CHAPTER 3

Methodology

In this chapter, the research design of the study is discussed. Details pertaining to the research design paradigm, the selection of sample schools and subjects for the case studies, the instruments employed and methods of data collection are outlined.

Design of the study

The selection of a research design depends on the purpose of the study and the research questions it aims to answer. LeCompte & Preissle (1993) illustrated this clearly when they said that a research design involves "deciding what the research purpose and questions will be, what information most appropriately will answer specific research questions, and which strategies are most effective for obtaining it". Thus, theory and methods in research are "inextricably linked" because theoretical assumptions influence the formulation of questions as well as determine data collection methods (LeCompte & Preissle, 1993).

This is a longitudinal study on the technology adoption process in four public, pilot smart schools in the Klang valley. It looks at adoption-diffusion issues from the perspectives of teachers specially trained to implement technology-integrated instruction. More specifically, it seeks answers to the questions listed in Table 2 on page 59. Since the premise of this study is that change is brought about by individuals within a system, it

follows that both individual and systemic factors need to be examined and the most appropriate research design is a holistic and dynamic, investigative approach (Borg & Gall, 1989). A review of related literature shows that many researchers have, in the past, rejected the variance research methodology of quantitative studies for a less structured qualitative approach to studying the innovation decision process (Eisner, 1991; Bogdan & Biklen, 1992; Rogers, 1995).

My selection of a qualitative research design is based on the nature of the research questions asked in the research study, the answers sought, my theoretical platform as a researcher and my self-perceived research skills and strengths. Translated into operational terms, my choice was shaped by the answers to four simple questions: "What am I looking at?", "What am I looking for?", "What platform am I operating from?" and "What special skills do I bring into the study?"

Reflection on these four questions supported the adoption of a qualitative research paradigm. Firstly, my research questions dealt with the technology adoption process and as 'process' connotes dynamism and evolution not easily quantified or captured in a one-off survey, the best methodology was a hands-on approach where I could be on site to observe events as they unfolded.

Secondly, the answers sought were not close-ended "yes-no" answers as I wanted to tap into the thoughts of those involved in the technology adoption process. In all probability, the answers would run along lines of "*Yes when...*" or "*No when...*, or *"It was yes but became no because..."* or *"It was no but became yes due to..."* Again, the case begged for a qualitative research design.

Thirdly, although my study revolved round the use of technology in schools, my interest was not so much in the technicalities of the technology as in the people involved in the change process. My training in sociology also means that I am more comfortable with the anthropological-based, ethnographic approach than with any other approach.

And finally, I find that I enjoy acting like a sleuth, investigating and triangulating suppositions. It is my habit to hold running conversations in my head – "why did she say this?" – long after an event and to dwell on conversations past. I think of repartees when the time for making such responses is over, observe details which replay themselves in my mind and remember snatches of conversations vividly. However, although I make connections slowly, I am also patient and do not mind waiting for things to fall into place. These are my observations of my research strengths and I believe these skills particularly suited to qualitative research. Consequently, I selected the qualitative paradigm – it was a matter of 'best fit' based on my answers to the four questions posed.

As is often the case with qualitative studies, I embarked upon the study with very general research questions. As a teacher trainer, I had been involved with the smart school programme to train teachers to teach with technology but was uncertain what teachers did with their skills upon completion of the training. I wanted very much to find out what went on in the school milieu – did the teachers accept technology and if so, how were they using it in the classroom? Thus, I started field observations with that most basic of ethnographers' questions: "What is going on here?" (Wolcott, 1977).

However, after a preliminary exploratory study, clearer questions emerged which I listed down, together with plausible sources of information and possible methods of data collection, as show in Table 2 on the following page.

Table 2 : Design of the study

General Research Questions	Data to be collected	Sources and methods of data collection
1. Have the teachers who underwent the *14 Weeks In-service Training Programme for Teachers of Smart Schools* adopted technology in the case study schools?	• Determine the number of teachers who have adopted technology-integrated instruction	• SoCQ (Appendix 2) • SoCQ Workbook • Addendum (Appendix 2aii)
2. What were their primary concerns?	• Draw up individual composite concerns profiles of teachers	• SoCQ (Appendix 2) • SoCQ Workbook • SoCQ Profile Charts
3. What levels of technology use did they attain?	• Determine type, etxtent and pattern of technology use	• Observations • LoU (Appendix 3 & 4)
4. What factors promoted / inhibited the use of computer technology for technology-integrated instruction?	• Identify factors impacting upon technology adoption in the case study schools	• Interviews with teachers and principals • (Appendix 2bii & 5) • Observations
5. Given the same basic technology training, what caused variations in the teachers' responses to technology?	• Pinpoint factors for causing variations in the teachers' patterns of practice with technology	• Classroom observations and interviews
6. What uses of technology did the teachers find most useful? What were the perceived problems and benefits?	• Investigate teachers' perceptions of the role of technology in instruction	• Interviews • Classroom observations • Appendix 2bii
7. What were some of the optimal uses?	• Develop a profile of technology use by teachers	• Classroom observations • Interviews with teachers, principals and students
8. How did students perceive the use of computer technology for instruction and how do these perceptions differ from those of the teachers?	• Determine students' response to technology use	• Classroom observations • Interviews with students • Appendix 6

However, it must be emphasised that while these research questions guided the direction of the study, they only emerged and crystallised over time and needed to be rephrased and redefined as the study evolved. There was little attempt to hold variables constant to test theories. Instead, fieldwork was aimed at watching events unfold based on a generative model encouraging variation and change. No attempts were made either to influence pedagogical changes as my role was strictly that of a non-participant observer.

Subject selection

Phase 1a (exploratory) : Selection of training milieu

Although this study focused on the use of computer technologies in instruction in the pilot smart schools, fieldwork actually commenced outside the school setting, in the training milieu where the teachers underwent a special training programme to prepare them to implement technology-integrated instruction. Starting fieldwork from the training milieu meant an extra 14 weeks of field observations but I believed this starting point was necessary because teachers' responses to technology in the school are often affected by their experiences during training.

As things later turned out, this exploratory phase did yield benefits as it bought me time to interact with the teachers on neutral ground before I ventured onto their turf. The increased interaction provided me with insight into their backgrounds, strengths, preferences and idiosyncrasies. It also allowed the teachers to get used to my presence and to develop rapport with me so that by the time I finally joined them in the school milieu, they were at ease in my presence.

Consequently, my first task was to select a college to observe the teachers during their training. I decided to refer to the outcomes of a nation-wide monitoring exercise conducted by the Teacher Education Division (TED) between August 7 and September 2, 1998. Three factors constituted my selection criteria – the context factor (the IT facilities and infrastructure in the training milieu), the input factor (the course facilitators' expertise) and the process factor (the quality of training as evaluated by officers from TED).

Scores were allocated to each of the three criteria based on the report by the TED (please refer to Tables I, II and IIIa~c in Appendix 1 for details). Every ( ) awarded to the college by TED was given one mark and the summation of scores from Tables I, II, IIIa~c provided a tentative ranking of the colleges as represented in Table 3 on the following page. Please note that this rank carries no significance other than providing a measure to select the most suitable college for field observations.

As Table 3 on the following page shows, the highest ranked teacher training college within comfortable travelling distance (a prerequisite to reduce researcher fatigue) was college E which ranked third on the list. Consequently, throughout the 14 weeks of the training from June 1999, I was based in the college three days a week to observe the implementation of training. The teachers' portfolios, grades, attitudes and interaction patterns were scrutinized to identify suitable candidates for phase 2 of the research study. The teachers were also interviewed about the technological infrastructure in their schools and questioned about their willingness to be involved in the research study in line with the notion of informed consent.

Table 3 : Ranked score of the training colleges/ training milieu

Criteria for Selection	Names of teacher training colleges											
	A	B	C	D	E	F	G	H	I	J	K	L
Technological infrastructure	13	11	14	13	14	13	13	13	13	10	13	13
Quality of facilitators	9	9	9	9	9	9	9	9	9	4	9	9
Management of smart strategies	26	16	28	19	24	23	23	21	26	6	24	18
Portfolio Evaluation	12	12	12	11	15	4	7	16	18	4	6	9
Learning Package	11	11	11	9	11	11	11	11	11	4	11	10
Total scores	**71**	**59**	**74**	**61**	**73**	**60**	**63**	**70**	**77**	**28**	**63**	**59**
Crude Rank	**4**	**10**	**2**	**8**	**3**	**9**	**6**	**5**	**1**	**12**	**6**	**11**

Phase 1b : Selection of schools and teachers

In September 1999, the selection of schools for phase 2 of the research study was carried out in earnest. Teachers identified as potential case study material – articulate, reflective and empowered teachers with an interest in information and communication technologies – were sounded on their receptiveness to being involved in a long-term study. Those who were amenable were visited in their schools so that the IT infrastructure in the schools could be ascertained. An important factor influencing my choice of schools was their geographical locations. After all, as the key research

instrument (Bogdan & Biklen, 1992), I had to travel between schools while juggling multiple tasks – classroom observations, interviews, transcribing of field notes, literature review to design succeeding phases, and reflection on emergent data to triangulate and check for bias (Goetz & LeCompte, 1984).

Finally, four pilot smart schools in the Klang Valley – two level 'A' and two level 'B' – were selected. These levels refer to the levels of sophistication of the IT infrastructure provided by the MOE. Level 'A' schools are newly-built, custom-made smart schools, each with wired classrooms and more than 400 computers whilst level 'B' schools are ordinary lay schools with upgraded IT facilities (for details, please refer to Chapter 4).

The rationale for adopting multiple sites for observation – four in this study – was to capture as wide a range of teacher concerns in different levels of technological settings as possible in order to "maximize variation" (Merriam, 2001). No level 'B+' school was included as such schools were fully residential, boarding institutions and thus unrepresentative of typical lay schools. The four schools selected – Rajawali, Gemilang, Temasik and Sendayan– also had a 'kick start' IT component in their curriculum (Crawford, 1997) as computer literacy classes honed the students' computer skills prior to the introduction of technology-integrated instruction.

A critical case strategy was adopted to select the 4 schools. A critical case is a close approximation of an ideal case profile of a given condition and is typified by the statement "If it won't work here, it won't work anywhere" (Goetz & Lecompte, 1984; Patton, 1987). This strategy is helpful when resources limit the number of study sites which can be chosen as it allows 'best' sites to be selected. The strength of this approach

is that a good and persuasive critical case often lends more weight to generalisations and extrapolations.

All 4 schools selected were critical cases for technology adoption as they were officially-designated pilot smart schools provided with special technological infrastructure and smart teaching-learning materials. These schools were also backed by technical support services and staffed by a core group of teachers trained to implement technology-integrated instruction. In short, the case study schools were all poised to spearhead the implementation of technology-integrated instruction despite the fact that they had different levels of technological infrastructure and differing numbers of technology-trained teachers (as shown in Table 4 below).

Table 4 : The technological levels of the case study schools

School	IT Model	IT level	N (technology-trained teachers)
Rajawali	Lab & classroom model	A	12
Gemilang	Lab model	B	5
Temasik	Lab & simulation room model	B	8
Sendayan	Lab & simulation room model → lab & classroom model	B → A	22
	Total		47

The data collection process

Getting started

The entire data collection process for this study – from phase 1 (exploratory study) to phase 2d – stretched over 26 months, from June 1999 to August 2001. Phase 1a, which comprised observations of teachers at College E, started in June 1999 and lasted for 14 weeks. This was followed by a hunt for schools in September 1999 when, based on a list of potential candidates from field work in phase 1, several principals were contacted about the possibility of conducting a longitudinal qualitative study in their schools. Interestingly, some principals voiced reservations about the benefits of being involved in research studies, citing that past involvement had inconvenienced rather than benefited teachers and students. Eventually, the choice was narrowed down to four schools and the principals agreed, on condition that permission was obtained via proper bureaucratic channels and research findings shared with the school.

Feedback from the exploratory phase also helped to sharpen the focus for subsequent phases of the study. Interactions with teachers in the training milieu indicated that teachers had mixed feelings about the innovation – some were skeptical, some curious and excited while others were simply uncertain. However, all were concerned about their new roles with the technology. Consequently, a literature review on the concerns of teachers confronted with change and innovation was conducted and the Concerns-Based Adoption Model (CBAM) was selected as the most viable framework to tap into and give voice to the teacher.

The Stages of Concerns Questionnaire or SoCQ (Appendix 2) was adopted as a tool to chart the teachers' responses to technology. It was translated into Bahasa Malaysia and back-translated by a lecturer at the university. Both versions were then piloted in a school in October 1999 with a sample group of teachers who had attended the *14 Weeks In-Service Training Programme for Teachers of Smart Schools.* Surprisingly, more than half the teachers opted to fill in the English version, citing greater comfort with the language as the reason. Consequently, it was decided that both versions should be made simultaneously available to teachers to accommodate different language preferences and competencies.

Phase 2a : Walking the field

The research study entered its second phase in January 2000. As field observations stretched over 20 months, this phase was figuratively divided into several sub-phases to facilitate analysis of data. Phase 2a saw the administration of the SoCQ to teachers in the four case study schools who had attended the *14 Weeks In-Service Training Programme for Teachers of Smart Schools.* These teachers (totalling 47 in all) were considered change agents in the schools as they had been trained to lead the technology initiative. Their SoCQ scores were tabulated via an Excel Workbook to yield composite profiles and these provided the first snapshot of the teachers' concerns in the technology adoption process.

An addendum attached to the SoCQ compiled background data about the teachers and asked for permission to involve them in the study, in line with the notion of informed consent. An oral briefing advised them about the long-term nature of the study but

emphasized that participation would be at different levels and that only those who did not mind being observed in the classrooms and shadowed in schools would be so involved.

The teachers were informed that identities of the case study schools and respondents would be kept confidential and that they would be given pseudonyms in the write-up – they also reserved the right to edit parts of the study related to them.

In March 2000, all the teachers were interviewed, using an interview schedule based loosely on the LoU protocol of the CBAM (Appendix 3 & 4) to determine their levels of technology use. Attempts to videotape the interviews were abandoned when the teachers expressed reluctance to be caught on film. Thus, the interviews, conducted mainly in the school resource rooms during the teachers' free periods, were merely audio-taped on a mini recorder when the teachers permitted it. In instances when they were unwilling to be even audio recorded, only notes were jotted down.

Observations of the teachers in the classrooms started in April 2000. Given the time constraints, it was not possible to observe all the 47 teachers without incurring extreme physical and mental fatigue. Consequently, the SoCQ was used to identify adopters via their peak Stage 3 concerns (Maney, 1994). As the objective of the study was to look at how teachers used technology in the classroom, only those identified as adopters – 18 in all – were selected for classroom observations.

I visited every school at least once a week, usually for three to five hours per visit, except during examination seasons. The visits continued right through April, May, June and July 2000. On days when I was unable to visit the school for observations (there was a week when my car broke down and had to be sent to the workshop for repairs), telephone conversations and email kept me in constant communication with the teachers.

On occasions when I felt there was something worth seeing, two schools were slotted for observations in a day.

Interspersed with observations of the teachers were "one-legged conferences" (Hall & Hord, 1987). These referred to casual, informal interviews lasting only minutes, conducted as and when the opportunity arose. Usually, these interviews or encounters took place in corridors, in the car park, staff room, canteen, etc. My normal greeting of "Hi, how's the technology going?" often triggered an avalanche of information and invariably ended with a short trip to the school canteen 'for a drink', which did wonders for strengthening rapport.

However, although classroom observations were focused on the 18 teachers, the other 29 teachers were constantly talked to in order to perform "member checks" to triangulate what was said (Stake, 1975a) and to confirm emergent patterns and highlight discrepant cases which offered alternative or rival explanations (Lincoln & Guba, 1985; Silverman, 1993). Discrepant or negative cases function like null hypotheses as they enable the researcher to qualify, refine or elaborate on emergent constructs and thus challenge the fit and relevance of the patterns to the social reality of the experience under study (Goetz & Lecompte, 1984; Patton, 1987). Furthermore, there was the likelihood that non-adopting teachers might, over the duration of the field study, move on to become adopters and I wanted to be on hand to tap into their shift in orientations.

Phase 2b : Widening the radius of the walk

In August 2000, after the school break, phase 2b of the study was set into motion. I arranged for interviews with the heads of schools (Appendix 5). Other

administrative staff – the senior assistants, IT coordinators and technical support people – were interviewed via casual, one-legged conferences. A questionnaire was also administered to 233 Form Two students (Appendix 6). These students were selected because they did not have to sit for major public examinations at the end of the year. Furthermore, they had attended IT literacy classes in Form One and had been exposed to teachers' experimental forays into technology-integrated instruction in 1999 and 2000.

Consequently, two classes of Form 2 students from each school were asked to fill in the questionnaire. A relatively 'good' and 'weak' class were selected from each school in order to 'maximise commonalities and contrasts' among the respondents (Saye, 1994). Three students from each class were randomly selected and interviewed to get in-depth feedback as regards their perceptions of technology-integrated instruction. The interviews with students were carried out both singly and in groups as some students were observed to be reticent when interviewed alone but willing to share their views in groups. Most of the interviews were not taped due to the incessant background noise. However, lengthy field notes were taken.

Phase 2c : Zooming in

Phase 2c involved 'shadowing' of the teachers. Due to time and manpower constraints, only five teachers were selected to be shadowed. Although the initial plan was to 'shadow' at least one teacher in each of the four subjects – Bahasa Malaysia, English, Mathematics and Science – this criteria was later rejected in favour of teachers who were articulate, empowered, technologically competent and pedagogically innovative. As the focus of the study was technology adoption, it was felt that the

content or subjects taught were not of significant importance. Other factors considered in the selection of teachers were their composite concerns profiles, recommendations from school principals and the teachers' willingness to be 'shadowed'. A teacher from the pool of non-technology using teachers was also included for 'shadowing' to provide a discrepant case.

'Shadowing' of the five teachers began in September 2000. This phase overlapped slightly with interviews of two school principals who had earlier postponed their interviews due to tight schedules. In a way, this turned out to be a blessing as classroom observations interspersed with interviews provided welcome respite and reduced researcher fatigue.

I tried to glean information about my five teachers in order to understand their general psyche and perceptions of life as well as their attitudes towards technology-integrated instruction. I kept an open email dialogue with them and made telephone calls to follow up on email that weren't answered. These five teachers were observed in action in the classroom at least five times each over the period of 'shadowing' but they were constantly interviewed and their lesson plans, projects and participation in technology-related activities were regularly reviewed to gain insight into their pedagogical practices.

Phase 2d : Closure

The last phase of the fieldwork – the administration of the second SoCQ – was conducted in July and August 2001 to get a second snapshot of teachers' concerns regarding the adoption and use of technology in schools. All the teachers who had responded to the first SoCQ were invited to answer the second SoCQ to enable the

changes in concerns profiles to be charted. Thanks to the cooperation of the school principals, all did. Follow-up interviews were conducted where deemed necessary and the data reviewed for emergent patterns. Fieldwork officially ended in August 2000 but phone calls were still made to teachers to clarify doubts right till the end of the writing process.

I find the setting up of a timeline to guide data collection extremely helpful. This timeline provided a list of milestones to achieve, moving me from one target to the next. I stayed longer than the "one full cycle" on the field advocated by Wolcott because I felt there were still things to see. In retrospection, I think data collection is like taking a train journey – one has to be firm about getting off the train, however hard that may be. My time-line for data collection process is represented as in Figure 4 below.

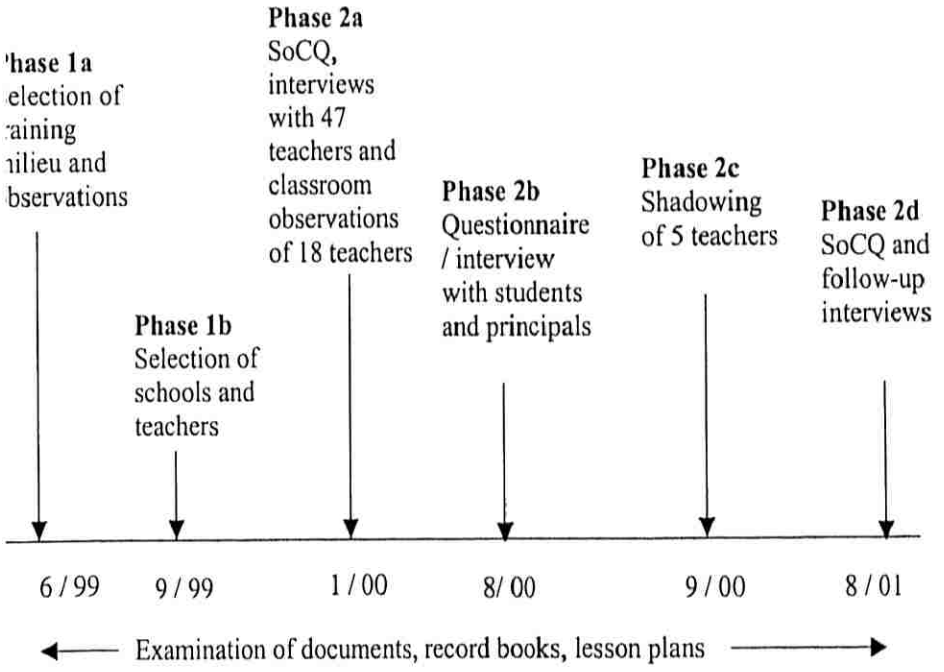

Figure 4: Timeline for data collection

The instruments

The Stages of Concerns Questionnaire (SoCQ)

In this study, the CBAM's Stages of Concern Questionnaire (SoCQ) served two purposes. Firstly, it provided a snapshot of the primary concerns of teachers confronted with technology use in the case study schools at two different points in time – the beginning and end of the research time frame – and in doing so, shed light on how teachers had progressed in the technology implementation initiative. Secondly, it was used to differentiate between adopters and non-adopters of technology (Maney, 1994) so that by interviewing teachers from both groups or populations, the factors impacting upon the technology adoption-diffusion process were identified.

As shown by Appendix 2, the SoCQ comprises 35 questions covering seven stages of concern (Hall et al., 1979) ranging from awareness to informational, personal, management, consequence, collaboration and refocusing concerns. As it has been validated and confirmed to have high internal reliability and validity (Hall et al., 1979), no attempt was made to revalidate the instrument in this study, especially since the original English version of the SoCQ was administered together with the translated version.

The Levels of Use (LoU) Protocol

The LoU describes what innovation users actually do with an innovation. It is a developmental growth continuum with eight levels that an individual moves through, starting with 'lack of knowledge' to a more sophisticated and highly effective use level.

Initial use of the innovation is typically disjointed and characterized by many problems but these usually diminish with continued use. To gauge the teachers' levels of use of the technology, a branching format of the focused interview technique was adopted (Appendix 4). The focused interview starts in an open-ended fashion and proceeds through a sequence of questions in a branching fashion that closes in on a particular subject. Each of the basic branching questions is followed by a series of levels and specific probes which helps the interviewer determine the level of use the interviewee is at. The CBAM's LoU has also been validated many times (Loucks, Newlove, & Hall, 1975). For more information about the LoU, please refer to the literature review.

Data collection methods

All four methods of data collection often employed in ethnographic studies were used in this research study (Glaser and Straus, 1975; Miles and Huberman, 1984).

Review of related material

An extensive review of related reading material was carried out. Case studies on the adoption of technology-integrated instruction in developed countries such as the United States and Singapore, and in the developing world, were examined. Formative evaluation reports, concept papers, theoretical blueprints and documents pertaining to the smart school pilot project were reviewed. These included the CRFPs (Concept Requests for Proposals), the Conceptual Blueprint and the technology master plan which outlined government initiatives as regards technology-integrated instruction in schools. In the

exploratory phase of the study, the teachers' lesson plans, learning packages, reflective journals, log books, attendance sheets, worksheets, portfolios, etc, were reviewed regularly to cull information on what actually happened during training. In the subsequent phases, the teachers' lesson plans, memos, teaching records and students' portfolios, exercise books and task sheets were systematically reviewed.

Observations

This was the primary tool for data gathering. Direct observation of school and classroom life is the richest vein of information, so I 'hung out' in the schools as often as possible, adopting the non-participant observational mode for several reasons.

Firstly, I believed participant observation would have exacted demands on my time and energy that I might not have been able to cope with. Secondly, I wanted to avoid the likelihood of role conflict as the teachers were aware of my involvement in teacher training prior to undertaking the research study and I did not want them to think that I was in the school in any supervisory capacity as research has shown that teachers were sensitive to differences between themselves and administrators (Wolcott, 1977). A more active role on my part might also have contaminated the 'reality' that I wanted to observe. Furthermore, there was the possibility that had I engaged in active participation, I might have found myself subjected to projective distortion and ended up over sympathetic with the teachers and less impartial to the natural course of events (Woods, 1986). Consequently, the mode of non-participant observation was preferred so that I might "lurk and watch" (Delamont, 1976).

Interviews

Eisner (1991) described educational connoisseurs as watching and listening to what is said in order to arrive at an understanding of what is happening. Consequently, in addition to observations, the interview method was also adopted to get information *about* people as well as *from* them. Interviews were conducted with school principals, teachers, students and Ministry officials to get as many different viewpoints as possible. These interviews were held both individually and in groups, via structured formats or casual, informal conversations. Efforts were made to encourage participants to speak their minds in an uninhibited way to allow for grounded theory to emerge. And as field notes were transcribed and analysed, new questions which cropped up were asked during subsequent interviews to gain deeper insight and to clarify ambiguities.

During interviews, the possession of a "third eye" (Woo & Zulkifli, 2001) which can tap into both the overt and subtle qualities of interviewees is a definite advantage. The "third eye" is the ability to instinctively zoom in on subtle cues and innuendos in speech or behaviour in the natural setting. It is this quality which enables the qualitative researcher to sense when something is "not quite right", when a pause might be too pregnant, a reply too glib. In other words, the "third eye" is the springboard which launches hunches and insight that, once triangulated, give qualitative studies that edge over quantitative ones.

'Shadowing'

Attempts were also made to 'shadow' five teachers as they participated in all type of school activities including staff development meetings, project briefings, etc. The aim

was to build up a composite picture of how these teachers actually used the technology in schools. This 'shadowing' took place randomly but was restricted to the school boundaries and within the teachers' schedules to minimise disruptions to their teaching duties and personal life. Nevertheless, I did manage to slip in a few home visits on a social level.

Data triangulation methods

Validity and reliability are issues of central concern in qualitative research because conclusions are drawn based on the analysis of cases instead of on a large sample or population. As such, qualitative studies do not enjoy the advantages of control and standardization offered by statistical tests and different techniques need to be employed to ensure that the data collected is valid and reliable.

Internal validity is the accuracy or congruence of one's findings with reality (Merriam, 2001). In qualitative research, reality actually hinges upon the researcher's interpretation of participants' understanding of a phenomenon. As these interpretations are accessed directly through observations and interviews, internal validity is not a huge problem in qualitative research (Merriam, 2001). Nonetheless, to shore up the validity of findings in this research study, various triangulation strategies such as interviewing multiple participants, observing multiple situations and cross-checking via multiple data collection methods were adopted (Borg & Gall, 1989).

I interviewed multiple participants for both verbal and non-verbal communication cues. These were then cross-checked with independent corroborations from other

respondents to verify the accuracy of information transcribed and interpreted as well as to minimise researcher bias. Multiple situations meant the teachers were observed in diverse situations at different times on different days. Multiple collection methods were also adopted to ensure that data obtained was not biased but representative. Artifacts, technology reports, hardware and software statistics, historical materials, record books, lesson plans, etc, were subjected to verification checks. Even drafts of this research study were not exempt but distributed to selected participants to be reviewed and edited for accuracy whilst posited relationships were checked against discrepant cases. A peer review (Merriam, 2001) was conducted by asking a teacher trainer to scan some of the raw data and assess the plausibility of the findings based on the data.

To a certain extent, the longitudinal time frame of the study also enhanced its validity as it increased the chances for rival explanations to emerge and be adequately investigated (Goetz & LeCompte, 1984; Patton, 1987). This reduced the risk of any 'Hawthorne effect' arising from reactivity to my presence in the school milieu. I knew that I was no longer 'reactive' when the students started greeting me by name in the corridors and teachers continued with their conversations without skipping a beat when I walked into the teachers' room; on one occasion, a senior assistant even asked if he could give me some relief classes.

External validity deals with the generalisability of the research findings, or the extent to which the findings can be applied to other situations. Two measures were adopted to enhance generalisability and encourage "context-bound extrapolations" (Patton, 1987).

Firstly, the technique of rich, thick description was adopted to enable readers to determine the applicability of findings to their particular situations. Secondly, the observations of multiple study sites – four in this case – meant that research findings could, hopefully, be applied to a greater range of situations.

Reliability refers to the extent the study and its research findings can be replicated. To enhance reliability, I again resorted to 'thick description' to clarify my role as researcher, my criteria for selection of teacher respondents, my description of settings and outlining of data collection methods and analysis (Goetz & LeCompte, 1984).

The use of verbatim accounts was also adopted wherever possible (Goetz & LeCompte, 1984). The use of the SoCQ and LoU protocols gave some elements of consistency to the study as it enabled the same procedures to be adopted to interview and observe respondents (Yin, 1993).

An external audit on the use of the SoCQ and LoU was conducted via periodical tele-mentoring by a researcher well-versed in the use of these instruments. Comparisons of research findings with current literature on technology adoption also provided further checks for consistency and replication of findings.

And finally, a clear audit trail was laid out, with regular monthly meetings with my supervising lecturer for discussions on the research process, especially with regards to observation techniques, subject selection, coding issues and interpretations arising out of the observations, interviews and the setting. Field notes were kept of all the meetings, documenting the subjects discussed along with suggestions and new leads for continuing investigation.

Data analysis methods

Data analysis was ongoing and concurrent with the data gathering process in keeping with the 'constant comparative' method (Glaser and Straus, 1975). Data collection, analysis and literature review were symbiotic and inform or drive each other. After each visit, field notes were reviewed and recorded within 24 hours. These notes were kept in duplicate, with the first copy retained in its original form so as to constitute a set of undisturbed running raw material of observation. This was to ensure that events could be easily reconstructed should there be inquiries at a later date.

The duplicate copy was then analysed by coding incidents into tentative conceptual categories which formed the basis for formulating other questions to guide further investigations on the field. The duplicate copy was initially cut up and filed in various shoe boxes based on emergent categories so that findings could be easily compared with initial categories. Through this constant comparison of data, analytical categories crystallized. Eventually, however, the data was keyed into the computer, making it easier to toggle data, create new categories and collapse them when necessary. The data was constantly checked for fit and to identify themes or patterns, with the original transcriptions read and re-read to get a sense of the whole and to provide a governing structure for analysis (Miles & Huberman, 1994). The special attention given to data that challenged original conceptualizations meant a return to data source which took place constantly right till the end of the study. In essence, this process of data analysis resembled taking data apart and then reconstructing it to identify the patterns that might reside within the data.

Summary

This chapter summarises the methodology adopted in conducting the research study. The research design is a qualitative framework using methodological pluralism and organisational holism as its conceptual pillars. The main research instrument was myself as the researcher and the vehicle for analysis was 'thick description' to penetrate manifest behaviour so as to arrive at the meanings events had for those who experienced them.

In order to increase ontological and procedural objectivity (Newell, 1976), multiple methods of data collection including extensive review of literature, perusal of documents and artifacts, interviews, observations and ethnographic-style 'shadowing' were employed. All data was checked, triangulated and structurally corroborated to seek a confluence of evidence. Special efforts were made to look for recurrent behaviour or patterns to ensure that events interpreted and appraised were not aberrant or exceptional but were characteristic of the situation. The CBAM model was adopted to increase procedural objectivity and decrease the scope for biased, personal interpretations. Member checks verified the accuracy of information transcribed and interpreted to minimise researcher bias. Informants were also invited to review and edit the information representing their perspectives to verify accuracy.

However, to a certain extent, the lines for research remained deliberately fluid to allow for the emergence of grounded theory. There were no fixed rules to direct my steps, no tests of significance to calculate, no variables to control in a lab-like setting. Instead, the cornerstones of the research were flexibility and adjustment underpinned by a

strong sense of faith that I had enough of the "enlightened eye" (Eisner, 1991) and the "third eye" (Woo & Zulkifli, 2001) to be able to recognize the significant when it came and would make the right moves.

This methodology was characterised by the constant need to change gears and was fuelled by my desire to interpret the educational world and say what could not be effectively said through numbers. In fact, it can even be said that this case study was not designed to test theory but to construct theory based on the practical experiences of the respondents involved. It is entirely up to the reader to determine whether it is appropriate to extrapolate and transfer the findings of this research to similar situations and settings.

As this research study is presented as a realist's tale chronicling the perceptions and experiences of teachers going through the technology adoption process, the chapters are arranged somewhat differently from that of quantitative dissertations in order to give voice to the participants as the need arises. The next chapter starts by providing a description of the schools and the teachers.