listen to you, they don't really pay attention to the exercise you ask them to do, or they don't how to do... I think it's because when they use the computer, they are so happy, so excited when they go back, they forget everything... they forget to do the work... then sometimes, what they learn from the computer, they don't really understand... put them into groups... they copy the whole thing from the computer, they drag everything, the whole thing, then write word by word but I don't know whether they understand...

(R:30.8.00.1)

A teacher opined that technology-integrated instruction helped students acquire technology skills but not subject content:

I force them to write notes when they read tutorial... if not, they'll be clicking back and forth, because they like that particular piece of music. What they are learning is not the content, the ILO (intended learning outcome) not achieved, the learning outcome becomes how to click the mouse, (they) just click the answer to the question...

(G:3.7.01)
Anna too noticed this ‘clicking syndrome’: “The other class just click... click... click, don’t bother to ask (questions)...” (T:19.6.00.4). She noted that her students wasted lots of time when they used technology to wander in cyber space:

A world out there full of information but get there not so easy. Most of the time, cannot get what we want. *Indak khabar daripada kata* (sounds better than it actually is)... students have high hopes but (in the end) very tired. I see that in my students...  

(T:21.4.00.2)

Even trailblazer Shah noted that constant use of technology-integrated instruction seemed to result in de-skilling among students:

The students type on computer but in the exam (which is) paper format, find they cannot do. Could be lack of practice using pen and paper... part of it may be stupidity, lack of writing skills, reading skills, education is not an ABC thing... not sure if it’s the computer but (I) believe it’s part of the reason, slows down (learning)...  

(R:12.6.00.3)

In the end, many teachers wondered if the students learnt anything at all with the technology. One said,

Even when they (students) click correct answer, I don’t know if they really know answer...  

(G;2.8.01.2)

Consequently, even after the smart school software was installed, some teachers remained sceptical about the effectiveness, and cost-effectiveness, of technology use. Chin spoke her mind on this matter:
Yesterday, half the computers hanged because so many students accessed... (so) I could not conduct a lesson, they self-access and went to the virtual experiment on how to read a thermometer. Drag and drop thermometer to beaker of hot water and ice, and read the temperature. If we do (the experiment) in the science lab, it'll cost less than RM10 instead of the millions of ringgit on the courseware...

(G:23.4.01.1)

To sum up, the teachers' voices indicated that while an increasing number may have adopted the technology within the research time frame, many were not really convinced that it was an effective mode of instruction.

Lack of confidence to cope with technology

Another problem encountered was the teachers' lack of confidence in their ability to handle the diverse demands of technology-integrated instruction. For technology was demanding.

Firstly, there were technical glitches to cope with. These ranged from simple problems like viruses and disabled disk drives to system conflicts. Lightning surges disrupted technology use at Gemilang at least three times within the research time frame. Although technically the responsibility of the IT coordinator, the teachers were often left to resolve these technical glitches themselves. Thus, technology-using teachers had to be able to troubleshoot and think on their feet. At times, the problems seemed endless, so much so that some teachers wondered if the technology was worth the effort: "If not this problem, then that problem" (S:17.4.00.2).

Several teachers attributed their lack of confidence to inadequate IT skills to handle the multi-level tasking, simultaneity of activities and immediacy of response
required of technology-based classrooms. In the words of one teacher: “We have to keep switching our minds to help (the students)…” (G:2.5.01.4).

Then, there were problems with the software. Even after Release One and Two of the smart school software was launched, problems continued to haunt the teachers and to undermine their confidence in their ability to use the technology effectively:

We have the (English) software in the system but it can’t be launched, most of it anyway… and we can’t do anything about it…  
(T:18.8.01.1)

The teachers’ lack of confidence abated slightly with time and training but was never fully assuaged and remained a background problem throughout the research time frame as the teachers tried to acquire technological skills while “running after the syllabus” (G1.10.002).

Lack of support from colleagues and the school administration

Rounding up the list of perceived problems and obstacles was the lack of support from colleagues. Fortunately, the number of teachers citing lack of support from colleagues was only 18%. Teachers like Ling readily acknowledged the crucial role that emotional support from peers and colleagues played in encouraging them in their technological forays:

(We) are very interested in what challenges have been brought by this new revolution in technology, we get excited when we see something new, try it together…  
(R:21.8.00.7)
And finally, last on the list of perceived problems was the lack of support from the school leadership. Fortunately again, only a small number of teachers (8%) perceived that there was a lack of support from the school head. Instead, comments like "HM is supportive..." (T:28.7.00.3) were often heard among technology-using teachers who cited that supportive principals motivated them in their adoption efforts by setting clear boundaries, crystallizing the school's stand and altogether acting as a cohesive force to drive the technology implementation initiative in the respective schools.

So spoke the teachers. Let us now tune in to the voices of the school principals.

The principals' voices

Semi-structured interviews (please refer to Appendix 5 for interview schedule) were held with the school principals to tap into their experiences with the innovation. Analysis of these voices revealed an interesting phenomenon, that is, all four school principals perceived the obstacles to the success of the technology implementation initiative as stemming from a single factor—readiness! Two major strands to the issue of readiness were identified—the teachers' readiness to adopt the innovation and the system's readiness to support their efforts.

The teachers' readiness

The right mindset. The school principals perceived the teachers' mindset or readiness for change as the main obstacle to the innovation. They were unanimous in
their opinion that technology could be institutionalised in the classroom if the "change-versus-homeostasis" equation was tipped in favour of the former.

'Homeostasis' is the tendency of schools to repel change and move back to previous states of equilibrium after being disturbed by external forces (Senge, 1990). For an innovation to diffuse effectively, the forces of homeostasis have to be overcome so that change may take place. Unfortunately, research findings suggest that computers sometimes tended to support stasis rather than encourage change in the educational system. Whitaker (1993) for instance, likened the homeostatic tendency in schools to an "inheritance factor" which made teachers reluctant to jettison inherited practices for new and untested modes of instruction. The principal of Temasik readily agreed:

The problem is NOT not having an appropriate smart classroom. In reality, the problem is getting students and teachers to use these facilities, (that's) the real problem. Overall, teachers will avoid using IT except for certain few learning activity. I mean, it's not in their culture yet. They don't see that it's natural to go there and use the facilities. IT is old in the world but in our system of education, it's new. And when it's new, there's lots of new things that we have to handle... Many of them don't find it so useful because they cannot yet utilize it properly. We have simulation rooms, (that's) not a problem. We can set up classrooms to give the teachers the opportunity to access the Internet, other facilities like OHP, audio thing... we can put there and other things in one room... not that much of a problem. But readiness, readiness is the most important factor to push technology (and) the teachers are not ready...
The principal of Rajawali also agreed, pointing out that the right mindset was crucial to the success of the technology implementation initiative:

(The) most important factor to ensure success is the teachers’ mindset must be right. They must be positive about it and on top of that, be prepared to go all out...

(R:20.9.00.5)

To her, the right mindset could overcome all problems because

If you’ve set your mind to something, to learn something, you would do it, you would do something...

(R:21.8.00.9)

Consequently, all four principals in the case study schools strove to inculcate and to promote a pro-technology mindset among the teachers as they wanted them “to have the culture of IT” (S:18.2.00.1) and to move away from “the old way of doing things…” (T:19.8.01.3).

**Low morale.** The readiness of the teachers to adopt technology use and to diffuse it to others was also affected by the low morale of the teachers observed within the research time frame. This low morale affected their readiness to take up new challenges and to embark upon major changes in the school milieu. Initial interviews suggested that this low morale might be the spillover from the downswing of the pendulum syndrome (Maddux et al., 1997), resulting from the delay and the scaled-down scope of the smart school project which, after all the hype and fanfare that had heralded it, did result in massive disappointment for many teachers.
Even a principal noted that her teachers were disheartened: "...sudah tawarlah (disillusioned)" (G:5.6.00.2). Another principal felt that the teachers' disappointment and frustration were due to the numerous delays in providing schools with the software and learning packages. Interviews with the teachers confirmed that all these were factors which aggravated the low morale of the teachers. A disgruntled teacher said:

I was on the leading edge of technology when I was teaching outside. When I came to this smart school, it's like I am in a cocoon. (The) closest to technology (in this school) is powerpoint...  

(R:10.7.00.3)

Another complained bitterly:

(There is) no such thing as smart school. Show me one. We told the whole world (of our smart schools) and we have nothing... 

(R:21.8.00.3)

However, by the end of the research time frame in mid 2001, another reason behind the teachers' low morale had emerged – the demands the technology made on their time.

A school principal admitted that technology initially increased the teachers’ work load: "...they will feel that they are being overloaded..." (T:16.8.01.2). Interviews with the teachers showed this to be true. A teacher revealed how the technology had not made her work paperless but had, instead, increased the paper work:

(I) stay back till 4pm for at least two afternoons a week... (technology) is not paperless, it's increased our burdens... 

(T:16.8.01.2)
Her colleague added:

(We are) fed up because have to spend hours in front of the PC to do all the things. I have to spend two afternoons a week to fill in lesson plans. What about attendance? We cannot rekod mengajar (fill in teaching record book) at home... if I have the same lesson on Tuesday, (I) cannot cut and paste it on Wednesday, (I have to) type everything in...

(T:16.8.01.2)

Similar complaints were heard from teachers at Gemilang. Witness the following exchange as three teachers keyed their students' particulars into computers. The exchange clearly highlighted some of the reasons for the teachers' low morale:

A: Two hours just to key in two (student) profiles.
B: The person who designed this management courseware don't teach I think, don't understand our problems...
A: Not user friendly- lah. Cannot delete when we key in the wrong name.
   Aiyah, I've given an Indian father to this (Chinese) boy... (burst of laughter)
A: I've given my boy two fathers... (more laughter). This is not the teacher's job, clerk's job...
B: You think they care?
A: If I have two years to finish the syllabus, ok! Two periods to cover what I usually teach in 20 minutes... And now this... (grimace)

(G:2.5.01.5)

Clearly, the technology made strong demands on the teachers' time and this contributed to the decline in their morale.

A final point to make concerning the low morale of the teachers. An exacerbating factor appeared to be the debilitating impact of the contra reward loop observed in the school system which loaded hard-working teachers with even more work instead of rewarding them for their efforts. Little wonder that the teachers felt short-changed:
What did I get from the course? More work, more responsibilities, and not even a pat on the back...

(T:28.3.00.1)

Another teacher expressed her distress:

_Tak boleh tahan lah. Semua sekali sekarang jatuh balik pada guru sekolah_
(I can’t stand it anymore. Everything now falls back onto the school teacher)...

(T:14.9.00.6)

Perhaps Anna got to the root of the problem when she said plaintively:

Too taxing, this _bestari_ thing. Because the focus is not more on the students, I mean, it’s more on the teachers...

(T:14.9.00.6)

Over at Gemilang, another teacher complained that she was actually ‘penalised’ for attending the course:

(I’m) very upset… I do all these donkey jobs (but) don’t get appreciated... It’s bad enough to be in a profession where you have to be defensive, have to fight even for respect. At least in the school, give me some recognition. Teaching 10 years, don’t tell me I haven’t contributed. I was so busy, holding so many posts, nobody wanted to go for the course so HM asked me to go, so I went. I have been teaching the upper forms before the course but because I went for the course, I have to teach Form One because they are the _bestari_ classes... Then, because I teach Form One, I’m regarded as having less responsibilities and I don’t get promotion. I didn’t even ask to go for smart school (training). We all work so hard. A junior teacher got promotion, only confirmed last year... I feel penalised for going for that stupid course. The consequence of that, I have to teach Form One. I know it’s over but I have to express how I feel... At this rate, I might as well leave...

(G:2.5.01.1)

Even techno-savvy Ling confessed to “running out of energy…” (R:25.4.00.2).
Chin was equally, if brutally, honest:

Our contract is finishing. We are trying to get out of it, got nothing of this, no support. I want to run away... (I'm) too old to be doing all this, asking us to go to courses, attend workshop... nobody's heart is in it... (I'm) very tired. We feel abused... treat us like a chess piece... so disheartened, we are an abused lot... we prepared, we prepared again... we never saw the package again, now they ask us to do it again... (we've) all decided that we'll do what they ask but not put our heart in it... (other) teachers get the same pay... we (get) the Jabatan (Education department) breathing down our necks and implying we're not doing a good job... If they ever ask us to leave our family again, (I) may even take no pay leave...

(G:8.6.00.1)

In a nutshell, the teachers' low morale contributed to their lack of readiness and willingness to spearhead pedagogical changes in a committed manner. In a way, this research finding is hardly surprising as past research studies have often suggested that teachers whose workloads were increased without corresponding tangible increase in rewards usually suffered from low morale (Collis, 1988; Herzberg, 1966).

Cultural compression. Aggravating the teachers' low morale was the cultural compression (Wolcott, 1973) that teachers were subjected to as they underwent intense, microscopic scrutiny from the constant stream of visitors to the case study schools. School records showed that in the year 2000 alone, teachers at Rajawali played host to visitors from Thailand, Bangladesh, Sri Lanka, Cambodia, London, the United Kingdom, Indonesia, Myanmar and the Philippines. Gemilang, Sendayan and Temasik were not spared the high 'hit' rate either. A principal conceded that the constant visitors were a problem and exacted a mental toll on the teachers:
Teachers do voice out problem with too many visitors as extra responsibilities. I cannot handle them (the visitors) alone so I need their help. We have several groups under different KJ’s (heads of departments) but I handle (the) briefing. Sometimes, in a week, we have 3 to 4 sets of visitors, sometimes every day. They want to have a look at the infrastructure and the type of teaching going on... we are the focus of attention, we are the show-case for e-learning and the smart school... when we are the show-case, then we have to show everything that we have in a case...

(R:20.9.00.5)

A teacher remarked candidly:

I feel sick... we have so many pelawat (visitors) every month, sometimes twice a day. We have 4 teams, 7 teachers one team, just to prepare for visitors ... (to prepare) special lessons using technology...

(R:18.6.00.3)

Another teacher described her discomfiture over constantly being in the limelight:

Are the bestari teachers running away? Tak enjoy (I don’t enjoy) my work since I became a smart school teacher. I don’t feel I could do what’s expected, everybody is looking at us, expecting us to do wonders, expect us to do everything, expect us to use our discretion, we want to run away...

(T:26.7.00.4)

The unwelcome attention and scrutiny led to added stress for the teachers – “We’re in a zoo” (R:25.6.00.6) – and made them hesitate about wholeheartedly embracing the technology in the school. Ultimately, this acted against the diffusion process.

Brain drain. The principals’ voices also warned of a worrying trend in the case study schools. As teachers upgraded their technological competencies, they found themselves increasingly sought after by the private sector. Hence, a subtle brain drain
occurred as techno-savvy teachers filtered out of the school system. At Rajawali, a teacher who had been trained to lead in the technology initiative left to join a public university. At Temasik, four star teachers left within a year – one joined a private software company, another assumed a post in a college while two were absorbed by private universities. This brain drain did not include the large number of teachers leaving the case study schools for further studies. A school principal expressed his frustration and helplessness to stem the brain drain:

We lose our best teachers. They go to the smart school projects, they join swasta (private sector). They apply for lectureship somewhere. It’s a serious brain drain. It’s a real problem. The problem is especially serious in this school. Maybe it’s because this school is being focused by many sectors and many levels… This year, I’ve lost five ‘smart’ teachers out of those who went for the 14 weeks’ training. For English, we have only one (teacher) now. It’s a big problem, a very serious thing… (I’ve) so very little control over the problem. It’s a big problem and I feel astonished why this thing has been going, you know, like that. It’s a very serious thing…

(T:5.8.00.3)

The problem was compounded when the teachers who left were not replaced by similarly technology-trained teachers:

We are supposed to be leading school towards smart teaching and learning, and they’re not sending (IT trained) teachers, so teachers going out and no ‘smart’ teachers coming in and they send fresh (graduates), from the U. don’t know what to do… and I have seven Form One smart classes…

(T:15.8.00.4)

Interviews with the teachers suggested multiple possible reasons for the brain drain.

However, a few pinpointed the technology initiative as the catalyst for leaving:
I cannot last at the rate I’m going, I’ll burn out. If the smart school project had been better implemented, I don’t think they’d lose so many teachers...

(T:30.3.00.1-3)

The school principals were in a dilemma as they were helpless to prevent teachers from leaving but duty-bound to try. A principal related his attempts to salvage the position by negotiating the time of departure so as to minimise the adverse impact on the school:

When they ask me, ‘Shall I ask this opportunity? Put in my application?’... I'll say, ‘Why not? Don't tell me you want to rot here.’... I tell them like that but this year, after so many going out... I told them, ‘The rest, well you have to sign MOU with me. This (leaving the school) will be done only at the end of the year. So then, we can reorganise and we can do the retraining very early...

(T:15.8.00.3)

The system’s readiness

Inappropriate evaluation system. Apart from the teachers’ lack of readiness, the principals in the case study schools also perceived a lack of readiness on the part of the education system to support the technology implementation initiative. For instance, right till the end of the research time frame, the school evaluation system remained unchanged – exam-oriented and at odds with the liberal mode of evaluation advocated by technology-integrated instruction. This lack of readiness on the part of the system also made many teachers hesitate over technology adoption.
One such teacher demanded to know when the evaluation system would be revamped in line with the use of technology:

How about the exam? We were told (year) 2001, exam would be bestari style but (this has not happened)... we don't want our students to be victimised you know. We are doing (technology) fully, okay, we are going into all this thing, syllabus is definitely different but what's going to happen to our kids? Definitely, if they want to change the exam, major exam, they have to do something. We have to prepare the students. We don't want our results to be affected...

(S:30.3.00.4)

Another said:

Definitely we acknowledge that we need technology because of the era we are moving into but at the same time we have to acknowledge we also have a responsibility. Like our hands are tied. It's not that we don't want to but it's because of the exam system...

(S:4.3.00.4)

The school principals were equally worried:

At the end of the day, (students) would be assessed on the exam results. They have to fall back on the old system... They have to go back to KBSM, without utilizing full computer facilities...

(T:15.8.00.1)

Over at Gemilang, the principal commented: “As long as we have exams like now, we cannot really afford to use the technology...” (G:12.6.00.3). The principal of Sendayan observed: “It’s the academic we have to worry about, otherwise the parents will be after us...” (S:26.2.00.1). Perhaps the principal of Rajawali summed it up best when she said:
The bottom line is exams — that's the most important thing the school has to worry about. How many As, Bs or Cs the students get... The (Smart School) Conceptual Framework touch on evaluation but the evaluation there seem to be so ideal, you evaluate students according to their own pace but at the end of the day, you talk about PMR, you talk about that one shot kind of exam; fix the day, fix the time, whether you know, whether you don't know, that's it. Sit for it and carry the results for life, forever...

(R:30.9.00.3)

In other words, principals found themselves faced with a tough decision — they had to fit technology-integrated instruction into old mode exam-oriented classrooms. It was almost as if the policy-makers wanted to move with the times but were afraid to let go of the present system which had served so well for so long. There was little room for negotiating this deadlock.

The teacher appraisal system was another facet of the lack of readiness on the part of the education system which acted as an obstacle to the successful implementation of technology-integrated instruction. Traditionally, teacher appraisals exalted student performance and rewarded teacher compliance rather than the risk-taking and experimentation valued by the constructivist mode of instruction. Thus, teachers were disheartened when their performance appraisals followed this traditional mode and sidelined technology even after the pilot smart school project was launched. Listen to what a teacher had to say:

Head of Department came to observe me, specially asked me not to have PC, (she) wants conventional teaching, I don’t know why, she may be afraid that with PCs, won’t be much teaching, hard to evaluate us. They have a standard observation form given by the Department with lots of criteria which don’t touch on smart school way or technology...

(G:13.6.00.2)
To sum up, the principals’ voices singled out the lack of readiness on the part of the evaluation systems – both student evaluation (public examinations) and teacher appraisal systems – as obstacles to the technology implementation initiative, pointing out that both had not been adapted to accommodate technology-integrated instruction. Retaining old modes of evaluation in new mode classrooms was akin to asking the teachers to teach the skills of tomorrow with the tools of today and the evaluation criteria of yesterday.

Lack of support systems. The education system was also not ready with appropriate technical, backup support systems. Although a Help Desk had been set up at the Education Technology Division by the end of the research time frame, help was not always forthcoming when the teachers needed it. A teacher related her experience:

We showed them (the Help Desk people but) no results, siapa nak bertanggung jawab? (who wants to be responsible?) ‘Help desk is 24 hours,’ they say saja (just talk only)...

(T:16.8.01.2)

Then there was the issue of the schools’ readiness to provide support for the security problems presented by the new technology. The principal of Gemilang expressed her concern:

Moral values are slowly decaying. (Students today) are not afraid of the police because they have lawyers. They take advantage of the law because it can be manipulated. I worry (about the computers), I have that niggling thing ‘What will happen?’, I can’t be staying here (in the school after school hours) but of course, I worry. We cannot afford a fireproof room, we have to put our PCs in the prison to prevent theft...

(G:5.6.00.6)
The principal’s fears were not totally unfounded as within the research time frame, arson occurred in the school twice. In the second incident, about 20% of the teachers’ room was razed, the computer lab was totally disabled and several students detained for questioning (‘What’s happening in schools?’ July 9, 2000). A few days later, a similar case of arson broke out at Temasik in the wee hours of the morning but fortunately, this was discovered before much damage was done (T:26.7.00.2). Cases of petty theft involving computer peripherals were often reported, including an instance when a brand new computer was carted away from the teachers’ room at Gernilang in broad daylight (G:23.4.01.4).

To sum up, the gist of feedback from the principals in the case study schools showed that they perceived the lack of readiness of teachers as well as of the system as having a negative impact on the diffusion of the innovation. Despite this, however, they remained convinced that technology was an inevitable part of the future and thus continued to promote its adoption and diffusion. Perhaps the principal of Temasik best summed up the sentiments of his counterparts when he noted ruefully that:

The school is part of the nation and our nation is talking about technology and making sure our country is at par and competitive. We are moving that way. So, for good or for bad, we are going to carry on with the technology...

(T:15.8.00.6)

The students’ voices

Thus far, research findings suggest that teachers and school principals had slightly different perceptions of what constituted the primary obstacle to the technology implementation initiative. The teachers’ voices revealed that teachers perceived the time
constraints problem as central to the issue of technology adoption while the principals' voices showed their worries were centred upon the issue of readiness. But what of the students' voices? As the targeted end users of the innovation, the students' voices also need to be heard and heeded before the innovation can be truly institutionalised.

Attempts to tap into the students' voices were made via an interview schedule (Appendix 6) administered to 233 students in mid-August 2000. The results of the open-ended interviews (tabulated in Table 16 below) shows that the students had a wide range of opinions and perceptions of the innovation. However, one primary concern was uppermost in their minds – good academic results! Hence, it is only fitting that in this study, the vocalisation of their voices is heard via their responses to three key questions, all centred round the issue of academic excellence.

Table 16: Students' perceptions of technology-integrated instruction

<table>
<thead>
<tr>
<th></th>
<th>Enjoyable</th>
<th>Difficult/ boring</th>
<th>Easy</th>
<th>Not sure</th>
<th>Effective</th>
<th>Creative</th>
<th>Waste of time</th>
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<tr>
<td>R</td>
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<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>143 (61%)</td>
<td>32 (14%)</td>
<td>11 (12%)</td>
<td>25 (11%)</td>
<td>19 (8%)</td>
<td>11 (5%)</td>
<td>8 (3%)</td>
</tr>
</tbody>
</table>

*Responses are based on number of times comment was mentioned, hence total may not add up to 100%
Do we have time for technology?

This was the priority question that emerged clearly from the students' voices. Most of them were performance-oriented and wanted to excel in examinations. Although Table 16 indicated clearly that the majority of the students (61%) found technology-integrated lessons 'enjoyable', follow-up interviews revealed that many were concerned about the time expended on technology. Tune in to the following verbatim feedback from the students:

Group work with the help of the computer helps make group activities cool. But, we students seem to take up most of our time doing these work... (ISS:S12)

It's kinda wasting time, decorating the pages, making it interesting... (ISS:S13)

It is interesting but sometimes (sic) it is a waste of time because there are not enough computers for us to use... (ISS:S14)

Not suitable for the Malaysian education system because it is time-consuming and we have a syllabus to catch up. We have too much syllabus to keep up with and computer work takes up twice the time the teacher can teach... Maybe the ministry might consider shortening the syllabus!! (ISS:S16)

It is more time-consuming: one has to master using the PC and the input we receive isn't installed in our brains. The talk and chalk method proves to be more effective for understanding and memory based lesson... If this (technology) is to be implemented when I was in primary, I don't see the problem. But now, it's pretty tough because we have to keep up with the syllabus (sic) especially if we're sitting for a 'big' examination, it sometimes takes a lot of time and energy, it is pretty hectic for the Form 3 and 5s... (ISS:S15)
In other words, feedback from the students' voices revealed that although many enjoyed technology-integrated lessons, they worried about the time spent and were reluctant to wholeheartedly engage in it.

**Does it work?**

The students' voices suggested that they would willingly embrace technology in the classroom if it improved their grades. Table 16 clearly shows only 8% of the students believed in the efficacy of computers in instruction. The voices captured below underlined their anxiety:

- Sometimes it is fun to use computers for some subject such as English, BM. But not for the serious subjects like Math, Add Math, History that need more concentration and we must understand more about it. *(ISS:S14)*

- It (computers) can't really 'teach'. It can only be used to type up work and do presentations. *(ISS:T63)*

- When we write English essays, the computer will correct the grammatical errors. This will not train the students grammar... *(ISS:T75)*

- I find that looking at the computer screen for a long time irritates my eyes and the information does not really sink into my head. *(ISS:S22)*

- It's fun but it might distract us from our studies, I think computers will only make us become lazy... *(ISS:G36)*

- We should actually do the experiment rater *sic* than look for the results from the net or whatever... *(ISS:G37)*

- We need to understand more and need to study first before facing the having a lesson using computer, while the normal lesson, we can understand more because all the points are being explained orally. *(ISS:S14)*
Using the computer, we have to think hard ourselves to find what is actually the teacher is teaching and it really pressure (sic) us when we failed to think properly. For me, I prefer the normal lesson that when the teacher just talk and talk and give us as much information we need and it make us understand better…

(ISS:S11)

Can the teachers do it properly?

And finally, as Table 17 below shows, the students’ voices indicated that about 25% of them had doubts about their teachers’ ability to engage in, and effectively manage, technology-integrated instruction.

Table 17: Aspects of technology-integrated instruction disliked by students

<table>
<thead>
<tr>
<th></th>
<th>Management of learning</th>
<th>Sharing hardware</th>
<th>Time constraints</th>
<th>Technical glitches</th>
<th>Lack of IT skills</th>
<th>Clashes</th>
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<tr>
<td>*Total</td>
<td>58 (25%)</td>
<td>46 (20%)</td>
<td>29 (12%)</td>
<td>27 (12%)</td>
<td>13 (6%)</td>
<td>10 (4%)</td>
</tr>
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</table>

*Responses are based on number of mentions

Listen to the students’ voices:

Most of the time it’s very disorganized.          (ISS:G63)

We are actually the one who teach the teacher how to use or run the program…          (ISS:S8)
I hate sharing with my partner! She conquers every single thing on the desktop and the teacher lets her!!

Sometimes is a waste of time and some teachers dunno how to teach (with technology).

The class is going to become more noisy and sometimes when there isn’t enough computers, people quarrel (sic) on who will control the computer...

I know it is unfair for me to say this, but most of the students already know how to use the computers and it gets pretty boring if the teacher decides to go slow for the other students who don’t know how to use the computer...

Teachers are too fussy and scared to let us use the computer because they think we do not know how to use it

Certain teacher become more draggy then (sic) ever

I think teachers are not very exposed to the wonders of IT and where it can lead us. It will be globally used but it might take quite some time (before) it goes in full swing in Malaysia and Asia...

Summary

To summarise in conclusion, this section tried to give voice to the participants directly confronted with the innovation in the school milieu by capturing their perceptions of the problems encountered. The obstacles which emerged from these voices were able to explain why different teachers responded differently to the innovation in different school milieus but could not really account for variations in their responses in the same setting. To understand that, we need to delve a little deeper – as we will in the next section – into the psyche of the individual teachers ‘shadowed’. 
Variations in teachers' responses to technology in the same setting

A literature review into the reasons why teachers in the same school, enjoying the same physical, cultural and technological advantages, varied in their responses to the use of technology suggests that the most plausible factor lay in the teachers' innate predisposition to change (Harvey, Kell & Drexler, 1990; Honey & Moeller, 1990; Saye, 1994). Extensive observations of the teachers over a longitudinal time frame coupled with intensive interviews, reading of related literature and personal reflections upon the issue suggest that four factors might have played crucial roles in affecting the teachers' predisposition to change in the case study schools.

Teachers' belief systems

The first factor which possibly, and most probably, influenced the teachers' predisposition to change was their belief system. Research studies have consistently pointed to deeply-held beliefs as pivotal to change (Baldridge & Deal, 1975; Cuban, 1986), especially in places of great uncertainty like schools (Nespor, 1987). Field observations of the case study teachers indicate strong support for this proposition.

To understand the impact of belief systems on teachers' responses to technology, it is necessary to review the main tenets of two different instructional paradigms – the traditional and the constructivist. The traditional paradigm exalts the teacher as the sole leader and authority in the classroom, who holds the locus of classroom control in her hands as she paces out instruction. The curriculum in such classrooms is usually
presented in the form of discrete facts in teacher-centered fashion, with assessment focused on performance measured by student reiteration of facts.

The constructivist paradigm, however, advocates student-centered classrooms with less emphasis on structure and control, and encourages multiple sources of authority. Learners work side by side to solve authentic problems and assessment is focused on process outcomes.

When the case study teachers' mental beliefs of what constituted good teaching practices were matched and compared against their responses to technology use, an interesting pattern emerged as there appeared to be a link between the teachers' belief system of what constituted good instruction and their eventual preferred pedagogical practice. It was found that teachers who leaned towards the constructivist paradigm were more receptive to technology adoption. Typical examples were trailblazer Shah and beacon Ling who both had very progressive mental beliefs about the changes sweeping through the country and were keen to adopt technology in the classroom:

We know it (technology) is coming and we're all looking forward to it…

(R:20.9.00.5)

In contrast, teachers like Mei who clung strongly to the traditional paradigm appeared to resist, and even to fight, technology use. Intensive discussions with Mei suggest that her rejection of technology probably stemmed from her mental belief system that good instruction is synonymous with telling and listening, as epitomised by the ‘sage on the stage’ spouting knowledge in front of the classroom. Consequently, Mei (and teachers like her) rejected technology because of her mental belief system that the old ways were best and that it was what students wanted:
(Students will be) really lost (with the new paradigm)... they're different from the western countries where they can do on their own...

(S:4.3.00.5)

These teachers preferred to teach as they themselves had been taught, persuaded by their belief system that this was what good instruction was all about:

I don’t see much use for technology. Students prefer the teacher-centred way, they like to be bossed around, told what to do...

(G:1.10.00.1)

In other words, field observations, interviews, reading and reflection upon this issue suggest that the teachers’ belief systems might be pivotal to influencing their attitudes towards technology. This factor probably accounted for variations in the responses of teachers towards technology adoption, especially among those teaching in the same physical and technological setting.

Risk tolerance levels

In-depth interviews with the case study teachers suggest that the second factor which might possibly account for variations in their responses to technology was their ability to take risks and accept challenges in the classroom. Doyle (1983) defined risk as the likelihood of being able to meet the standards by which a task is judged. Taken in this context, the risk factor in technology-integrated instruction refers to the teachers’ perception of their ability to meet the standards set by technology as they go about trying to achieve instructional objectives. Clearly, technology-integrated instruction has more
inherent risks than traditional modes of instruction since technology-based classrooms have many elements beyond the teachers’ control.

I posit a linear relationship between a teacher’s risk tolerance level and technology adoption as technology high-flyers like Ling and Shah appeared to possess high risk tolerance levels. These teachers were not discouraged by the uncertainties shrouding technology-integrated instruction; instead, they perceived technology-related problems as mere “hiccups” (G:9.4.01.1) to be ironed out.

On the other side of the risk tolerance coin is the challenge tolerance quotient. Both Ling and Shah were not only able to tolerate risks but also appeared exhilarated by the challenges of technology. Even Chin later reluctantly admitted: “(Technology) made me excited about teaching all over again…” (G:2.5.01.4).

Conversely, low-technology users were heard making comments like “(I’m) not an adventurous person…” (G:12.3.01.1) and “(I’m) full of inertia…” (G:12.6.00.3). Compare this attitude with a technology high-flyer who explained why she adopted technology-integrated instruction: “I thrive on challenges. I cannot imagine being on a plateau…” (G:3.1.00.1).

To sum up, field work suggests that the teachers’ risk tolerance levels affected their ability to handle the uncertainties inherent in technology-integrated instruction and affected their responses towards change and ultimately, technology use.

Teaching goals

The third factor that might possibly have affected the teachers’ predisposition to change and caused variations in their responses to technology lay in the teachers’
teaching goals. Many researchers have propounded a definite relationship between teaching goals and technology adoption (Ginsberg and Zelman, 1988; Saye, 1994). Intensive observations of the teachers at Gemilang and a look at the subsequent chain of events there seemed to support this proposition.

For much of the research time frame, teachers at Gemilang were observed struggling with student discipline problems. Teachers talked in hushed tones about suspected arson in the school in 1997 and 1999 (G:2.7.00:1). In early 2000, the car of the discipline teacher had been set alight, supposedly by students although this was never proved (G:11.4.00:4). Then, four students were mysteriously detained by the police for questioning (What's happening in schools? July 9, 2000). Given this kind of a school setting, it is hardly surprising that some teachers at Gemilang were reluctant to adopt technology use as they worried about a method of instruction which required them to transfer the locus of control over to the students. Consequently, two different responses to technology were observed among the teachers.

One group totally rejected the notion of technology adoption because they did not want to relinquish classroom control. Their primary goal in teaching was to retain power and control over the students and they could not reconcile themselves to a pedagogy which required them to do just the opposite.

No technology! (Students are) rowdy, careless, rebel, have no sense of responsibility at all

(G:15.2.00.1)

Even when finally coerced by top-down pressure to bring their students into the computer lab, the teachers held tightly onto traditional pedagogies and continued with teacher-
centered instruction as they systematically moved students through the technology. In short, the technology was merely an add-on.

Another group of teachers, however, did just the opposite – they warmly embraced technology use despite problems with student discipline. When interviewed, these teachers revealed that their decision in favour of technology was primarily due to the fact that they had very different teaching goals.

If I don’t care about my students, I won’t do anything. But some of my students are very keen, they like it (technology) and have the potential. I still try to lay some foundation for them...

(G:8.6.00.2)

In short, these teachers adopted technology use because they saw that their students enjoyed playing around with the technology and derived benefits from it. Thus, despite the perceived discipline problems, they were willing to relinquish some of their control over the students in the hope that this would help the students.

In other words, the teachers’ responses to technology were influenced by differences in teaching goals – whether they rated retaining the locus of power and control over students in their hands as higher or lower than student empowerment and intrinsic rewards in teaching.

Technology quotient

The fourth factor which might have accounted for variations in the teachers’ predispositions to change and affected their decisions regarding technology use was their
technology quotient or ability to cut to the heart of the smart school vision and see the possibilities and potential offered by the technology.

Different teachers were observed experiencing differing degrees of difficulty in translating the smart school vision into operational goals, a task made more difficult by the fact that at the time of the research study, there was no concrete model of a smart school in the country from which they could model. Consequently, all the teachers had different notions of what technology-integrated instruction entailed and even where technology stood in the smart school equation. As a teacher put it:

Some say technology is bestari (smart). Others say drills are not bestari but nobody knows exactly what it is. Many of the teachers in my school think the package is bestari...

(G:12.6.00:2)

One teacher even decided that technology had no place in the smart school vision until she was persuaded otherwise by the school principal:

I felt that smart learning don’t need to be computer based. That’s what we were taught but here, the HM equate smart learning with computers. Like he said, if smart learning does not require computers, why does the government want to spend so many billions of ringgit on computers, all that hardware?

(T:8.8.00.2)

Yet others linked smart learning only with learning packages and were “...holding on to their packages like bibles...” (T:1.3.00:1).

Conversely, there were teachers who had clear technological visions despite the lack of models. One such teacher cut to the heart of the dilemma faced by teachers in the case study schools very early in the technology implementation initiative:
On the one hand, we have to finish the syllabus and (do) some work related to computers. Example, lens, (we) do the actual experiment and have software for students to explore lenses on the computer. Another school of thought (is) we teach lens, then students use IT to do presentations, graphs and to churn out some product. If we follow this school of thought, then, some schools can easily use IT. But I think we follow the first school of IT, I teach this part of the lesson, my IT also something to do with lens. But at this stage, we can only do the second school. Private schools are more down to earth; (they) go for the second option... no crying for software....

(S:17.2.00.2)

The presence of such teachers provided a locus for technology adoption in the schools. Their ability to grasp the smart school vision quickly and zoom in on core issues helped them come to grips with shortcomings and close the gaps between what was needed and what was possible. Besides acting as focal points to synergise attempts at technology adoption, their high technological quotient also made them technologically driven individuals who worked under their own steam. In this way, high technological quotients also affected and accounted for variations in teachers' responses towards technology.

In a nutshell, four factors – teachers' belief systems, their risk tolerance levels, teaching goals and technology quotients – appeared to have impacted upon the teachers' decisions regarding technology use in the schools, possibly accounting for variations in their responses within the same technological and physical setting. These factors determined whether the teachers became the 'accidental tourists' engaged in conserving behaviours, or the 'voyageurs' who experimented with new modes of instruction highlighted by Saye in his study (1994).
Conclusion

To summarise, this chapter confirmed that teachers trained to lead in the technology implementation initiative helped to diffuse the innovation. It highlighted phases in the diffusion process, from preparation to early adoption, crisis, adaptation and ultimately, invention. The chapter then gave voice to the major players in the technology initiative so that they could recount the problems encountered in the schools. And finally, the chapter investigated the factors that caused variations in the teachers' responses to technology, especially among those serving in the same setting. Four factors were highlighted – the teachers’ belief systems, their risk tolerance levels, teaching goals and technological quotients. When this is superimposed on the profile of teachers developed in an earlier section (Figure 5 on page 110), a more complete profile of the technology-using teachers is drawn, as represented by Figure 13 below.

\[ trailblazer \quad beacon \quad adaptive \text{-} adopter \quad strategic \text{-} adopter \quad resistor \]

**TECHNOCRAT TEACHERS**
- Future oriented
- ‘Voyageurs’
- Progressive mental beliefs
- High risk-challenge tolerance
- Liberating teaching goals, e.g. empowerment and process outcomes
- High technological quotient

**CRAFT TEACHERS**
- Rooted in the ‘here and now’ practicalities
- ‘Accidental tourists’
- Conservative mental beliefs
- Low risk-challenge tolerance
- Practical teaching goals, e.g. control and product outcomes
- Low technological quotient

**Figure 13**: The continuum of technology-using teachers (revised)
In conclusion, suffice it to say that the technology diffusion process seems to be complicated as the teachers' responses to technology appear to have been affected by the complex interplay of factors at bureaucratic, school, teacher and client levels, which were then subjected to a teacher filter of mental beliefs, diverse teaching goals, different risk tolerance levels and varying technological quotients. All these variables appear to have affected the teachers' predispositions for change and resulted in them opting for preferred patterns of pedagogical practices, some of which will be described in the next chapter.