CHAPTER 5

Report of findings : Technology adoption

This chapter adopts a three-pronged approach to examining the technology adoption process. Firstly, it tries to answer the research question 'Have the teachers who attended the *14 Weeks' In-Service Training Programme for Teachers of Smart Schools* adopted technology-integrated instruction in the four case study schools?' In attempting to answer this question, this chapter inevitably charts the progress of the technology implementation initiative as it taps into the teachers' primary concerns regarding technology use within the research time frame. Secondly, this chapter also explores teachers' levels of technology use via the CBAM's LoU protocol. And finally, the chapter investigates the factors which impacted upon the technology adoption process in the school milieu.

Examining teachers' concerns

Identifying technology adopters

In order to determine whether the teachers trained in the *14 Weeks' In-Service Training Programme for Teachers of Smart Schools* have integrated technology in their classroom instruction, their composite SoC profiles were examined to determine the two highest stage scores. If the teacher's peak or second highest stage concern was Stage 3 or higher, then he or she was, as explained in Chapter 3, wrestling with management concerns and therefore, an adopter of technology (Maney, 1994).

Based on this line of reasoning, out of the 47 teachers whose concerns profiles were drawn in February 2000, the number found to have the concerns profiles of adopters was 18 (38.3%) as indicated in Table 7 below.

Table 7: Number of teachers with adopter profiles (February 2000)

School	Number of teachers trained to teach with technology	Number of adopters	
		(N)	(%)*
Temasik	8	5	62.5
Rajawali	12	5	41.7
Gemilang	5	2	40.0
Sendayan	22	6	22.7
Total	**47**	**18**	**38.3**

* *Arranged in descending order*

As Table 7 above shows, Temasik had the most number of adopters (62.5%) in the year 2000 followed by Rajawali (41.7%) and Gemilang (40.0%). The school with the least number of adopters was Sendayan which had less than a quarter of its technology-trained teachers (22.7%) categorized as adopters.

In August 2001, a second snapshot of the teachers' concerns profiles was taken to determine if the wave of technology adoption was cresting or ebbing. The number of adopters was found to have increased to 28 (77.5%) as indicated in Table 8 on the next page.

Table 8 : Number of teachers with adopter profiles (August 2001)

School	Number of teachers trained to teach with technology	Number of adopters	
		(N)	(%)*
Gemilang	4	4	100
Temasik	6	5	83.3
Rajawali	11	7	63.6
Sendayan	19	12	63.2
Total	**40**	**28**	**77.5**

* *Arranged in descending order*

Comparison of the concerns profiles suggests that the technology implementation initiative was on an upswing. Although the total number of teachers in the sample had dropped from 47 to 40 due to movement accruing from transfers, resignations and death, the number of adopters more than doubled from 38.3% to 77.5% within the research time frame. Thus, in answer to the first research question 'Have teachers who were trained in the *14 Weeks In-Service Training Programme for Teachers of Smart Schools* adopted technology-integrated instruction in the pilot smart schools?', the answer appears to be a resounding 'Yes!'.

Drawing composite concerns profiles

The SoCQ also allowed individual and group composite concerns profiles to be drawn so that more in-depth information could be gleaned via analyses of peak and mean stage scores.

Peak stage scores. Table 9 below shows clearly that the peak concerns of teachers in February 2000 were information concerns but that these had shifted to management concerns by August 2001.

Table 9 : Teachers' peak concerns in February 2000 and August 2001

Number of teachers		Peak Stage Concerns of Teachers						
		S0	S1	S2	S3	S4	S5	S6
Feb 2000	N = 47	10	12	5	7	1	7	5
	(%)	(21.3)	**(25.5)**	(10.6)	(14.9)	(2.1)	(14.9)	(10.6)
Aug 2001	N = 40*	5*	5*	5*	17*	0*	8*	9*
	(%)	(12.5)	(12.5)	(12.5)	**(42.5)**	(0)	(20)	(22.5)

* *Total citation of peak stage concerns exceed total number of teachers because some teachers had several stages with the same peaks, in which case, all peak stage scores were included as peak stage concerns.*

This shift in concerns, captured via the two SoC snapshots, became even more pronounced when the concerns were arranged in descending order of importance as shown in Table 10 on the following page.

Table 10 : Comparison of teachers' peak stage concerns

Teachers' peak concerns in Feb 2000	Teachers' peak concerns in Aug 2001
Information (25.5%)	Management (42.4%)
Awareness (21.3%)	Refocusing (22.5%)
Management (14.9%)	Collaboration (20%)
Collaboration (14.9%)	Awareness (12.5%)
Personal (10.6%)	Information (12.5%)
Refocusing (10.6%)	Personal (12.5%)
Consequence (2.1%)	Consequence (0%)

As Table 10 above shows, heading the list of concerns in February 2000 was information concerns (25.5%) followed by awareness (21.3%), management and collaboration concerns (14.9% respectively), personal and refocusing concerns (10.6% respectively) and finally, consequence / impact concerns (2.1% respectively). However, by August 2001, management concerns topped the list at 42.4%, followed by refocusing concerns (22.5%), collaboration concerns (20%) and finally, awareness, information and personal concerns (12.5% respectively.) The picture which emerges is one of increased adoption. However, enhanced refocusing concerns suggests that teachers were looking at alternatives, a hint that not all was well and that intervention measures might be required. The impact concerns were low, probably because the teachers were novice users of technology who needed guidance and support from others (also suggested by the increase in collaborative concerns from 14.9% to 20%).

This finding is consistent with literature on technology adoption which states that new adopters often look to others for help (Nik Zaharah, 2000). The pattern of peak stage concerns which emerged is also consistent with the profile of concerns drawn from a separate and independent study of 74 smart school teachers in 12 pilot smart schools throughout Malaysia carried out at about the same time (Sathiamoorthy Kannan, 2001).

Mean stage scores / profile analysis. The teachers' composite concerns profiles also allowed school composite concerns profiles to be drawn. To do this, individual stage scores were aggregated to obtain mean stage scores for the school as shown in Table 11 (for February 2000) and Table 12 (for August 2001). The peak and second highest stage scores are in italics. For actual stage scores, please refer to Appendices 7.1a~d (for February 2000) and Appendices 7.2a~d (for August 2001).

Table 11 : Percentile mean scores of teachers' SoC (February 2000)

	Percentile Mean Scores of Teachers' Stages of Concerns						
Schools	**S0**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
Rajawali	70	86	85	*87*	76	*88*	84
Gemilang	*88*	*90*	78	85	41	63	51
Temasik	77	81	*85*	*88*	43	74	81
Sendayan	78	*86*	*86*	73	44	76	78
Mean	78	**86**	**84**	83	51	75	74

Table 11 shows clearly that in February 2000, Rajawali and Temasik had composite adopter profiles (peak Stage 3 concerns), Gemilang was seeking information about the innovation and on the verge of adoption whilst Sendayan had strong personal concerns and was clearly a non-adopter. However, as indicated by the peak Stage 3 concerns in Table 12 below, all four pilot smart schools had become adopters by August 2001.

Table 12 : Percentile mean scores of teachers' SoC (August 2001)

Schools	Percentile Mean Scores of Teachers' Stages of Concerns						
	S0	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
Rajawali	68	82	84	**87**	84	**89**	85
Gemilang	**90**	86	85	**93**	60	81	81
Temasik	**92**	91	89	**94**	66	80	91
Sendayan	73	88	89	**90**	80	86	**91**
Mean	81	87	87	**91**	72	84	87

To take the analysis one step further, when the mean stage scores from the first and second snapshots of the SoC are plotted on a SoC profile chart, the 'growth' of the innovation is charted. This is represented as in Figure 6 on the following page.

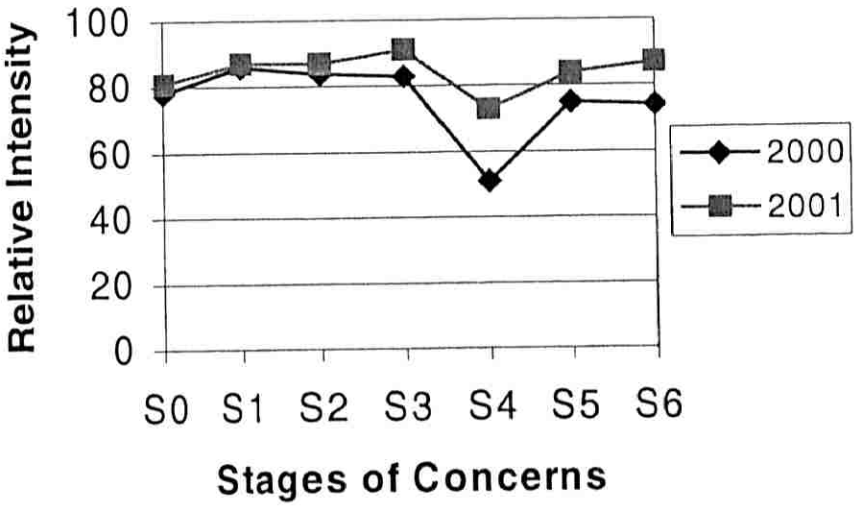

Figure 6 : Comparison of aggregated mean SoC scores for the case study schools (2000 and 2001)

Figure 6 above reveals that the technology adoption process has undergone several interesting changes within the research time frame. Firstly, teachers' concerns about the innovation have generally increased in intensity by the year 2001. Secondly, the overall concerns profile which emerges is one of increased adoption of technology use as indicated by the emergence of new peak Stage 3 concerns. And finally, the 'tail-up' in the concerns profile for the year 2001 sends a clear message that not all is well with the innovation and that appropriate intervention measures are called for.

In addition to the mean SoC profile for schools, individual growth profiles for the respective schools for 2000 and 2001 were also drawn to zoom in and to compare how individual schools fared in the technology adoption process within the research time frame. These individual school profiles are represented as in Figure 7 for Rajawali, Figure 8 for Gemilang, Figure 9 for Temasik and Figure 10 for Sendayan.

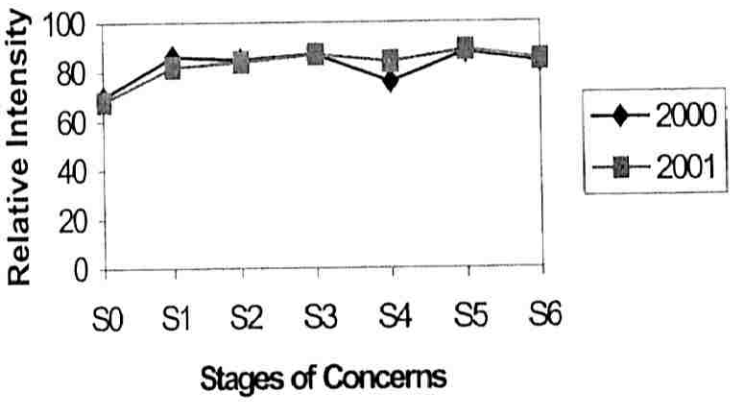

Figure 7 : Comparison of mean SoC scores at Rajawali (2000 and 2001)

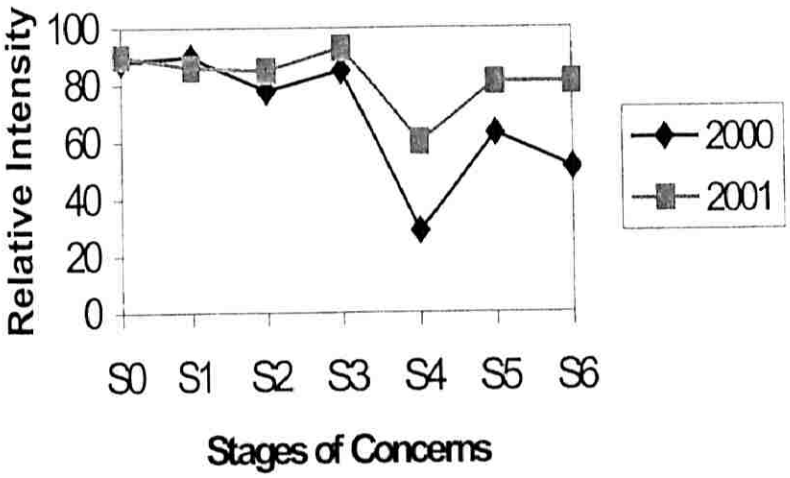

Figure 8 : Comparison of mean SoC scores at Gemilang (2000 and 2001)

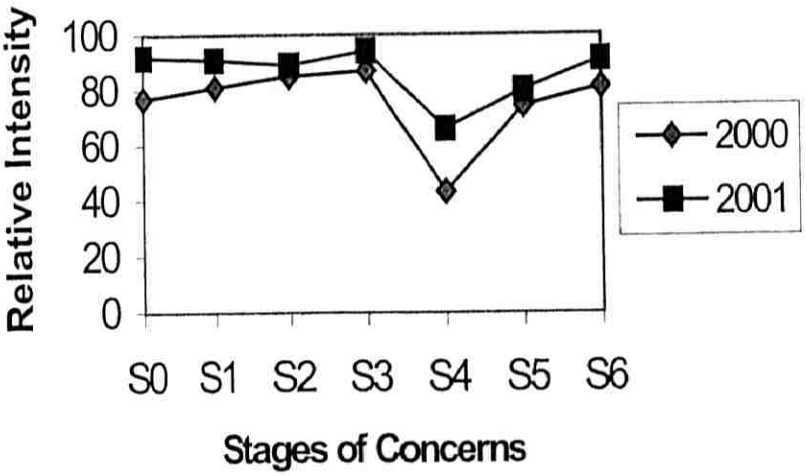

Figure 9 : Comparison of mean SoC scores at Temasik (2000 and 2001)

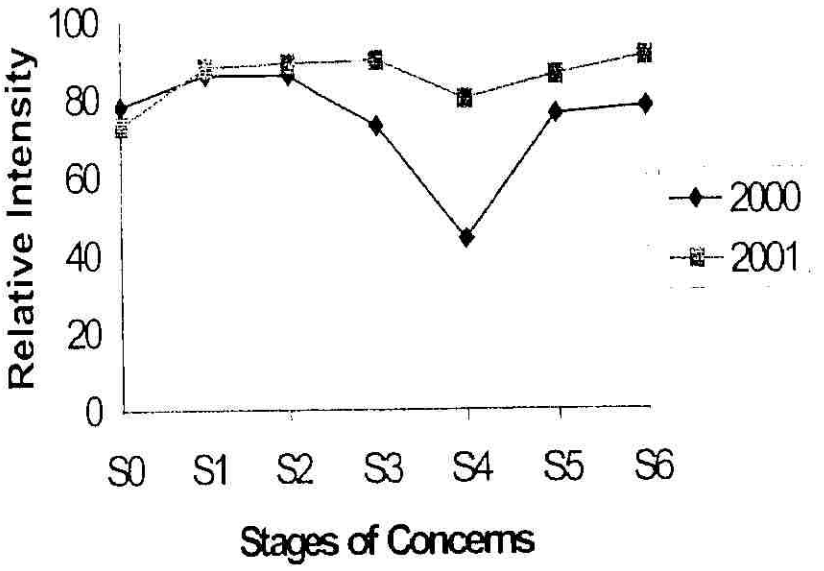

Figure 10 : Comparison of mean SoC scores at Sendayan (2000 and 2001)

The profile analysis provided by Figures 7, 8, 9 and 10 reveals that two schools – Temasik and Sendayan – had acquired a distinct 'tail-up' while Gemilang seemed on the brink of developing one too. The 'tail-up' sends a clear warning signal that teachers in these schools were seriously looking at alternatives and modifications to the innovation.

Follow-up interviews with randomly selected teachers at Temasik, Sendayan and Gemilang suggested that the cause of the 'tail-up' was due to dissatisfaction arising from problems with access to technology and disappointment over the first two releases of the software. All this will be dealt with in greater detail in the chapter on perceived problems.

Summary

To sum up, it is clear that the SoC was a viable means to tap into teachers' concerns to show where they stood in relation to an innovation. The stage score (SoC) interpretations provided a gestalt of teachers faced with the daunting task of pioneering technology-integrated instruction and reminded policy-makers that not all teachers were keen to acquire new skills and to teach in new modalities. For that is what technology-integrated instruction demanded of teachers – that they embrace a kinesthetic modality some may have little affinity for and little desire to acquire (Durost, 1994; Geisert & Futrell, 2000). By pinpointing teacher concerns, the SoC profiles actually paved the way for appropriate interventions to be put in place.

The strong interest in collaboration as highlighted by the concerns profiles was also an important point to note. It was almost as if teachers were saying: "I'd like to use the technology but I want someone to be near when I do it in case things go wrong." Research suggests this to be a common sentiment among novice users of technology (Ray, 1991; Nik Zaharah, 2000). After all, research studies have often pointed to the fact that inter-psychological connections enhance intra-psychological learning (Vygotsky, 1978). Thus, creating new opportunities for collaboration among teachers may prove a commendable measure for policy-makers to consider in order to promote technology adoption. Such measures would provide teachers with avenues of support as well as forums for discussion and the sharing of ideas (Martin, 1993; Nias, 1991; Sandholtz, Dwyer & Ringstaff, 1993).

Examining teachers' levels of technology use

To answer the research question 'What level of technology use did the teachers attain?', the teachers were interviewed based on a schedule adapted from the CBAM's LoU protocol (Appendix 3). These interviews, conducted via the branching format (Appendix 4) and focused interview technique (Hope, 1995), were held twice within the research time frame – in February 2000 and again in August 2001 – and triangulated with classroom observations. The results are tabulated as in Table 13 below:

Table 13 : Teacher's levels of technology use

Levels of Use (LoU)	February 2000		August 2001	
	N	%	N	%
0 (Non use)	–	–	–	–
1 (Orientation)	2	4.3	–	–
2 (Preparation)	27	57.4	11	27.5
3 (Mechanical)	18	38.3	27	67.5
4a (Routine)	–	–	2	5.0
4b (Refinement)	–	–	–	–
5 (Integration)	–	–	–	–
6 (Renewal)	–	–	–	–
Total N	**47**	**100**	**40**	**100**

As can be seen from Table 13 above, none of the case study teachers were at LoU0 in February 2000. This was not surprising as all 47 teachers had attended the *14 Weeks' In-Service Training Programme for Teachers of Smart Schools* and had, at the very least, minimal knowledge and involvement in the innovation.

Two teachers (4.3%) were determined to be at LoU1 (orientation) which meant that they were actively acquiring information about implementing technology-integrated instruction although they were still unsure when they would actually do so. When questioned, one of them said simply: "I don't know" (S:20.2.00.1).

The majority of the teachers (57.4%) were determined to be at LoU 2, that is, they were preparing to use the technology. Some had even targeted specific dates for adoption. One said that she would start using the technology "...as soon as the smart school project (was) launched" (S:29.2.00:1). Another replied that she was waiting for more hardware and software to be put in place but "...the intention to use technology is always there..." (S:29.2.00:1). Yet others linked the date for adoption with the date for moving to their new, high-tech premises:

> when we shift to the new place, the (science) equipment can be attached to measure things and sent direct to computers... teachers can do programming... then, science and computer can merge... (S:19.2.00:1)

Focused interviews with the teachers suggested that about 18 teachers (38.3%) were already at LoU3 or 'mechanical use'. Field observations supported this, showing teachers using the technology in superficial ways as they tried to cope with technical glitches. Most of the time, the teachers just integrated CDs into lessons, making few modifications or alterations. The general pattern of use among these teachers was disjointed, with occasional lapses into non-use. In a way, this was not surprising as the innovation was still in its first cycle and "individuals do not use an innovation for the first or even the second time as effectively and efficiently as they do after four or five cycles of use" (Hall et al., 1979).

By February 2001, the teachers' general levels of use had shifted slightly upwards. No teacher was observed to be at Lou1. The number of teachers at LoU2 had also dropped from 27 to 11 (that is, from 57.4% to 27.5%). However, the number of teachers determined to be at LoU3 seemed to have increased substantially from 18 to 27 (from 38.3% to 67.5%).

Two teachers from LoU3 – Ling and Shah – also moved to LoU4a or 'routine' use. Ling found herself settled into comfortable routines with the technology quite early in the research time frame. Field observations showed her hovering towards LoU4b or the 'refinement' level of use but she was prevented from moving into these higher levels of use by her students' low English proficiency and inability to engage in independent learning:

> I tried a web-based project, a very nice project but they (students) found it difficult, so frustrating… difficult for them to put together. Also the pupils themselves lack of independence and motivation, I had to push and push…
>
> (R:9.2.01.2)

Consequently, Ling stabilized her routine with the technology and remained at LoU4a till the end of the research time frame.

Similarly, Shah, too, was unable to progress to higher levels of technology use but for a different reason – he was asked to switch curricular subjects so often that he did not have time to familiarise himself with a subject long enough to move to higher levels of technology use. Thus, like Ling, he too ended up establishing a routine with self-created templates and subsequently made few changes in his pedagogy once this routine was established with his students.

To sum up, research findings showed a slight upwards shift in the teachers' levels of use within the research time frame but this movement was limited. Once the teachers reached LoU3, they seemed overwhelmed by user-oriented problems and remained at that LoU till the end of the research time frame. This difficulty in moving teachers to higher and more sophisticated levels of technology use has also been noted by other researchers (Carstens, 1995; Hope, 1995; Sharifah, 2000). Conclusions drawn from analyses of both the SoC and the LoU further confirmed that the technology adoption process was on an upwards trend although the pace of adoption differed. Clearly, there were forces at work that impacted upon the technology adoption process in the four case study schools.

The discussion so far has described and charted the progress of the technology adoption process in the four case study schools. However, it is not enough for qualitative studies to just describe something – there must also be an effort to "account for what we have given an account of" (Eisner, 1991) so that we may appraise the innovation and decide on future courses of action. Thus, the next section will highlight the factors that seemed to have impacted upon the technology adoption process. Field observations revealed that four levels of factors – policy, school, teacher and student level – seemed to have been especially potent in this respect.

Factors impacting upon the technology adoption process

Policy level factors

Shared vision. At policy or bureaucratic level, a key factor to promoting technology adoption is the formulation of a well-articulated, shared vision backed by the

setting up of appropriate measures to manage and nurture the innovation until it becomes part of the established culture (Finkel, 1990; Rowntree, 1974; Wiske & Zodhiates, 1988). Unfortunately, interviews with the teachers in the case study schools revealed that, for much of the academic year 2000 at least, the smart school vision was not that effectively shared with others further down the bureaucratic line.

Feedback from the grassroots implementers of the smart school vision revealed that many of the teachers were hazy about the finer details of the vision: "...the whole concept is too vague, too remote..." (G:12.6.00.2). Almost all the teachers expressed uncertainty about what they were supposed to achieve with the technology, given the lack of changes to the exam-oriented evaluation system in schools:

> We need to acknowledge that we have the syllabus and we have the exam. How do we use it (technology) in order to achieve that (good exam results)?
>
> (S:4.3.00.4)

A school principal observed that many of her teachers were confused about what they had to do:

> "Sometimes I feel they themselves don't understand the concept..."
>
> (S:14.2.00.3)

When interviewed, several teachers readily admitted that they did not know how to translate the smart school vision into classroom reality. Many berated the MOE for the lack of clear-cut instructions and directives:

> Show us how to use (the technology). Don't tell us only. You (MOE) know your A-B-C-D… but we (teachers) need to be taught how to read; you know (how to form) the word but we need to be taught how to form sentences…
>
> (S:4.3.00.6)

Some of the teachers felt as lost and swallowed up by the technology as the Tramp in Chaplin's *Modern Times*. One lamented:

> Presentation, presentation, what's the point? To me, it's a waste of time. Not one hour or two hours but HOURS… sometimes the whole day, girls also complain 'What do we learn?'…
>
> (S:14.2.00.3)

In fact, there was so little information about the smart school project that at one time, teachers were even uncertain whether it was on or off:

> *Sekarang, smart school dah lancar atau belum? Projek negara dah lancar atau belum? Komputer dah ada… Rugilah kalau tak guna. Apakah kita tunggu?*
> (Now, is the smart school launched or not, the nationwide project, is it launched or not? Computers are here… A waste if don't use. What are we waiting for?)
>
> (T:8.8.00.6)

Some wondered about the delay in the official launching of the project when all the hardware was already in place in the schools:

> I don't know what they want to '*lancar*' (launch), smart school or '*boleh guna lab*' (use of computer labs)… supposed to be (launched) last September, last April, then last August…
>
> (T:8.8.00.6)

It is true that a great deal of the teachers' confusion and ambiguity could be attributed to the delay in implementation caused by the economic crisis of the late 1990s. However, it is also true that the perceived lack of top-down transparency in the implementation of the technology initiative did not help. Some teachers complained about being kept in the dark about what was, after all, a national-scale project:

> Don't know what's happening. MOE never tell us anything... I do not know what to say...
>
> (G:5.6.00.1,3,7)

Throughout the research time frame, interviews with the teachers suggested that although many were aware of the implementation of the pilot smart school project, details about new software, curricular amendments and changes to the examination system were not shared and the exclusion of the teacher corps from these important decisions seriously impeded their commitment to technology adoption.

This finding that many smart school teachers actually lacked a clear understanding of the smart school vision is backed by the research findings of an earlier study which indicated that only 53.3% of 120 teachers surveyed understood the smart school concept (Siti Junaidah, 1999 in Mohammed Sani Ibrahim, Jamalul Lail Abdul Wahab, Mohd Izham Mohd Hamzah and Warnoh Katiman, 1999).

Perhaps a teacher best summed up the feelings of her peers when she said:

> We are all fed up. Maybe they meant well but the vision has not been passed on. Somewhere along the line, the fire of the torch has been put out, so we're just passing on the torch without the fire, just the holder...
>
> (G:12.6.00.4)

Appropriate support system. Another factor which adversely impacted upon the technology adoption process in the four case study schools was the lack of an appropriate support system for teachers involved in early adoption. Research on systemic change in education readily attests to the importance of this factor (Dwyer et al., 1991). Sadly, many teachers felt that they were not provided with adequate support, especially in the academic year 2000. A teacher commented:

> We plan a vision and it's all worked out, but from point A to point B, nobody is helping us...we need to have the network up and running, we need more training, we have no courseware, we are running on pirated courseware, courtesy of (a teacher's name)... that kind of support which we don't have.
>
> (R:10.7.00.3)

Another complained that "a lot of us on our own do things on our own *(sic)* the school should be doing..." (R:10.7.00.2). One expressed disappointment over the lack of top-down support: "We thought the smart school project will go on smoothly, (that) we only have to wait for software but..." (R:12.6.00.1). Even a school principal shook his head sadly over the lack of an appropriate support system for teachers to fall back on:

> Readiness is the most important factor to push technology. Actually, teachers are always ready, you know. Historically, teachers are up to managing and on record, they're excellent in carrying on projects. I don't see great problems in the teacher community but it's readiness from the bigger picture. Are the systems ready? When we talk about the smart learning using computer as teaching facilities, as an enabler, are we ready with that, you know? Are the computers ready with the software? Are we ready with the backup? Breakdowns? The technical problems – are we ready? I mean, we don't have anybody in school... major problem... major breakdown, we rely on people outside and because we rely on people outside, we have to tolerate their timetables. They have other priorities...
>
> (T:15.8.00.2)

After months of waiting for the MOE to take the lead, the teachers were horrified when they realized that the very people to whom they had looked to for support was instead turning to them for help:

> We are waiting for them to give us the software and now the Consortium is hunting us down to produce the software. It's a joke...
>
> (R:1.10.00.1)

The attitude of certain ministry-level education officers added to the teachers' perception that top-down support was lacking. A teacher described how her colleagues were called back by MOE to produce technology-based teaching and learning materials again and again but never saw the materials filtered back to the teachers who needed to use them:

> We saved it on diskette... we gave her (officer from MOE) diskette so that she'll copy for other teachers to use as examples but there's nothing... and she didn't even return (the diskette), not till now...
>
> (T:10.8.00.1)

This perceived lack of bureaucratic support was an inhibiting factor to technology adoption and discouraged some teachers from even wanting to try out the technology. When asked if she intended to adopt technology use in the near future, Mei replied: "See how *lah*. See how the top people, see how they organise it and all" (S:4.3.00.17).

The situation improved slightly in the academic year 2001 when more technical support was provided after Release One and Release Two of the smart school software were installed on the school servers in January and July, and a Help Desk was set up at the Educational Technology Division. However, teachers still expressed frustration over

the delay in technical assistance when glitches occurred. As a teacher so aptly put it: "Repair must be immediate otherwise teachers (will be) demotivated" (R:21.8.00.6).

To sum up, the perceived lack of an adequate support system, especially in the early part of the academic year 2000, worked against the technology adoption process and resulted in many teachers turning their backs on technology.

Funding. Funding also impacted upon the technology adoption process in the schools. The problem of funding is a major one as technology requires a long-term commitment of funds (Brady & Barth, 1992; Finkel, 1990; Siti Suria Salim, 2000). Field observations revealed that all four case study schools grappled with this problem:

> (Teachers) want to download stuff, (want to) surf for information. Fine but we must have photostating facilities, printing paper, cartridges and ink...
>
> (G:12.6.00.2)

The principal at Rajawali explained how her hands were tied in this matter:

> The per capita grant they give us is still the same, same like the non-smart schools. No changes, no difference, the launching fund they give us, same as the other secondary schools...we have ...heads (students), funding is according to heads, the more we have, the more we get, so we we're getting very minimum. And this fund covers all the teaching and learning materials for the students. A serious constraint for us. At one point, we had no paper, we borrowed from the primary school. We can do fund raising but it takes time to organise and to get the work force together. So many things to be done...
>
> (R:20.9.00.3)

In cases where external sources of funds were sourced, the technology adoption process proceeded more smoothly. Gemilang for instance enlisted the help of the local community to provide hardware for the school.

> We had help from the community, parents' support, a IT carnival to collect money to buy PCs, accessories, scanners, printers... The PIBG is very supportive, whatever we needed, they gave it...
> (G:5.6.00.3)

At Temasik, the path to technology adoption was smoother partly because the principal was an energetic fund-raiser:

> I'm used to this. I'm not new in the field of raising funds... (it's) what I call 'internal strength'...
> (T:15.8.00.4)

In other words, the ability of schools to source for external funding affected the technology adoption-diffusion process.

School level factors

School leadership. At organizational level, school leadership impacted greatly upon the technology adoption process. The important role played by school principals in deciding the fate of innovations has often been highlighted in research studies. Weick for instance, talked about how heads of schools "stimulate initiatives to move in a common direction" (Weick, 1982). Other studies noted that technology was quickly adopted when school heads actively promoted it and involved teachers in the decision-making process (Brady & Barth, 1992; Hall et al., 1987; Khazimah Mustaffa, 2000; Maney, 1994; McCormick, 1992; Strudler & Gall, 1988). Field observations showed this to be true.

At Gemilang for instance, the technology initiative benefited from a principal who was driven by a technology vision and prepared to bend rules:

> I am answerable to the parents, I'm going to force the issue, otherwise it's (the technology project) going to be a white elephant, I won't let the (computer) room be locked and turned into a white elephant...
>
> (G:17.2.00.1)

The principal realised very early in the technology implementation initiative that she needed teacher support to ensure the success of technology projects (Willis, 1993) and thus actively sought out "technology champions" (Carstens, 1995) to help her realise her vision. She assigned one such person as the school's IT coordinator and this person soon became a pivotal force in the school's technology initiative. The extent of the principal's influence is best summed up by a teacher who said: "What the Principal wants, we have to follow" (R:12.6.00.1). Under her leadership, the teachers of Gemilang were literally coerced into adopting technology. She herself was a good role model who constantly reminded the teachers to be ready for change:

> We better be prepared – although we don't know how far the exam system will change, if at all, (but we) still have to be prepared and start early...
>
> (G:2.3.00.1)

Similarly, at Sendayan High, the principal realized that while a solid base of support might keep an innovation on an even keel, growth was unlikely to occur unless pressure in various forms and degrees of subtlety was applied. Consequently, she too 'persuaded' her teachers to adopt the technology. Her strategy was, however, more

subtle. Convinced of the value of praise in motivating teachers (Brady & Barth, 1992; Finkel, 1990; Wiske & Zodhiates, 1988), she took pains to single out techno-savvy teachers for recognition. A teacher described the positive impact of this:

> She's very, very good. She'll come and see you personally and give you support, makes your day. I've never had that kind of thing with other HM. Once, I was teaching, she knocked, came in and said some nice things. She made it like I did something so good. I just thought I was doing my job. She could come down from the office, say something nice to me. I was in a daze the whole day...
>
> (S:13.4.00.5)

Quite clearly, the principal's public recognition of teachers' fledgling efforts with technology increased their commitment levels.

To sum up, school leadership was an important factor in shaping teachers' responses to technology. The principals' attitudes and responses to the technology initiative sent out messages which influenced teachers' inclinations to accept change. Generally, schools with pro-technology heads had more technology adopters among the staff.

Availability and accessibility to technology. Many researchers have cited this as a major impediment to teachers' acceptance and integration of technology into their lessons (Becker, 1991; Brady & Barth, 1992; Wiske & Zodhiates, 1988). As the principal of Rajawali explained:

> Of course, the physical environment is important, the infrastructure. As it is now, we've been open for nine months, not even LAN. The school (is) not wired up yet. The teachers come and talk to me but I tell them this is a policy matter. The teachers have been trained as early as 1998 and they know they are coming here. They had high hopes. Then they come here and see the facilities not available, they feel, well, they cannot make use of what they have learnt, let's put it that way.
>
> (R:20.9.00.5)

Lack of hardware seriously inhibited the technology adoption process in all four schools as teachers struggled to manage classrooms where students had to share computers:

> There is only one of me. The students have different levels of skills and there is (sic) limited computers. One group can do work on the computer but there are other students and they all need monitoring and instruction. It is better that I give my students 100% of me than split my attention and time between one group at the computer and the remaining students at their desk... the facilities are so limited and our hands are tied... I asked how to overcome lack of networking... (they said to) copy diskettes... I suppose if you've nothing better to do...
>
> (R:10.7.00.5)

Besides availability, the issue of accessibility to hardware was equally important. Research suggests that technology has a better chance of being integrated into the curriculum if it is located in the classroom (Watson, 1990). Field observations seemed to support this when technology use at Rajawali dropped drastically after the opening of extra classrooms led to several classes being without computers. A teacher explained:

> (I) used to have PCs in my classroom but now, more classes are open and we have to book, so I cut down. *Leceh*! (Troublesome)...
>
> (R:10.7.00.1)

Her colleague agreed:

> I used to use computers every day when the classes sat in the classroom with computers. Now (I) have to book so (I) slow down.
>
> (R:10.7.00.1)

Software was equally important. For much of the academic year 2000, the smart school software was not readily available and teachers depended on the limited CDs prepared by the Educational Technology Division. The software problem was somewhat alleviated with the first and second release of the smart school software but technical glitches still disrupted smooth use, especially for English and Mathematics. As the teachers were contract bound to use only the software developed by the Consortium for the first three years of the pilot project, the lack of availability and accessibility to software became major inhibiting factors to the technology adoption process.

School climate and collegiality. Research studies suggest that school culture affected the technology adoption process (Becker, 1994). Unfortunately, the traditional school climate – conservative (Chiew, 1999), with limited avenues for teacher collaboration (Lieberman, 1995) and generally more tolerant of the status quo than of change and innovation (Payzant, 1989) – is not conducive to technology adoption in schools.

Field observations revealed that school culture and ethos also affected the technology adoption process. Ling, for instance, attributed her enthusiasm for technology use at Rajawali to the pro-change and pro-technology culture prevalent there:

> We have people who are quite high tech around here, we discuss, like, web pages, problems, that's why I enjoy here. Makes me go on... I have people who are of like mind with me...
>
> (R:21.8.00.7)

It is the presence of such "like-minded" colleagues that encouraged Ling to explore and to experiment with new software:

> (Shah) asked me to try a shareware (called) 'Mark in'... students emails a composition and you can mark it, marking without a red pen. I'm going to try it out...
>
> (R:18.6.00.2)

The pro-technology culture at Rajawali not only gave her emotional support but also provided her with an avenue for venting frustrations, sharing ideas and celebrating successes. This sustained her efforts at innovation and paved the way for the creation of core groups of like-minded technology champions (Carstens, 1995), multiplicative agents (Hodgson, 1995) and opinion leaders (Rogers, 1995) who will actually drive the technology adoption process. Almost all the teachers in the case study schools highlighted the importance of having colleagues with whom they could bounce ideas off as a key factor in promoting technology adoption.

Staff development opportunities. Continuous staff development activity was observed to be another plus factor in promoting technology adoption, as cited in many research studies (Brady & Barth, 1992; Maddux, 1991; Pantiel & Petersen, 1984). Field observations showed staff development activities conducted on a regular basis in the four case study schools. At Rajawali, 10 technology-based workshops were held in the

academic year 2000 alone while at Gemilang, sessions were held every alternate Saturday morning. The teachers were generally keen to enhance their technology competencies:

> In a school like ours which is supposed to be a high technology thing, teachers should be well informed and well skilled to handle the technology. If they are not, they should get some training…
> (R:21.8.00.9)

Interviews with teachers revealed that those who regularly attended staff development sessions were more confident and more creative in integrating computer use in the classroom.

Syllabus mandates and time constraints. Another important factor which impacted upon the technology adoption process was the curricular factor, in particular, syllabus mandates and time constraints. Syllabus-wise, some teachers perceived certain subjects as less suitable for technology integration. A clear example was Bahasa Malaysia for which the use of technology, especially web-based instructional materials, was generally perceived to be scarce and "of limited use" (S:18.3.00.1). Similarly, another teacher expressed her opinion that science should not be technology-based but experiment-based:

> I feel it's not so suitable… for Science, better for them to *pegang* (hold) … hands on (is) more effective…
> (T:8.8.00.1)

All these perceptions, justified or otherwise, affected the teachers' decisions concerning technology adoption.

Time constraints is another facet of the syllabus factor. Time constraints have been constantly cited as inhibiting technology adoption in literature (Becker, 1991; Cuban, 1993; Dwyer et al., 1991; Marcinkiewicz, 1995; Salmah Yunus, 1994; Strudler & Gall, 1988; Wiske & Zodhiates, 1988). Almost all the teachers in the case study schools perceived time constraints as a major obstacle to technology adoption. A teacher explained how she was so discouraged by time constraints that she eventually gave up on the idea of technology use:

> Initially I liked the technology, I find that I was so excited by it but I found that you need (time) to prepare. From experience, I find that you need to prepare so that you actually teach within that 80 minutes, (so) students learn something. You need to have different kinds of input. The smarter ones need to have certain activity, the weaker ones tend to be lost if you give them the same level of activity. Technology needs to be planned technology and that takes time. We (also) have to find the technology to help them pass the exam. That's the constraint.
>
> (S:4.3.00.2)

Technology-integrated instruction often required students to participate in problem-solving projects. In Singapore, the scope of the syllabus has been reduced by some 30% (Singapore MOE, 1998) to free time for in-depth investigations into research issues but this has not yet been carried out in Malaysia, at least not within the research time frame. The result is that teachers who wished to integrate technology into their lessons found themselves fighting a lop-sided battle against time constraints. The time constraints problem was felt in different ways:

> We install (CDs) and that takes time. Training gives ideas but implementing ideas takes time, preparation to use IT lab takes time too...
>
> (T:10.8.00.3)

Technology also took away valuable instructional time:

> The thing is, to use it (technology), to actually use it in class would take a lot of time. If you have to ask them to browse in class, I think double period also not enough...
>
> (S:16.3.00.1)

Consequently, many teachers ended up letting technology slide:

> I don't think I'll use it (technology) *lah* unless I can finish my syllabus earlier, then I'll think about it *lah*...
>
> (S:16.3.00.1)

Even school principals advised their teachers to be cautious about technology adoption because they were not prepared to compromise on student performance outcomes. As one of them put it:

> At the end of the day, people always judge us by how many per cent (passes) in each of the subject.
>
> (R:20.9.00.3)

Perhaps ambivalent technology-user Anna has the last word when she said that:

> (I won't integrate technology) unless we have nothing else to do. I'm teaching 27 periods a week, 5 periods a day. Can you imagine the tons of worksheets I need to prepare, if I want to teach using technology? The task sheets, I mean. Then, if they use technology, I'm afraid they will not complete the task sheets. They'll have no time, they'll be handing up empty ones...
>
> (T:15.8.00.1)

Teacher level factors

Teachers' technology competencies. At teacher level, the technology adoption process in the four case study schools was affected by the teachers' technological competencies. This is consistent with the findings of research studies (US Congress, OTA, 1988; Wiske & Zodhiates 1988) which state that the teachers' low technology competencies, compounded by computer phobia and a lack of confidence, were major inhibiting factors in technology adoption (Geisert & Futrell, 2000; Heywood and Norman, 1988).

Interviews with the teachers revealed that many had rejected technology use because they felt they lacked the technological skills. Some were so lacking in confidence that they did not even want to think about the computer, much less adopt it. "I'm not very good at technology..." (G:13.6.00.2) was their usual lament. One teacher elaborated on her fears: "No, no, I'm not mechanically inclined...I'm not going to be able to create the stuff" (S:29.2.00.3). Another said:

> By golly, I can't see myself leading them into like Flash and Authorware, I don't see myself being able to lead them in that direction... maybe students can fill in or somebody else can fill in...
>
> (S:27.6.00.3)

Clearly, low technological competencies – perceived or real – inhibited the teachers' inclination to adopt technology in the classroom.

Teachers' perceptions of computer efficacy. Although research findings suggest that technology enhances learning outcomes (Kulik & Kulik, 1987), many

teachers in the case study schools were reluctant to fully embrace technology-integrated instruction because they were not convinced about the efficacy of computers in schools. Some cited research findings which pointed out that enhanced learning outcomes in technology-based classrooms stemmed not from the technology itself but from the pedagogy adopted with the technology (Thompson, Simonson & Gargrave, 1992). Consequently, many teachers preferred to adopt a 'wait-and-see' attitude. As Mei put it: "...(even) if I don't enter (computer) lab, lesson still goes on as usual. No problem" (S:18.3.00.1).

Some of the teachers' doubts about the efficacy of computers stemmed from negative feedback from students. One student gave the thumbs down on technology-integrated instruction, saying that such lessons "...become slower and (we) actually don't get what is actually the teacher are (sic) going to teach us..." (ISS: S11). Another told the teacher that she preferred "...something tangible, like structure, real stuff" (S:10.4.00.1). Consequently, many teachers regarded technology as a 'filler' which needed to be replaced by serious learning when exams approached:

> Exams are coming soon and I have to give them serious stuff. I find that with computers, sometimes, the children don't take things seriously so now, I have to give them serious assignments...
> (R:10.7.00.2)

Okolo, Bahr and Reith (1993) also cited the lack of efficacy in computers as one of five major factors inhibiting technology adoption in their 10-year retrospective study on computer-based instruction in schools. Maddux et al. (1997) suggested that a possible reason for this lay in the "negative impact of inflated claims" which resulted from the

backlash of opinion against technology due to over hype, especially when examination results plunged, seemingly as a result of technology use, as happened in the case study schools:

> (Teachers are) very worried. Maths results have dropped since February, March, April...
>
> (R:18.6.00.1)

Witness how even a school principal had second thoughts about technology use after examination results dropped drastically:

> The results plunged from 95 straight As in 1998 to 66 in 1999. I have to put a stop to this...
>
> (S:29.2.00.1)

Mei explained her uneasiness:

> When I give them (students) work, (they) look up information but when I give questions to answer, they cannot (answer). They print out information but they cannot read it, they cannot absorb it, cannot use it for recall... they just keep all the information...
>
> (S:13.4.00.2)

Consequently, many teachers found themselves caught in the back swing of the pendulum syndrome when overly optimistic expectations alternated with disappointment and disillusionment (Slavin, 1989).

Teachers' previous experience with computers. The teachers' previous experience with computers also affected their inclination to adopt or to reject technology use in the classroom. Ling, for instance, had previously worked as a freelancer for a

software company and found that this experience helped move her beyond personal concerns and gave her mastery over the technology. Consequently, she was very comfortable with technology and willingly prepared technology-based show lessons for visitors, even at short notice.

Another teacher described how previous positive experiences with technology had also made her more receptive to technology use:

> I'm very pro-computer technology... I did my first degree... and my final presentation was through video conferencing. I didn't get to see my lecturer. I was evaluated by a group of lecturers by remote control. I was in Malacca, I was (living in) Kuala Lumpur but the system was down, so (I) went to Malacca. It was a wonderful experience, that video conferencing... I would like to try it sometime with my students...
>
> (S:7.3.00.2)

Her positive experiences had made her so pro-technology that she insisted students email assignments to her whenever possible:

> I ask students to write reflections after every topic... took (them) some time to get used to it (emailing the reflections) but now that I've tried it, I'm glad I did it...
>
> (G:12.6.00.1)

Client level factors

Students' response to technology. And finally, at client level, the students' response to the teachers' novice efforts with technology affected their decisions regarding continued technology adoption. For instance, if students responded negatively to technology-integrated instruction, the teachers soon rejected it. Conversely, when students responded positively, the teachers were quite unabashed about using the

technology as bait to lure students to class. Anna was won over to technology use by her students' enthusiasm:

> Students like the PC; it's new, it's cool, it's trendy, students love it. They look forward to it every time…
>
> (G:13.6.00.3)

Many teachers commented that their students paid more attention in class when technology was adopted because they saw technology-integrated instruction as "…something very different" (R:4.7.00.4), so much so that they often forgot the time when engrossed in technology-based projects:

> *Tak perasaan pun dua masa... Ini tengok, dia orang tak mahu keluar pun…*
> (Didn't notice the double period. Look, they still don't want to leave the classroom…)
>
> (R:2.5.00.5)

In short, the students' responses to technology impacted upon the technology adoption process by acting on the teachers' morale.

Parental support for technology. Research shows that teachers tend to retreat from innovations resisted by parents (Sheingold, Hawkins & Char, 1990). Interviews and field observations suggested that this factor also affected technology adoption in the case study schools. A teacher shared her experience:

> One mother came to ask me, 'What's the *bestari* about?'… I told her about technology and self-directed learning and thinking skills. She was not very receptive. She was more concerned about whether it'll prepare her child for the skills she needs to succeed in exams…
>
> (G:12.6.00.1)

Another parent related how she felt "pressured" into buying a computer for her son:

> *Bestari* causes pressure. Last year, I didn't have Internet at home, pressure for my son and me, he feels the lack. Finally, I had to install, pressured to install, colour cartridge, scanner... it's costly...
>
> (T:21.4.002)

When these parents voiced their unhappiness to teachers, the teachers were discouraged from continuing with technology use. After a parent-teacher meeting, a dejected teacher voiced doubts that technology-integrated instruction would ever catch on:

> Ideally, *bestari* means students can sit at home and learn from materials posted on the web to learn. I don't see Malaysian parents as ready for it. They want children out of their homes for a few hours...
>
> (R:10.7.00.3)

Conclusion

To sum up, this chapter looked at the primary concerns of teachers involved in the technology adoption process, examined their levels of use of technology and investigated factors which impacted upon technology adoption in the case study schools. The results suggest that more teachers were beginning to integrate technology in instruction although levels of use remained low. A host of factors seemed to have been responsible for this.

At policy or bureaucratic level, the perceived lack of a shared vision seemed to have been a stumbling block as teachers proved discerning about the use of technology and only showed enthusiasm when they understood the vision, shared it to some degree

and had some say in its implementation. Inadequate support systems and financial constraints also inhibited the technology adoption process.

At school or institutional level, effective leadership, availability and accessibility to technology, the school climate or cultural ethos, staff development opportunities, curricular considerations and time constraints played key roles in promoting or inhibiting technology adoption. At teacher level, teachers' technological competencies, perceptions of computer efficacy and previous experience with computers affected their inclination to adopt technology. And finally, at client level, the students' responses and parents' reactions to the teachers' novice experimentations of technology seemed to have impacted upon the technology adoption process as well.

The interplay of all these factors is summarised in Figure 11 on the following page. However, while these factors explain, to a certain extent, why teachers in different settings responded differently to the use of technology in instruction, they are unable to account for variations in the responses of teachers within the same physical, cultural and technological setting where external factors like school leadership and access to technology are held constant. The factors are also unable to explain, why, after having initiated technology adoption, some teachers are able to sustain their efforts while others rejected technology soon after. This will be dealt with in the next chapter.

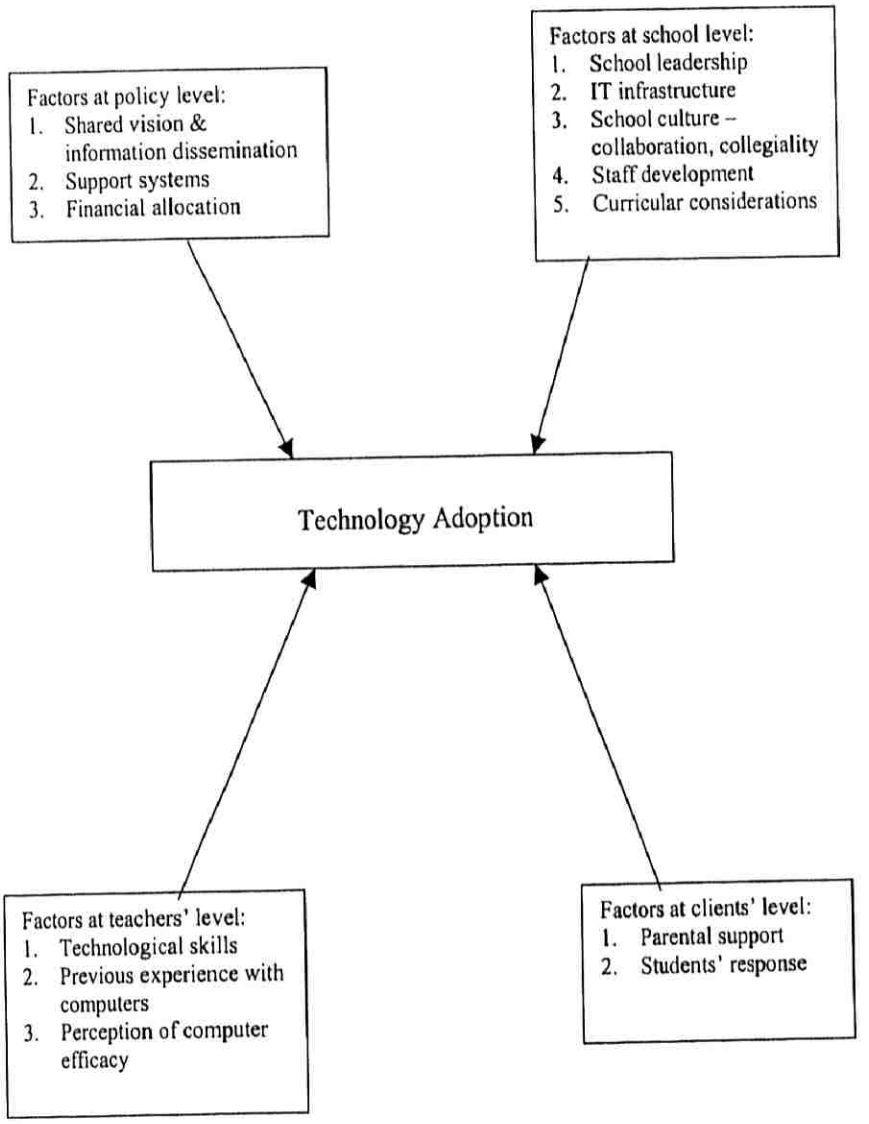

Figure 11 : Factors which impacted upon the technology adoption process