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Factors that Influence the Integration of Information and Communications Technology into the Classroom – Pre-service Mathematics Teachers' Perceptions

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Abstract: In the light of the recent focus on the use of technology in education, a Crucial Factors in the Integration of ICT Survey (CFS) was developed to examine mathematics teachers' perceptions of the degree of importance pertaining to the key factors influencing the integration of Information and Communications Technology (ICT) into the classroom. The purpose of this study was to field-test this instrument which measures secondary school mathematics teachers' perceptions of the positive impact of the following factors on ICT implementation as identified by a review of the literature: (a) usefulness and worthiness of technology, (b) support from various departments in the school, (c) availability and accessibility of technology, (d) professional development opportunities in technology, (e) leadership, planning and implementation of technology, and (f) partnerships with external organisations. In this study, a total of 60 pre-service mathematics teachers were surveyed. The results show that these pre-service teachers rate both professional development opportunities and the availability and accessibility of technology as the most influential factors among the six in determining the extent to which they will employ ICT in the classroom. However, all factors are deemed important in determining whether teachers utilised technology in the classroom.

Introduction

ICT has pervaded almost every facet of our society and is ubiquitous in the business world, the workplace, and the home. To ensure that schools keep pace with these societal developments and tap the enormous potential of ICT in teaching and learning, many countries have invested considerable amounts of resources to integrate ICT into education. Singapore, for instance, invested S$2 billion between 1997 and 2002 to facilitate ICT integration in schools, spending mostly on hardware, software, infrastructure and the training of teachers (Education, 2002). With the equipment and infrastructure in place, the challenge now is for teachers to explore ways of using ICT in their teaching in order to increase the quality of education. However, we now must question what are the most crucial factors that contribute to the extent to which ICT is integrated in the classroom?

The purpose of this study was therefore to develop and field-test the Crucial Factors in the Integration of ICT Survey (CFS) to investigate mathematics teachers' perceptions of the relative importance of the various factors, in comparison with each other, that will influence their use of ICT in the classroom. In this paper, the first instance of field-testing of the instrument, with pre-service teachers and the results of this testing, is reported. The pre-service teachers of today are the in-service teachers of tomorrow. By discovering the factors that influence them positively in the application of ICT into the classroom, measures may be taken to prepare school culture and environment in order to facilitate the integration of ICT for the teachers of today. The following sections will detail the rationale behind instrument development and testing in addition to the theoretical framework that shaped its development process.

Background and Rationale

Integration of ICT into education is a procedure in which instructional technologies such as computers and software are applied regularly to support both teaching and learning across levels and subject matter (Eib & Mehlinger, 1998). There has been a significant amount of research devoted to the integration of ICT in schools, its effects on student learning and attainment, and hindrances that prevent its successful use (e.g., Becker, 1993; Butzin, 1992; Cafolla & Knee, 1999; Cradler, 1999; Kozma & Croninger, 1992). While some researchers have indicated the benefits of integrating ICT into education (e.g., Holinga, 1999; Taylor, 1992; Wiburg, 1997), others have found that applications of ICT in the classroom resulted in little or no positive improvement in student attainment (e.g., Slavin, 1991; Stevens, 1992). Picciano (1998), on the other hand, observed that the benefits that ICT integration confers on student achievement are not uniform at all grade levels.

In Singapore, the affluent nature of our society ensures that the average household has at least one desktop computer in the home with Internet access. Of those that do not, nonetheless they have access to computers in school and a variety of other publicly accessible locations such as cyber cafes. The Ministry of Education (MOE) in Singapore has recognised the importance of equipping our students with technological skills that will allow smooth transition into the workplace of the future. In the light of this, MOE developed its first Masterplan for Information Technology in Education, which came into effect from 1997 through to 2002. The initial Masterplan (MP1) was a blueprint for the use of ICT in schools and allowed every child to gain access to an ICT-enriched school environment (Ministry of Education, 1997). As of this writing, MP1 has moved into its second phase, the Masterplan II (MP2), which consolidates and builds on the achievements of the previous phase.

The aim of MP2 is to provide a systemic and holistic approach to ICT that integrates and addresses key areas in education such as curriculum, assessment, instruction, professional development, pupil learning and school culture. Its focus is the harnessing of technology to enhance the interactions between these areas to bring about engaged and holistic learning. One of its key intended outcomes includes the use of ICT by pupils for active learning (MOE, 2002). This focus comes through the study of research that has shown that technology implementation in the curriculum not only motivates learning, but also improves student performance on a school-wide scale (Butzin, 1992; Holinga, 1999, Morgan, 1998, Office of Educational Technology, 1995; Riel, 1989; Sarangarm, 1992). The use of technology is also in accordance with the movement towards student-centered instruction and increased motivation of learners where the teacher’s role is that of a facilitator and students are active participants (Bagley & Hunter, 1992).

However, technology implementation has not been entirely successful at the school level, even globally, for a variety of reasons. Research has shown that technology integration in some parts of the world has not been smooth due to inappropriate planning, lack of training, insufficient budget and shortage of resources (Butzin, 1992; Cafolla & Knee, 1999; Dias, 1999; OET, 1995). While Singapore’s technological thrust in education has been implemented at a national level by the nation’s leadership, the main implementers of technology, as Wiburg (1997) pointed out, are teachers. They are the first to experiment with instructional technology and its products and to suffer should there be any inappropriate planning. To implement technology successfully, teachers need to master the instructional techniques and technologies and integrate them into the curriculum (Dockstader, 1999). As teachers have the best understanding of what needs to be taught, the advantages and difficulties encountered in the integration of technology into instruction (Bagley & Hunter, 1992; Cuban, 1993; Novak & Berger, 1991; OET, 1995), it is imperative that their concerns and feedback be considered and addressed adequately. Therefore, the overall purpose of this study was to develop and field-test an instrument that might be a reliable measure in garnering teachers’ perceptions of the positive impacts of certain factors on ICT integration.

Theoretical Framework

Ritchie and Wiburg (1994) identified four technology integration predictor variables in their study which are said to influence the use of technology in the classroom: (a) leadership and support by principals, (b) technology professional development opportunities, (c) attitude of teachers towards technology in teaching, and (d) establishment of technological partnerships with outside organisations. Wiburg (1997) proposed that there were still other crucial variables that might influence the degree to which technology is integrated into schools. Indeed, the four variables described by Ritchie and Wiburg are insufficient to completely describe the application of ICT in local Singapore schools. In the present study two other factors have been identified: the availability and accessibility of technological resources and the presence of technical staff to assist teachers whenever necessary (see Chang, 2002). Thus, the six critical factors (each with key descriptor) utilised during the CFS development are:

(a) Usefulness and worthiness of technology (usefulness)
(b) Support from various departments in the school (support)
(c) Availability and accessibility of technology (availability)
(d) Professional development opportunities (development)
(e) Leadership, planning and implementation (leadership)
(f) Partnerships with external organizations (partnerships)

Note: The key descriptor is used to facilitate discussion throughout the rest of the paper; that is, when "availability" is presented in the tabulated results, what is referred to is really both availability and accessibility of technology. Each of these factors is considered below.

Usefulness and Worthiness of Technology

The use of computers is not as easily assimilated as a teaching tool as other innovations such as the visualiser. In fact, while the latter may be operated with the depression of a few buttons, the computer is a far more advanced machine that often requires technical assistance in order to explore and learn (Scrimshaw, 1997). The use of technology is also changing instruction from teacher-centeredness to student-centeredness, which in turn causes teachers to re-examine teaching and learning strategies (Baily, 1997; Ritchie & Wiburg, 1994; Riel, 1989). In a report from the University of California (UCLA), "Apple Classrooms of Tomorrow" (ACOT) was evaluated where teachers themselves reported that ACOT improved classroom organisation and teaching methods that could assist in supporting students' motivation and independent learning orientation (Baker, Gearhart, & Herman, 1994). These pre-service secondary school mathematics teachers needed to be made aware of technology such as graphing calculators which have been shown to promote a dynamic classroom environment and increase students' levels of confidence through understanding of mathematical concepts and through an increase in problem-solving abilities (Dunham, 1993). How pre-service secondary school mathematics teachers perceive technology, useful or otherwise, clearly affects their future application of ICT in the classroom.

Support from Various Departments in the School

Support from school administrative personnel as well as the various departments, (e.g., ICT Department, subject departments) is vital in determining the success or failure of technology integration. Role models are required in order to convince teachers of the importance of technology integration (Cafolla & Knee, 1999; Dede, 1994; Ritchie & Wiburg, 1994; Salzano, 1992), and these departments must provide such models. In addition, Moersch (1999) indicated that school administrators need to observe how qualified teachers use technology in the classroom, and how students' academic achievement results improve from the application of instructional technology.

Along with strong support by administrative personnel, leadership and the various departments in the school, technical and instructional support is also a determiner of the extent to which teachers employ technology in the classroom. The technical assistant provides expertise in the field of technology and is a good resource to provide technology information and workshops to teachers (Durost, 1994). Instruction in the use of technology is critical, as teachers need to acquire the skills required for the integration of technology and be able to apply them. The presence of support, therefore, is integral to the extent to which teachers integrate technology with their lessons.

Availability and Accessibility of Technology

As Kozma and Croninger (1992) pointed out, the benefits that technology confers upon education can only be realised if both teachers and students have access to this technology. For the effective integration into curriculum, Stetson and Bagwell (1999) noted that during initial training, integration into methods courses and accessible adequate resources need to be present. They also stated that one of the keys to the success of technology integration in schools is the accessibility to quality resources. Teachers must not only have access to hardware and software, but they must also be trained to use them.

In accordance with this, Whitehead (1993) found some difficulties that render teachers reluctant to use computers for teaching. These difficulties included factors such as too few classroom computers, a non-operational networking system, lack of useful and updated software and children having difficulties in operating computers. The inadequacy and shortage of technology resources are big problems in technology integration in the classroom since technology integration cannot occur without computers and appropriate software support (Dias, 1999). Hence, the availability and accessibility of technological resources is included as a factor that affects technology integration on the part of teachers.

Professional Development Opportunities

A key concern in technology integration is the professional development of teachers. Dias (1999) pointed out the need for teachers to move beyond using computers for drill-and-practice, but opt rather, for an integrated approach to curriculum. Ritchie and Wiburg (1997) mentioned that the development of staff is crucial to technology integration in schools as teachers frequently complain of inadequate training resources and insufficient time. As such, the approach to technology training "should be professional, peer-level and supported by adequate funding" (Foley, 1993, p.25). Research has also indicated that in order to integrate technology into the curriculum successfully, teachers need to be able to use and master technological resources effectively in any teaching subject (OET, 1995). In mathematics education, professional development in technology would include both the skills required to utilise ICT tools such as dynamic geometry software (e.g., Geometer's Sketchpad), graphing software, spreadsheet software and graphing calculators, as well as the pedagogy required for successful utilisation of such software in the classroom. This requirement could be successfully attained by developing teachers professionally in the area of technology.

Leadership, Planning and Implementation of Technology

Principals in Singapore are no longer the sole implementers of technology in the curriculum nor are they the only people involved in the planning process. In fact, many researchers have identified effective leadership as a key ingredient of, and vitally important to, the success of any innovation in education (e.g., Bennett, 1996; Fullan, 1993). They, along with the ICT committee that is usually present in local secondary schools, provide the administrative support, along with professional understanding and commitment to technology integration that influences the allocation of resources, professional development opportunities and teacher motivation, all of which are crucial on a school-wide level (OET, 1995; Stevens, 1992). Administrators who have a greater understanding and dedication to technology integration can impact the level of technology implementation in schools (Wellburn, 1999). However, the responsibility is not solely the principals' although effective leadership on their part helps to establish a culture of suitable verbal communication and professionalism that is just as important for successful technology integration (Wiburg, 1997).

Kearsley and Lynch (1994) suggested that the potential benefits of good technology leadership could include improved academic achievement, improved school attendance and reduced attrition, better vocational preparation of students, more efficient administrative operations and reduced teacher/staff burnout and turnover (p.10). Winter (1998) maintained that the process for technology planning is synonymous with other types of planning: the right people need to be approached, the right questions need to be asked and the right answers acquired. Teachers, therefore, should be allowed a voice in the planning process – not only to provide a realistic representation of what happens in the school setting, but also to create a sense of ownership towards any ICT programme.

Partnerships with External Organisations

For the implementation of technology integration to be a success, schools need to establish a variety of school-community partnerships, which are formed with business companies, other schools, universities, organisations and individuals around the world (Knapp & Glenn, 1996). In van Dusen and Worthen's (1995) evaluation of the computer-based Integrated Learning System (ILS), they stated that partnerships with external organisations and agencies assisted ILS with alleviating insufficient means of traditional budget support by obtaining finances through other means. In addition, partnerships with these organisations allowed students to gain experience in the field of technology through projects and experimentation.

Design of Study

A field test of the survey instrument, the CFS, was conducted with pre-service secondary school mathematics teachers enrolled in the Postgraduate Diploma in Education (PGDE) Programme in the National Institute of Education (NIE) in Singapore. An indication of the factors that have positive influence on local pre-service secondary school mathematics teachers' integration of ICT into the classroom on a personal level could thus be obtained. In this first field-testing of the CFS, a sample of 60 pre-service teachers was used. The pre-service teachers surveyed have had at least a month of contractual experience in teaching mathematics at a local secondary school and have sufficient knowledge of the school environment, thereby placing them in a position to comment on the factors important to ICT integration. Anonymity was assured so that the pre-service teachers surveyed would not hesitate to reflect their frank observations and perceptions in the survey.

The Survey Instrument

The four-page survey instrument, the CFS, used in the study was constructed with the intent to acquire as much background information as possible regarding the teachers' demographics in addition to their professional designations and the extent to which they viewed each factor pertinent to ICT integration into the classroom at the time of the survey. Apart from the introduction to the survey which details its intent and some basic instructions, the instrument is divided into two sections: (A) background information, and (B) perceptions of the factors influencing ICT integration.

Part A was designed to obtain the demographic data of the survey participants such as gender, academic qualifications and teaching experience. In the second section, Part B, statements are divided according to the six factors, as previously defined, that are presumed to influence teachers' overall attitude towards implementing technology in the classroom (see Appendix). There are six statements per factor for a total of 36 statements (Table 1). Each statement was obtained through perusal of the literature regarding a given factor in order to ascertain what teachers consider important within its scope. For example, Durost (1994) attributed a significant degree of importance to the support provided by a technical assistant, which gave rise to Statement 26 of the questionnaire. The score for each item is determined by the participant's response to the statement in a 4-point Likert scale; that is, whether or not they "strongly disagree" (1 point), "disagree" (2 points), "agree" (3 points) or "strongly agree" (4 points) that each item has any positive bearing on the degree of potential ICT implementation in their classrooms in the future. The score for each factor is the mean score of the six individual item scores for that factor.

Table 1
Statements from Part B of the survey assigned into the categories that affect teachers' level of technology implementation in the classroom.

Factor	**Question Number**					
Usefulness	1	7	13	19	25	31
Support	2	8	14	20	26	32
Availability	3	9	15	21	27	33
Development	4	10	16	22	28	34
Leadership	5	11	17	23	29	35
Partnership	6	12	18	24	30	36

A total of 60 pre-service secondary school mathematics teachers were requested to respond to the statements, in accordance with the instructions and sample responses provided in anticipation of misinterpretations of the questionnaire. For example, in responding to Statement 3 of Part B of the questionnaire, the author clarified that the respondents were not to indicate whether computer technology was readily accessible to teachers but to indicate the extent to which they agree or disagree that ready accessibility to computer technology would influence the degree to which they integrate ICT into the classroom. Only upon ascertaining that the respondents were clear about what was expected were they asked to complete the questionnaire.

After the completed surveys were collected and the results compiled, a number of analyses were performed to ascertain the degree to which each factor potentially will affect pre-service secondary school mathematics teachers' level of technology integration and implementation in the classroom overall. The analyses and the results are discussed in the next section of the paper.

Results and Discussion

Table 2 reports the mean and standard deviation of factor scores and the reliabilities (Cronbach's alpha) for each of the subscales measuring the six factors that influence pre-service teachers' ICT integration. The reliabilities of the six subscales of the CFS are all within an acceptable range (0.65 to 0.81). The overall reliability of the CFS was 0.93.

Table 2
Statistics on Factor Scores

	Useful-ness	Support	Avail-ability	Develop-ment	Leader-ship	Partner-ships
Mean Score	2.95	3.13	3.21	3.29	3.15	2.95
Standard deviation	0.49	0.43	0.59	0.42	0.39	0.45
Reliability	0.80	0.73	0.81	0.70	0.65	0.73

The six factors are ranked in the following order: Development, Availability, Leadership, Support and Partnerships in accordance with the order of the highest to lowest mean scores. The results obtained from the field-test of the CFS thus show that pre-service secondary school mathematics teachers perceive that professional development opportunities is the most important factor in determining whether they use ICT in their classrooms (mean score=3.29 out of a possible total of 4). This coincides with Ritchie and Wiburg's (1994) observations that teachers often complain about the lack of adequate training resources and also mirrors their concerns that the lack of professional training will affect technology integration in schools negatively. It follows, therefore, that should this need be met adequately, the pre-service mathematics teachers surveyed will likely be more predisposed to integrating ICT into classroom instruction. Addressing this requirement for increased ICT use is therefore integral to the future of teaching with technology. This finding is consistent with findings in other countries such as Jamaica (Barrett, 2003). Equipment and hardware functionality are equally important to local pre-service mathematics secondary school teachers as indicated by its second position in the factor ranking with a mean score of 3.21. As Dias (1999) asserted, teachers can hardly be expected to utilise non-existent or faulty technology in their classrooms. By providing quality equipment and software for the purpose of ICT integration, these pre-service mathematics teachers indicated that they will likely want to utilise them in their classrooms. Both leadership and support are ranked in the middle with a 3.15 mean score for the former and 3.13 for the latter. The pre-service teachers surveyed therefore seem to consider these two factors important in ICT implementation in the classroom. This is also in agreement with the findings of some researchers who deem leadership, support, professional development and partnerships important factors that help teachers decide to what extent ICT is implemented in their classrooms (e.g., Cafolla & Knee, 1999; Knapp & Glenn, 1996; Kozma & Schank, 1998; Stevens, 1992).

Partnerships with external organisations and usefulness and worthiness of technology are the last two ranked factors with mean item scores of 2.96 and 2.95 respectively. These results indicate that the individuals surveyed do not necessarily feel that external partnerships are of utmost importance when it comes to future integration of ICT into their classroom practices. The leadership of schools is the entity that is most concerned with such partnerships in order to provide the funding for quality equipment and external training. As teachers might be more removed from this process, it therefore follows that they feel that they might not necessarily be affected by this factor. It also appears that the surveyed pre-service mathematics teachers are less affected by perceptions of usefulness than expected. This is not entirely in accordance with Ritchie and Wiburg's findings that the more teachers are convinced of the merits of using technology in the classroom, the more likely they are to harness it (Ritchie & Wiburg, 1994). It appears that while it is a factor that is worth considering (indicated by the mean score of 2.95 which is reasonably close to a neutral response of 2.5), these pre-service mathematics teachers do not consider it of utmost importance. Overall, the local pre-service secondary school mathematics teachers sampled found all the factors crucial to the ICT integration process, albeit at differing levels as evidenced by the differing factor mean scores. The rank of individual factors in order of importance was ascertained through the mean score of each factor. It is also worthwhile to note that teachers tend to share the same views as evidenced by the standard deviation of the individual factors (standard deviation ranges from 0.39 to 0.59).

Paired sample t-tests were applied to analyse the difference between mean scores of the factors. The results reveal that the mean score for Development was significantly higher than that for Leadership at the 5% level (Table 3). However, the difference between the top two factors, Development and Availability, was not significant at the 5% level. The only mean scores of consecutively ranked factors that yielded a significant difference at the 5% level are Support and Usefulness. On the whole, this demonstrates that the two most important factors are Availability and Development.

Table 4 presents the Pearson correlation coefficients between each of the six factors. The correlations between the factors range from 0.324 to 0.739, all of which are significant at the 1% level with the exception of professional development

Table 3
Results of paired sample t-tests on the four top-ranked factors

Pair	**t**	**Significance (2-tailed)**
Development – Availability	0.834	0.411
Availability – Leadership	0.859	0.397
Leadership – Support	0.220	0.827
Support – Usefulness	2.231	0.034
Partnership – Usefulness	0.008	0.993
Development – Partnership	4.334	0.000
Development – Leadership	2.276	0.030
Development – Support	2.238	0.033
Availability – Support	1.037	0.308

opportunities and usefulness and worthiness of technology (0.324). The reason behind the lack of correlation between development and usefulness is not clear. This finding, however, suggests that the instrument needs further refinement, perhaps in terms of the phrasing of certain statements in both the development and usefulness subscales. That the factors are highly correlated also suggests that the number of factors could be reduced. For instance, Support and Availability which are the most highly correlated could be merged into a single factor.

Table 4
Intercorrelation among factors

Scale	Useful-ness	Support	Avail-ability	Develop-ment	Leader-ship	Partner-ships
Usefulness	--	.541**	.508**	.324	.502**	.678**
Support		--	.732**	.617**	.677**	.610**
Availability			--	.554**	.739**	.553**
Development				--	.658**	.531**
Leadership					--	.591**
Partnerships						--
Total						

** Correlation is significant at the 0.01 level (2-tailed).

Conclusion

The purpose of the present study has been to field-test the CFS that has been developed to investigate secondary school mathematics teachers' perceptions of the importance of various factors that influence their use of ICT in the classroom. As well as obtaining feedback relating to the survey instrument, the results of the field-testing show that pre-service secondary school mathematics teachers generally agree that the following six factors are important in determining the degree to which they integrate ICT into their classroom practices: (a) teachers' perceptions of the usefulness and worthiness of technology, (b) support from various departments in the school, (c) availability and accessibility of technology, (d) professional development opportunities in technology, (e) leadership, planning and implementation of technology, and (f) partnerships with external organisations. Of the six factors, professional development opportunities ranked the highest followed by availability and accessibility of technology. Although other factors ranked lower than these two factors, they should not be neglected as they each recorded a mean score that is at least 2.95. If all these factors are addressed sufficiently in local secondary schools and in order of priority according to the ranking provided by pre-service secondary school mathematics teachers, it is clear that the pre-service teachers surveyed might consider utilising ICT with greater frequency and for more direct classroom tasks. The data obtained, while not representative of the entire pre-service secondary school mathematics teacher population, does provide a perspective from which key issues in the quality of education through the use of ICT may be addressed.

However, while the results do give an indication as to what pre-service secondary school mathematics teachers perceive are contributing factors to technology integration in the classroom, the results are not conclusive. Furthermore, although the survey instrument provides an avenue for honest responses based on anonymity, participants may express more socially acceptable opinions and therefore conceal their true attitudes (Oppenheim, 1992). Additional qualitative research is required in order to ascertain the details of teachers' perceptions for each factor specifically. Even then, the results would largely be subjective as it is difficult to obtain a "general" view of technology integration, given that ICT use is largely a personal classroom strategy issue. Nonetheless, research in this field would enable the leadership to take necessary steps towards providing better address the individual factors that teachers deem most crucial in the integration of ICT, thereby increasing its application and thus, usefulness in the classroom.

The present study certainly has limitations that are important to address in subsequent research. Possibilities for further enquiry could therefore include: (a) a wider sample of respondents; (b) a reconceptionalisation of the factors to be considered when integrating ICT into teaching, as well as (c) further identifying the constituents deemed important in each factor itself. Future in-depth qualitative studies should also be conducted to achieve theoretical triangulation. For example, in-depth interviews could be conducted to provide fuller explanation of the interesting patterns that have emerged from the quantitative data analysis.

It is also acknowledged that while it is perhaps easier to make some links between some factors and cultures of change, given that the intricate relationships that exist between teachers and school culture are widely documented in the current literature, more work needs to be done to establish the links between these six factors and the integration of ICT into teaching. Furthermore, it cannot be assumed that dispositions towards one area of change in a school would necessarily mean similar dispositions to all aspects of change. There is therefore a need to determine in future studies which features of the change are influenced by practice pertaining to each of the six factors in the context of ICT integration.

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Appendix
CRUCIAL FACTORS IN THE INTEGRATION OF ICT SURVEY

Part B: Perceptions of ICT Integration
The following are statements pertaining to ICT integration in the classroom. Please respond to these based on your personal experience and knowledge of your school.

Please indicate the ***extent to which you agree or disagree whether the statements below are important in determining the degree to which you integrate ICT into your classroom practices*** *by making a cross in the appropriate box.*

Scale:	**1** – Strongly disagree	**2** - Disagree	**3** - Agree	**4** – Strongly Agree

		1	2	3	4
1.	The use of technology in administrative work decreases the overall amount of time spent on these requirements in the teacher's job scope.				
2.	Additional personnel are provided for the supervision of students when the lesson is carried out in the computer laboratory.				
3.	Computer technology is readily accessible to teachers.				
4.	The school frequently provides in-house courses or workshops in ICT to supplement teachers' existing knowledge.				
5.	School leadership recognises and addresses fears and expectations concerning the impact of ICT use on teachers' workloads and routines.				
6.	Technological development opportunities are frequently provided by external sources. E.g., Texas Instruments, NUS				
7.	The use of technology in instruction benefits students academically.				
8.	Adequate instructional support is provided when required in the event technology is integrated into curricula.				

		1	2	3	4
9.	Electronic technological resources such as computers, projectors, software and hardware are readily available in the classroom.				
10.	Leadership readily recommends and approves in-service technology-related courses to teachers. E.g., courses provided by NIE				
11.	Teachers are actively involved in the placement and utilisation decisions of technological tools. E.g., computers				
12.	External organisations provide the leadership with assistance in making technology-based decisions.				
13.	The use of instructional technology in developing subject-related skill sets enables students to acquire them with relative ease. E.g., science process skills, mathematical problem solving heuristics				
14.	School leadership is supportive of the use of technology in instruction.				
15.	Hardware is consistently operational in the classroom.				
16.	In-service training in technology is an ongoing process that includes content-specific strategies that are linked to curricular goals.				
17.	Leadership accepts and seriously considers the suggestions provided by teachers in the use of ICT.				
18.	The school frequently forms partnerships with external organisations to conduct ICT-related projects for staff and students.				
19.	Students are actively engaged in the lesson when technology is used in instruction.				
20.	Administrative support is available to assist teachers in technology implementation within the classroom.				
21.	School instructional technology resources are organised				

		1	2	3	4
	and maintained well.				
22.	Opportunities are given for teachers to develop a comfortable level with technology.				
23.	Clear expectations for technology implementation drive purchasing decisions.				
24.	Students often visit ICT-related external companies to learn more about their operations.				
25.	The benefits of ICT integration in classroom instruction (e.g., content knowledge and skill acquisition, student engagement and self efficacy) far outweigh the constraints that it presents (e.g., logistics, classroom management).				
26.	Technical support is provided promptly whenever it is required and is largely adequate.				
27.	Web resources (e.g., subscription-based websites such as BrainPOP) and the Internet are available in the classroom.				
28.	The school technology specialist or teacher trainers provide technology development opportunities.				
29.	The technology planning process always includes teachers, students, administrators, parents and community members.				
30.	Work attachment opportunities are readily available for staff and students in ICT-related companies.				
31.	Students' use of technology provides them with other critical skills such as research apart from acquisition of content knowledge.				
32.	Quality of technical support provided by technical staff or the school technology committee is adequate.				
33.	Technology is readily accessible to students.				

		1	2	3	4
34.	In-service training in technology is developmental and geared towards individual staff member's degree of competency and readiness.				
35.	The school leadership is understanding of the practical constraints teachers face in the implementation of ICT in the classroom.				
36.	External ICT-related companies frequently conduct assembly talks for students based on their area of expertise.				