

OECD/CERT ICT PROGRAMME

A Case Study of ICT and Reform at School 2

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CONTENT PAGE

Overview

∨ Description of School	3
∨ Staff Profile	3
∨ Student Profile	4
∨ ICT in School 2	.....	4
∨ Reform in School 2	.....	5
The Past		
∨ History of ICT	.....	6
∨ History of Reform	.....	7
∨ Adopters of ICT and Reform	.....	9
∨ Barrier	.....	10
The Present		
∨ Use of ICT	.....	11
∨ Impact of ICT	.....	12
∨ Description of Reform	.....	14
∨ Impact of Reform	.....	15
Hypothesis 1	.....	18
Hypothesis 2	.....	20
Hypothesis 3	.....	22
Hypothesis 4	.....	25
Hypothesis 5	.....	27
Projection for Future	.....	28
Appendix A : Research Records	.....	A-1
Appendix B : ICT Practices Survey for Teachers	.....	B-1
Appendix C : Students Profile	.....	C-1
Appendix D : ICT-Reform Relationship	.....	D-1

Appendix E : Implementation Status of CTA System	.....	E-1
Appendix F : Performance Statistics	.....	F-1

Overview

Description of School

1. School 2 was established in 1963 as a private institution. In 1968, under an act of Parliament, it was given a new lease of life as a public institution. The campus is spread over 35.4 hectares of suburban land located in central Singapore. There are 14 academic departments and 11 supporting centres, including Advanced IT Application Centre, Computer Centre, Computer-Based Learning Centre (CBLC) and Continuing Education Centre.

2. School 2 offers over 20 business-related and technology-based diploma programs. In addition, part-time, specialist and advanced diploma programs are offered. To stay ahead and produce graduates who are well equipped for the workplace, School 2 continuously encourages new and innovative approaches in teaching

methods and curriculum.

Staff Profile

3. School 2 has a staff strength of about 800. The academic management team includes the Principal, 3 Deputy Principals, Director of Institute of Professional Development (IPD) and 14 Heads of Departments/Academic (HODs). According to the ICT Practices Survey for Teachers conducted in December 2000 through a sampling of lecturers drawn from all departments, most staff are comfortable with the following use of ICT : write a paper (96%), search for information on the World Wide Web (90%), send and receive email (97%) and present information (93%). 82% of them rate their ability in the use of computers as good. (See Appendix B : ICT Practices Survey for Teachers)

Students Profile

4. >From an initial intake of 116 students in 1968, the student population reached 14,378 in 2000. Statistics showed that 50% of students surveyed in 2000 came from middle-income families staying in 4 or 5-room flat. (see Appendix C : Students Profile).

ICT in School 2

1. In 1997, School 2 launched a 5-year *Multimedia Education Master Plan 1997 2002* with a mission to enable effective use of Information Technology, the Internet and multimedia for teaching and learning. The Master Plan recommended that teaching and learning resources be developed in tandem to achieve the following goals ¹ :
2. Goal 1 (Multimedia Learning) : To achieve 100% student participation in the use of Multimedia Technologies in learning within 5 years.
3. Goal 2 (Multimedia Teaching) : To achieve full staff participation in using Multimedia Technologies in teaching within 5 years.
4. Goal 3 (Multimedia Resources) : To address issues on organisation, production resources and infrastructure that are needed to support the above two goals.

These goals aim to steer School 2 towards the vision of ONE community . A campus-wide network named SCHOOL 2-Net was set up to achieve these vision and goals.

Reform in School 2

6. One of the initiatives under the *Multimedia Education Master Plan 1997-2002* is SCHOOL 2-ONE; an umbrella term coined to cover information technology initiatives for teaching and learning in School 2. The reform, SCHOOL 2-ONE, seeks to realise the vision of ubiquitous computing with learning taking place anytime, anywhere. SCHOOL 2-ONE aimed to provide a modern, more efficient and effective teaching and learning environment using the Internet technology with the following objectives¹:

- √ Develop life-long habit of independent and active learning and creative thinking.

1. Reduce staff marking and administrative load, eliminating Supplementary Examinations.
2. Increase graduate output through minimising attrition.
3. Create a wireless mobile computing environment to foster pervasive use of IT.

Our study at School 2 focused on two components of SCHOOL 2-ONE - Computerised Tutoring and Assessment (CTA) system and Mobile Computing programme.

7. Computerised Tutoring and Assessment (CTA) system is a learning environment using web-based technologies. The system aims to guide and monitor students online during supervised tutorial classes and unsupervised self-study periods. The Computerised Tutoring component is a self-paced, self-accessed multimedia learning program which supplements the tutorial classes for difficult examinable modules. In the Computerised Assessment component, students answer questions generated from question banks. These answers are graded automatically by the system.

8. Mobile Computing programme aims to create an environment whereby learning can take place anytime, anywhere. With notebook computers, students will be able to access the SCHOOL 2-Net and the Internet through strategically located access points within the campus. Mobile Computing programme serves to ease the resource constraints on the SCHOOL 2-ONE laboratory operations and to create ubiquitous use of ICT for education both within and outside campus.

The Past

History of ICT

9. School 2 anticipated that the development of ICT, electronic communication and electronic commerce through the Internet would radically change education and realised the need to strategise itself competitively.

10. In November 1996, the Multimedia Steering Committee, chaired by the Head of Maths and Science Centre (MSC) and made up of representatives from all academic departments and support centres, mapped the 5-year *Multimedia Education Master Plan 1997 2002* to enable effective use of ICT, Internet and Multimedia for teaching and learning. To achieve this mission, the goals of empowering 100% of the students with core ICT skills for learning, empowering all staff in the use of multimedia for teaching and preparing the organisation and infrastructure support were formed.

11. To realise the three goals, three Multimedia Sub-Committees (Learning, Teaching, and Production) were tasked to map out the action plans each working towards a goal. These action plans include development of multimedia learning programmes, computerised tutoring and assessment system, re-training of staff in handling multimedia teaching, computerised management system and mobile computing. A fourth group, Multimedia Technology Sub-Committee, focuses on organisational, technology and infrastructure issues that need to be addressed in considering and implementing multimedia education in School 2. (Refer to Appendix D for graphical representations)

12. A centralised body called the Information Technology Coordination Committee (ITCC) was set up to coordinate the various sub-committees. Problems and issues faced across these sub-committees would be surfaced and sorted out by ITCC.

History of Reform

13. In July 1995, the Mathematics and Science Centre piloted online Mathematics tutorial system involving 6 laboratories serving about 2000 students. Other computer-aided instruction (CAI) projects like SCHOOL 2-Maths & Tutor-Me were also launched. These projects found that a self-paced and self-access learning platform was effective in dealing with the learning difficulties of weak or unmotivated students³. The findings led to the conceptualisation of the Computerised Tutoring and Assessment (CTA) system by the Multimedia Learning Sub-Committee. The implementation was formalised as an initiative under the SCHOOL 2-ONE.

14. In March 1997, the development effort focussed on creating a hybrid version of the CTA system by extending the existing window-based tutoring software with a new database and Web-based management information software. It was used for 5 pilot examinable modules chosen by 5 participating departments. A Web version of CTA was developed for full implementation. 8 phases were mapped from Jan 1998 to Jan 2005 to implement the tutoring and assessment system progressively by semester. 12 examinable modules and 9 tutorial modules were implemented during Phase I in 1998. By Phase III in 2000, the modules implemented increased to 133 examinable modules and 74 tutorial modules. It was targeted to implement computerised assessment for all examinable modules (estimated at 400 modules) by year 2005 and to selectively implement computerised tutoring for about 25% of the examinable modules. (See Appendix E for Implementation Phases)

15. Mobile Computing programme was rolled out progressively in parallel with the CTA system. The Accountancy Department was selected to pilot the Mobile Computing Programme because ICT was already being used extensively by their staff who had business background. During the pilot phase, the school provided notebook computers to all first-year students. Subsequently, all future first-year students were required to purchase a notebook computer. During the implementation of Mobile Computing programme, the management also provided schemes to help students with financial problems (family income below S\$1500) to pay for notebook computers or lease notebook computers from the school at a nominal fee of S\$60 per semester. It was targeted to complete by 2005 extending to the whole campus population.

16. Most staff interviewed agreed that the reform was greatly supported by the top management. Strong support committees were put in place to help different departments to embark on the reform. According to Admin 3, we have top level support in the sense that the management are very conscious of the importance of ICT. (21 Nov 2000) The estimated cost of the reform was about \$5 million. The management also sought additional funding from the Ministry of Education, TOTE Board⁴ and other sources of funding. Admin 2 also commented, ...the top management because they have the vision...have been very supportive in providing funds to ensure that departments can move in this direction... (8 Jan 2001) All staff was provided with an email account and personal computer or notebook computer each.

17. Briefing and training were provided for whenever new initiatives were rolled out. As mentioned by Admin 4, The support for training was good. (13 Dec 2000) For example, lecturers who devised questions for the question bank in the CTA system attended a refresher course on design of instructional objectives and the writing of test items. Independent item-review committees were set up to evaluate test items for content, wording, typo-errors and relevance to the instructional objectives. An analysis team would analyse the test items based on students comments and performance. Test items would then be fine-tuned.

Adopters of ICT and Reform

1. About 70-75 % of the courses conducted in School 2 are technology courses (e.g. Electrical/Civil/Computer Engineering, Multimedia Computing, Information Technology). These staff have ICT background already. As Admin 3 commented, ICT is a given (21 Nov 2000). There were pockets of people from Mechanical Engineering and Maths & Science Centre (MSC) trying out computerised-aided instruction (CAI) projects even before the launch of the Multimedia Master Plan. These groups of people were self-driven, adventurous, IT savvy and are willing to take risks (8 Jan 2001) as described by Admin 2. Most of the staff from these departments used ICT as part of their normal teaching duties.

Barriers

1. However, some staff resisted the reform. These staff were mostly not trained in ICT and they were older and did not use computers for their everyday work (21 Nov 2000) as commented by one of the administrator. According to another administrator, some staff were very cautious and required a lot of

convincing before embarking on the reform. Both noted that the management had to convince this group of people through the HODs, course managers and module leaders. These staff required details of the reform to be clearly spelt out. The management also shared success stories to encourage and motivate the staff. Others who resisted the reform were not convinced by the effectiveness of the CTA system. As noted by an administrator and staff member interviewed, some staff members questioned the validity of using computers for assessment. One of the staff members indicated that there was a similar system available which was developed much earlier than the CTA system and had more features. (27 Jan 2001)

20. Admin 2 mentioned that CTA required a lot of time on the part of the teaching staff to put up their items, to design their items, to develop and computerised their materials for the tutorial...so time is actually the main factor here. (8 Jan 2001) From the staff's perspective, time is required to develop very good package...it's not easy. (SM3, 27 Jan 2001)

1. Not all the computer laboratories could be used for computerised assessment under the CTA system. Scheduling these tests was a problem for the staff due to insufficient facilities. Under SCHOOL 2-ONE, there are plans to build more computer laboratories to accommodate the heavy usage. Mobile Computing programme was another strategy to overcome this problem.
1. The CTA system is very dependent on the technical status of the server. As pointed out by one staff member interviewed, if the server is down or the response is very slow, then students may even be asked to come back on another occasion for the test. (SM1, 27 Jan 2001) This view is supported by the students interviewed, if there is a lot of classes having the same server....the question pop out very slow...really very slow. (Student 3, 27 Jan 2001) and this affect badly for students performance (S5, 27 Jan 2001).

Present

Use of ICT

1. Lecture notes are posted onto the SCHOOL 2 Net server and students are able to access them through a web browser. With the provision of a dialup account for every student, they are able to communicate with their peers and lecturers for queries and to submit their assignments even from home. All students in the interview agreed that we learn from there [SCHOOL 2 Net] all the notes...Power Point slides, graphics...pose our answers through the discussion data base and...comment on each other answers. (S3, 27 Jan 2001) The staff observed that the students use a lot of this [ICT] to chat with their friends and to consult their tutors...open up an avenue for them to learn. (SM1, 27 Jan 2001)
1. Staff use the campus system SCHOOL 2 Net for administrative purposes like applying for leave electronically, posting messages through emails as well as for academic purposes like preparing lecture notes, posting assignments and projects. As a staff member remarked, in fact, basically, all my work are done through ICT...at most I jot down some points, the rest is all computer... (SM3, 27 Jan 2001)
1. Training, both formal (attending conferences, seminars, postgraduate courses) and informal (lunchtime sharing) are incorporated as part of staff development. The management provided funds to conduct in-house courses, organise forums/discussions and bring in consultants to help the staff. Staff were encouraged to share their knowledge/experience during lunchtime with other staff either from the same department or different departments. As Admin 2 commented ...we have what you call lunch time seminar and we invite people who have gone on this initiative to come on board to share problems, share how they actually get themselves prepared for such initiatives, what have they done, and staff

attending could actually learn from them... (8 Jan 2001) Admin 3 initiated such sharing sessions during the first two years of implementation. It was evident that these sharing sessions were beneficial as more departments began to organise their own sharing sessions. According to the administrator and teacher interviewed, ...they have come up and organise their own in-house seminars...and they have even open it up to other departments... (Admin 2, 8 Jan 2001) and ...share...what they have done and then through their sharing sort of like encourage the other staff to hop on to the same thing...so it has been quite successful. (SM4, 27 Jan 2001)

Impact of ICT

1. Students interviewed shared that the accessibility of lecture notes and communications with friends and lecturers is convenient and useful. As one student said, posting of lecture notes on the Internet is a very good idea because you can access it anywhere. (S7, 27 Jan 2001) Another student commented about the ease in communicating with the tutors when there are queries ...we have the assignment...email the tutor regarding the assignment...they respond quite quickly (S8, 27 Jan 2001). This impact of communication on learning was also supported by the staff interviewed. One of the staff members commented that communication with students and amongst staff has improved. (SM1, 27 Jan 2001) Another staff member added that ...students can email us easily if they have a problem or they find that there are mistakes in the notes... (SM2, 27 Jan 2001).

1. This communication network also encouraged group learning through discussions and consultation as noted and agreed by some students that we have to discuss projects...send details to our team leader...communicate with our group members (S6, 27 Jan 2001). Staff also shared that when we have discussion data base, the students have to put up their answers and they get feed back like comments from other group members as well as from the tutors themselves. (SM1, 27 Jan 2001)

1. However, some students noted that they prefer to print out lecture notes and make copies of the notes. One students elaborated this strategy, in order to cut cost [of accessing the Internet], we will just assign a person to just go in and download the notes and print out. (S4, 27 Jan 2001) Some prefer to access the Internet at campus rather than from home for a similar reason. That could also explain the heavy usage of computers in the campus.

1. >From our site visits, at the canteens and meeting places for students, we observed a substantial number of students (both individually and in groups) accessing the Internet, SCHOOL 2 Net and working on their assignments using notebook computers at various access points. This heavy usage of ICT in campus is also evident as students have difficulties accessing the computer laboratories even with the current access time from 8 a.m. to 9 p.m. As one staff member observed, There are a lot of students complaining that they don t have access to the computer meaning that whatever available time that they have, they would try to reach the computers to do some work. (SM2, 27 Jan 2001)

Description of Reform

30. The CTA system, based on guided and mastery learning methodology, is embedded with the notion of continuous topical assessment and core competency test for each of the examinable modules. Content for the Tutoring component and test items for the Assessment component were created and coded by lecturers with assistance from the programmers from the various supporting centres. (Refer to Pg 1). With the implementation of CTA, School 2 has progressively eliminated the need for supplementary examinations.

31. The Tutoring component serves to supplement difficult modules with notes, multimedia activities and trial tests so that students can learn and re-learn concepts. This free access to the content aims to encourage better

students to get ahead with certain modules and spend more time on other activities. As quoted by a student we can access the data base any time we want, 24 hours around the clock. (S2, 27 Jan 2001) It also provides students with adequate learning time to digest the content taught in lectures without increasing the staff tutoring workload. Students are allowed to take as many trial tests as [they] want (S1,S2, 27 Jan 2001) until they are confident to be assessed. Students who do not attain the core competencies prescribed in each module are guided and allowed to continue practising.

32. The Assessment component aims to assess and monitor students understanding of concepts. Students progress and performance can be monitored with information pertaining to students personal statistical data (e.g. Department, Module, Group Level), time spent on each question and their responses. Through this performance feedback, the system calibrated test items according to difficulty level to enhance the quality of computerised assessment. Students need to achieve 80% or more for each assessment needed to complete a module before proceeding to take the final written examination for grading purposes.

33. To support the operations of CTA system, the SCHOOL 2-ONE Operating Team, comprising an operation manager, a network manager and a system manager, is formed. This Operating Team also oversees a group of 40 technical support officers who man 46 computer laboratories under the CTA programme. The technical support officers were employed to help staff and students handle technical problems. In addition, each department has its own technical support officer.

34. Under the Mobile Computing project, students own notebook computers which can be connected to the campus network SCHOOL 2 Net. To date, about 2000

students own notebook computers. Currently, School 2 is implementing the wireless access system. The existing and new classrooms will be fitted with wireless network access points. These rooms can be used as conventional classrooms as well as computer laboratories using mobile computers.

Impact of Reform

1. Of the 400 modules offered, one-third is in the form of computerised tutorial. Lecture notes are placed online for the students to access anytime, anywhere. This reform has promoted independent learning as one of the staff members highlighted ...they are more independent now and what I like is that they always come back to me with alternatives ... (SM2, 27 Jan 2001). Another staff member agreed, they will be more independent...go into the web and look for information rather than just wait for notes to be given. (SM1, 27 Jan 2001) Students interviewed shared their views about independent learning using CTA system, ...they will just teach us and then we will be left to do our revisions through the...tutoring system. (S2, 27 Jan 2001) and because like there s certain things [information] you want to find quickly...you want to go and surf the Internet...get information from the whole system. (S8, 27 Jan 2001)

36. The staff felt that their workload has been considerably lightened. One staff member summarised, ...after it becomes computerised...marking is taken out of the work load, so right now, the members are very happy with it. (SM2, 27 Jan 2001)

1. Students are motivated to learn continuously through the use of ICT. One of the students was motivated to use the CTA system, ... CTA helps most of us to easier to pass [the assessment]. (S3, 27 Jan 2001). Admin 2 commented that it [ICT] makes learning more interesting for the students...students are more empowered. (8 Jan 2001) Another staff member said about continuous learning, because of the Tutoring [component], students are guided in their learning...don t have to lay off studying until end of the year or just before the test. (SM2, 27 Jan 2001)
1. However, it was also noted by the students that the Assessment component in CTA system only awards marks for the correct answer and not for the working. If the answer is just wrong even though you know how to do the working, you will actually get zero mark for the answer. (S4, 27 Jan 2001)
1. One student shared on the impact of the Mobile Computing programme, students also do more research, more projects using the mobile computing and computers... (SM4, 27 Jan 2001)

1. However, the Mobile Computing programme also brought about added responsibility for students. One student said, Out of 5 days, I carry the laptop for 4 days and it is ...really heavy although it is on the average about 3 kg... (S5, 27 Jan 2001) Security of notebook computers also posed a problem for students.

Hypothesis 1

Technology is a strong catalyst for educational innovation and improvement, especially when the World Wide Web is involved. The rival hypothesis is that where true school-wide improvement is found, technology served only as an additional resource and not as a catalyst, that the forces that drove the improvements also drove the application of technology to specific educational problems.

1. In our study of the reform, there is evidence to show that technology served as an important resource to support the reform. By virtue that the reform is technological in nature, the use of web-based technologies is imperative for School 2 to realise the vision of ubiquitous computing with learning taking place anytime, anywhere. However, there are other forces that drove the reform and the application of technology.
1. One of the driving forces is the anticipation that the workforce of the future require technological skills. School 2 felt a need to prepare and develop their graduates to be relevant to this workforce by equipping them with ICT skills. As put forward by Admin 3, ...the purpose of the reform is to ensure that students are using computers effectively while in the process of learning ...by the time they graduate, they are already well versed in computing and be able to apply whatever they learned into the job immediately...so this is what we want to see. (21 Nov 2000). This driving force not only plays an important role in the conceptualisation of the reform but also kept the reform moving by improving the existing technologies and exploring new ones such as Artificial Intelligence. Another staff member mentioned, ...because the whole world is moving that direction. In a way, we have no choice. We got to try even though we may not get successful first round, second round... (SM3, 27 Jan 2001).
1. Another driving force is staff s motivation. The staff believed that the use of ICT for teaching and learning is beneficial for both the students and staff as reflected in the section on the impact of ICT and reform. (Refer to Pg 12, 13 and 16). As Admin 2 noted, ...whatever development they are doing in this area of ICT, it enhances teaching and learning...it is ultimately going to benefit your students...that is a good justification and motivation for the staff. (8 Jan 2001) Another motivating factor for staff in driving the reform is the lightening of workload. As one staff member shared, ...it sorts of relieves my load a fair bit... (SM2, 27 Jan 2001) It was also noted that the number of planned modules to come on board the CTA system is more than what was planned in the first 3 years of implementation from 1998 to 2000. (See Appendix E : Implementation Phases). This was due to staff members who volunteered to come on board earlier, an indication of their high motivation level (Admin 3, 31 May 2001).
1. Therefore, although technology serves as a platform for the reform, what actually drove the reform was the school s belief that the use of technology was inevitable; indeed the use of technology is critical, whether it is to prepare their students for the future workforce or to enhance teaching and learning.

Hypothesis 2

The diffusion of the innovation/improvement (and therefore of ICT) followed the traditional diffusion pattern for innovations, as outlined by Rogers (1995). The rival hypothesis is that technology functions differently from traditional innovations and that therefore different diffusion patterns occur.

1. There is evidence that the diffusion pattern of the reform basically follows the traditional diffusion pattern outlined by Rogers (1995).
1. The management's intention was to roll out the reform in phases. (Refer to Appendix E: Implementation Phases). They worked out, using linear regression, the number of modules which should be computerised over 8 years, in order to achieve the target of 400 assessment modules and 120 tutorial modules. (Refer to Pg 8).
1. During Phase I of the implementation, five departments with staff of strong ICT background and competency level were identified to come on board early and act as role model for other departments to encourage them to come on board. As mentioned by Admin 2 who was also in the Steering Committee, we identify suitable departments particularly department that we know will be good role models....to encourage others ... (8 Jan 2001). They were the early adopters of the reform. Besides the 5 selected departments, other departments decided when to come on board and which modules to computerise, based on guidelines provided by the committee. One of the selection guidelines for computerised tutoring and assessment modules is that the modules must involve a large population of students. The decision to come on board was made by the module leaders and endorsed by their respective Heads of Department.
1. By the end of Phase II of implementation, all departments were involved in the reform except for Film & Media Studies department due to the nature of their modules which did not lend themselves to computerised assessment and tutoring. The actual number of modules embarked on the system was much higher than planned during Phase II and III as more module leaders volunteered to go on board. (See Appendix E: Implementation Phases). It was during these two phases that the majority of the departments were involved in the reform.
1. Within each department, some staff members were not willing to embark on the reform and they were the late adopters who were very cautious and required a lot of convincing.

Hypothesis 3

Successful implementation of ICT depends mostly upon staff competence in the integration of ICT into instruction and learning. This hypothesis assumes that teachers mediate ICT applications when they are successful, and that ICT's academic value relates positively to teacher competence. The rival hypothesis is that the school technological infrastructure and student ICT competence rather than staff competence determine ICT implementation outcomes.

1. In School 2, successful implementation of ICT depends not only on staff competency but also on the technological infrastructure and student ICT competencies.

1. About 70-75% of the courses conducted in School 2 are technology related. Staff in these departments were already equipped with necessary ICT skills (using word processor, search for information on the World Wide Web, send and receive email and present information using PowerPoint etc) as they have been using ICT extensively for their teaching. These staff acted as role models for others in using ICT for teaching. Sessions were organised for staff members to share with other departments the difficulties they encountered in the implementation of new initiatives and their strategies in overcoming these barriers as well as success stories to encourage other staff members. Feedback from staff were good and there was also an increase in the number of departments organising such sharing sessions. In this reform, staff are required to design web-based teaching materials, create test items, facilitate on-line discussions and communicate with students through e-mailing. Trainings were provided to staff when the reform was implemented to equip them with the necessary skills. All new staff members were required to attend basic courses in which they were inducted into using IT in teaching and learning. This shows that School 2 put a lot of emphasis on staff competency. In School 2, staff need to be equipped with certain level of ICT competency as Admin 2 commented that "...in our recruitment...we now recruit people with certain basic IT skills. So that they are not afraid of using IT in their teaching. (8 Jan 2001) Staff were also encouraged to upgrade their IT knowledge through 250 web-based IT modules available on-line whereby they can access them anywhere and anytime.

1. Student ICT competency also played a critical role in successful implementation of the reform. School 2 strategised the reform to focus their beginning effort on students as they felt it would be able to drive the staff in adopting the reform. As Admin 3 said, by focusing on the e-learning, we ensure students are learning from the computers in a very rapid pace and they get the benefits ...then influence the teaching later on. (21 Nov 2000) Although there was no quantitative evidence to determine the competency level of students, our classroom observations, site visits and interviews show that students were comfortable with the use of ICT in their learning. All students use ICT for communication, discussions, receiving and submission of assignments, indicating a level of competency. One staff member observed that, students [are] perpetually using the computers...even in classroom presentation...using PowerPoint, Microsoft Word and Excel to present their answers... (SM1, 27 Jan 2001)

1. Technological resources and infrastructure is another key factor towards successful implementation of ICT. It was noted by students and staff members that the lack of facilities is a barrier in the implementation. School 2 realised the importance of this key component and has invested to build and convert more rooms to computer laboratories. The move towards Mobile Computing to ease the constraints on the computer laboratories is another indicator of the importance of sufficient infrastructure. There is also strong technical support in School 2 as one staff mentioned, "...we have our own department technical officer that attends to the hardware, software problems and also if it has got to do with the note book then they have to go back to the vendors but when it comes to [SCHOOL 2 ONE] is more CBLC and MSC [Mathematics, Science and Computing] that will look into the

operational side of it. (SM1, 27 Jan 2001)

Hypothesis 4

Gaps in academic performance between high and low ability students will not increase when all students have equal access to ICT. The rival hypothesis is that equal access to ICT will lead to high ability students increasing the performance gap with low ability students.

1. Evidences gathered in our study do not support hypothesis 4 or its rival.
1. In School 2, high and low ability students have equal access to ICT. Lecture notes and tutorial material can be access campus-wide by any students. Students involved in the Mobile Computing programme each has a notebook computer and can get access to ICT anywhere in the campus. Students without notebook computer were able to access the computer facilities until 9 p.m. All students were able to access from home as each was given a dialup account.

56. According to staff interviewed, all students benefited from using ICT although the low ability students were likely to benefit more as compared to the high ability students. Admin 3 said that The CTA program...better support the weaker students ...because that give them the framework, the boundary for them to learn... (21 Nov 2000) Another staff member said, It gives weaker students more opportunity and time to learn at their own pace. (SM1, 27 Jan 2001) Low ability students felt more confident when they were able to retake their tests until they achieved the required grade before taking the final examinations. As noted by one staff member, the weaker students will benefit from this more because they are given a chance of re-test it also means that their score can improve ... (SM1, 27 Jan 2001).

1. Beyond the CTA system, all students learnt to be more independent and source for relevant information from the Internet for their projects. Students were able to email their queries and assignments to their lecturer and vice versa. ICT allows them to explore and learn through discovery.
1. Such benefits do not necessary register in academic performance as proposed in hypothesis 4. Moreover, equity in access to ICT may not be the only factor that affects the academic performance gap.

Hypothesis 5

The use of ICT will lead to the same or higher academic performance. The alternative hypothesis is that ICT use will lead to a lowering of academic standards.

1. Evidences gathered in the study show that the use of ICT leads to higher academic performance. However, it is noted that the use of ICT may not be the sole factor that leads to higher academic performance.
1. A comparison between students failure rates in two groups of examinable modules one group under CTA system and the other group consisting of the rest of the examinable modules not on board the CTA system was done over 2 academic years from July 1995 to January 2000. [Refer to Appendix F : Performance Status]
1. It is noted that the average failure rates of both groups dropped marginally over the years although the SCHOOL 2-ONE CTA group has a faster drop of failures. This strongly suggests that the students have benefited from the learning experience under School 2-ONE. On the other hand, it is noted that there is a drop in failure rate among those non-SCHOOL 2-ONE group. This positive impact may not necessarily be solely attributable to SCHOOL 2-ONE but is indicative in nature.

Projection of Future

1. Emphasis is given to benchmark and measure the progress of the Master Plan consistently by achieving the ISO 2000 and implementing quality management system. School 2 wants to learn from the findings of the progress gauges to further improve future plans. Currently, there are plans to set up SCHOOL 2 Net 2, a broad band network campus-wide.
 1. There are also plans to explore assessment using the wireless mobile computers and making an improved version of the CTA system that includes features like marking essay and implementing adaptive proficiency tests.
 1. A committee, e-School 2, has been set up to update ICT initiatives and chart future direction. Harnessing ICT for administrative purposes, School 2 will be focusing on e-administration to explore newer ways of managing administration procedures. On a bigger scale, School 2 has the intentions to encapsulate e-learning and e-teaching under the term e-Education and to integrate the e-Education with the e-administration so that the use of ICT would steer towards their vision of ONE community .
 1. In view of the fact that the school does continual benchmarking and evaluation of their Master Plan, has definite future plans, and has set up a new committee to look at future directions, it is highly likely that the reform will be sustained and even improved on .
1. *Multimedia Education Master Plan 1997 - 2002*
 2. Presentation Slides by Head of Department/Maths Science Centre
 3. *Multimedia Education Master Plan 1997 - 2002*
 4. TOTE Board is an additional funding source for schools and institutions embarking on specific educational initiatives.

Appendix A : Research Records

Research Team

Manonmani Mookaiah (Leader)	Senior IT Instructor IT Training, Educational Technology Division
Jumaliah bte Ahmad (Assistant Leader)	
Lim Li Kiang	
Willy Tan	

Period of Study

Contact Period	Date(s)
First contact	2 Nov 2000 2 hrs
Data collection period	2 Nov 2000 27 Jan 2001
Follow-up contact (e.g. verification of data)	28 Dec 2000 31 May 2001

Summary of Data Collected

Type & Quantity of Data	Average time spent	People involved
4 Interviews	2 hours per interview	4 Administrators
4 Focused Group discussions	2 hours per discussion	4 staff members and 8 pupils
2 Classroom Observations	3 hours per observation	1 teacher and 80 pupils
School's IT programme	3 hour reading	N.A.
School's web site	1 hour reading	N.A.

Legend of Data Sources

Admin 1	Deputy Principal/Academic
Admin 2	Director / IPD
Admin 3	Head / Maths, Science & Computing Centre
Admin 4	Head / Accountancy
SM1, SM2	Staff Members involved in reform
SM3, SM4	Staff Members not involved in reform
S1 S5	Students involved in reform
S6 S8	Students not involved in reform

Appendix B : ICT Practices Survey for Teachers

OECD/CERI ICT PROGRAMME

ICT Practices Survey for Teachers at School 2 (Figures in Percentages)

Number of staff members surveyed: 59

Percentage of staff members from total staff: 7.3%

A How comfortable are you with using a computer to do each of the following?

Ratings: 1 - Very Comfortable 2 - Comfortable 3 - Somewhat comfortable 4 - Not at all comfortable

	1	2	3	4
1 write a paper	71	25	3	0
2 search for information on the World Wide Web (WWW)	66	24	7	3
3 create and maintain web pages	25	22	36	17
4 use a data base	27	32	36	5
5 develop a data base	19	32	34	12
6 send and receive e-mail	83	14	2	2
7 write a program	27	20	34	19
8 draw a picture or diagram	44	36	15	3
9 present information (e.g., use PowerPoint or equivalent)	61	32	2	2

B How important is each of the following computer-related skills for your teaching?

Ratings: 1 - Very Important 2 - Important 3 So-So 4 - Not important at all

	1	2	3	4
10 write a paper with a word processor	2	3	5	7
11 search for information on the WWW	69	22	8	0
12 create Web pages	53	32	12	0
13 use a data base	15	36	29	17
14 develop a data base	14	41	36	10
15 send and receive e-mail	5	31	49	15
16 write a program	78	14	5	3
17 draw a picture or diagram with a graphing/drawing application	14	24	37	25
18 present information (e.g., use PowerPoint or equivalent)	32	36	22	10

C During the past school year, how often did your students on average do the following for the work you assigned?

Ratings: 1 Several times each week 2 Several times each month 3 A few times 4 - Never

	1	2	3	4
19 use the World Wide Web	25	36	27	12
20 create web pages	3	8	37	36
21 send or receive e-mail	24	31	32	5
22 use a word processing program	32	51	10	7
23 use a computer to play games	17	3	12	61
24 use a spreadsheet	7	20	36	34
25 use a graphics program	12	8	53	25
26 join in an on-line forum or chat room	7	10	39	39
27 use a presentation program (e.g., PowerPoint)	5	34	39	22

28 use an instructional program (including simulations)	15	12	25	39
29 other computer uses (please specify)	7	10	14	10

			Good	Fair	Poor
30	How would you rate your ability to use a computer?		82	16	2
Answer questions 31 - 38 based on experiences or policies from the last school year.					
				Yes	No
31	Was student computer use ever evaluated for grading?			59	41
32	Did you create or modify a Web site with any of the classes that you taught?			36	64
33	Did you participate as a student or instructor in a virtual course through the Internet/World Wide Web?			41	59
34	Did you involve your students in collaborative learning over the Internet/World Wide Web with students from other classes?			17	83
		all	most	some	little
35	What portion of the computer use in your classes was directly related to the course content?	22	42	32	3
36	What portion of the computer use that you assigned was done by students individually?	16	41	36	7
		some restrictions		designated sites only	
37	If you assigned World Wide Web searching, how much freedom did you allow students in locating sites to visit?	75		25	
		several times a week	a few times	never	no computer
38	If you have a computer at home, how often did you use it for preparing for teaching?	50	39	3	8
				Yes	No
39	Are you currently using technology to collaborate with other teachers (professional chat rooms, forums, network system or the like)?			37	63
		> 12	6 -11	1 - 5	none
40	How many e-mail messages do you send each week on average?	86	10	3	0
How many of the following have you ever done? Please tick the appropriate boxes.					
41	made changes to a computer s hardware				39
42	updated an application program (word processor, graphics program, etc.)				73
43	recovered a damaged file				54
44	created a web site				49
45	developed a data base				39

Appendix C : Students Profile

Data obtained from survey conducted by School 2

Appendix D : ICT-Reform Relationship

Adapted from Multimedia Education Master Plan of School 2

Appendix E : Implementation Phases of CTA System

SCHOOL 2-ONE Phase	Semester	Tutorial Modules for Computerised Tutoring		Examination Modules for Computerised Assessment	
		Actual	Planned	Actual	Planned
I	Jan 1998	9	9	12	12
II	Jan 1999	61	25	75	67
III	Jan 2000	74	41	133	123
IV	Jan 2001	85*	57	193*	178
V	Jan 2002	98*	72	219*	234
VI	Jan 2003	108*	88	228*	289
VII	Jan 2004	120*	104	258*	345
VIII	Jan 2005	123*	120	261*	400

Data obtained from Powerpoint presentation by HOD/MSC

* Prorated linearly from Phase III data

Appendix F : Performance Statistics

Data obtained from Powerpoint presentation by HOD/MSC