

ICT in Singapore's Education System

LEE Hui Fen Fiona^{*}, NOZAKI Hironari^{**}, UMEDA Kyoko^{***}

INTRODUCTION

Information technology has changed the world and it has connected people globally. Information became more accessible, making learning more dynamic in nature. These rapid technology developments and an increasing globalization have caused impacts on the education system. There is a need to change the education system in order to meet the needs of the students and to prepare them for the future where they will face many new challenges and opportunities. The learning culture of the classroom and school has thus shifted to better support independent learning among the students. The students need to be equipped with 21st century competencies like constantly seeking for new knowledge, knowledge generation and application, problem identification, critical thinking, creative thinking, innovative thinking, reflective thinking, ability to work as a team, etc. ICT is a valuable tool that can enrich the learning environment and better engage the learners. Education can also be customized using ICT to meet the needs and abilities of the students, thus developing lifelong learners. The Singapore Ministry of Education has thus developed 4 ICT Masterplans with the vision of enriching and transforming the learning environments of the students and equipping them with the critical competencies and dispositions to succeed in a knowledge economy.

DESIGN & METHODS

According to the information given by the Singapore Ministry of Education (2009, 2010), the vision, outcome goal and strategies of each masterplan will be described. Being a teacher from the year 2008 during the implementation of the second masterplan, the school's ICT mentor and cyber wellness co-ordinator from the year 2010, and the Subject Head of the IT department from the year 2012 during the implementation of the third Masterplan have allowed me to gather feedbacks and understand the difficulties faced during the implementation of each masterplan. These feedbacks and problems are being discussed in this paper as well.

1. First Masterplan for ICT in Education

The first masterplan for ICT in Education (1997 – 2002) laid a strong foundation for schools to harness ICT, particularly in the provision of basic ICT infrastructure and in equipping teachers with a basic level of ICT integration competency. The first masterplan aimed to enhance linkages between the school and the world around it so that teachers and students

^{*} Graduate student, Teacher Training Course, Aichi University of Education

^{**} Department of Educational Administration and Governance, Aichi University of Education

^{***} Department of Information sciences, Aichi University of Education

would be able to gain richer perspectives from communicating and collaborating with their counterparts as well as other organisations from around the world. The first masterplan also aimed to enhance creative thinking, lifelong learning and social responsibility as well as to develop innovative processes in education. Through ICT-based learning strategies, activities and experiences, it would help students to learn to think flexibly and innovatively, work well with others and exercise sound value-based judgements. Another goal of the first masterplan was to promote administrative and management excellence in the education system. ICT would enable school administration and educational management to be more efficient and effective. These goals were translated into four key dimensions: curriculum and assessment, teacher development, learning resources, and physical and technological infrastructure. The curriculum was shifted towards better balance between acquisition of factual knowledge and mastery of concepts and skills where students were encouraged to participate in more active and independent learning. Assessment modes that measured abilities in application of information, analysis and communication skills were included. All teachers were trained in purposeful use of ICT for teaching and new teachers were equipped with core skills to include the use of ICT in teaching. A range of educational software was developed and acquired to meet curriculum needs and use of relevant internet resources for teaching and learning were facilitated. Schools collaborated with institutions of higher learning institutions and industry organizations in providing training to teachers and developing meaningful and relevant resources. A system of convenient procurement to help schools obtain hardware and software easily and on time was designed. All schools would have a physical and technological infrastructure with a pupil-computer ratio of 6:1 for primary school and 5:1 for secondary school and junior college. Students were provided with access to ICT in all learning areas in the school and all schools were linked through the wide area network which enables high speed delivery of multimedia services on an island-wide basis.

From the feedbacks gathered from teachers during the implementation, I discovered that the following issues were observed. The provision of basic ICT infrastructure for all schools was carried out in phases and so some schools were only able to use ICT for teaching at a later stage. By the year 2000, teachers in all schools had received training in usage of ICT for teaching. Generally, most teachers had accepted ICT as a pedagogical tool in the classroom and had tried to carry out ICT-based teaching and learning activities in class. However, teachers still found it challenging and difficult to integrate ICT into the lessons as many felt that it was time-consuming to create and conduct ICT-based lessons and so would prefer to continue teaching using the traditional methods. As a result, not many ICT integrated lessons were conducted. Despite the challenges faced, there were still some pockets of excellence in the usage of ICT in teaching among some teachers and schools and these were used as reference models for others and for further innovation.

2. Second Masterplan for ICT in Education

The second masterplan for ICT in Education (2003 – 2008) built on the foundation of the

first Masterplan to strive for an effective and pervasive use of ICT in education to enhance educational processes and structures by strengthening the integration of ICT into the curriculum, establishing baseline ICT standards for students, and seeding innovative use of ICT among schools. To achieve the overall vision of “Thinking Schools, Learning Nation”, lifelong learners would be supported and developed by leveraging on ICT as an educational tool to customize education to meet the needs and abilities of the students. The second masterplan had six intended outcomes: students used ICT effectively for active learning, connections between curriculum, instruction and assessment were enhanced using ICT, teachers used ICT effectively for professional and personal growth, schools had the capacity and capability in using ICT for school improvement, there was an active research in ICT in education and there was an infrastructure that supported widespread and effective use of ICT. In order to achieve the intended outcomes, the second masterplan focused on establishing baseline standards for students’ learning experiences, teachers’ ICT integration practices, head of departments’ ICT planning practices, ICT infrastructure requirements and digital resources to ensure that all schools achieve a baseline level of ICT use. Schools that were ready to achieve higher levels of ICT use in education were fully supported by introducing more recognition schemes and conducting further research on developing and prototyping pedagogical models. Schools’ capacity was developed within the framework of autonomy to take full ownership of their schools’ ICT implementation. The integration of ICT in the curriculum and assessment was strengthened by focusing on areas of strategic importance and needs, and developing partnership models to resource the schools.

I realised that with the roll-out of the baseline ICT standards, schools were able to have a clearer view in integrating ICT into the curriculum. Schools were given the funds and full autonomy to develop their schools’ ICT plan and this had created a flexible environment for schools to explore different ways and technologies to achieve the second masterplan’s outcomes, and to choose ICT tools and resources that were most suitable to the needs of the students. Resources sharing platform called iSHARE had been launched to facilitate the sharing of teaching resources and material online. This platform encouraged teachers to share their ICT lessons online and enable teachers to tap on the available resources as references to create ICT integrated lessons. With the support of this platform, teachers were more comfortable in using the existing ICT tools and resources to create ICT enriched lessons and experiences in class. As a new teacher during the implementation of the second Masterplan, the baseline ICT standards and the sharing platform served as an important guide and resources for me as well as other teachers to plan and develop meaningful ICT-enabled lessons.

3. Third Masterplan for ICT in Education

The third masterplan for ICT in Education (2009 – 2014) was developed with the vision of harnessing ICT and transforming learners. The outcome goal was that students developed competencies for self-directed and collaborative learning through the effective use of ICT as well as became discerning and responsible ICT users. The outcome goal focused on self-

directed and collaborative learning which required learners to exercise a good range of 21st century skills and dispositions. It captured the affordance of ICT in enabling the learners to shape their own learning experience, both as individuals and in collaboration with others, and in enabling learning to take place wherever and whenever the learner chose. With the increased usage of technology to deepen the self-directed and collaborative learning experiences, ensuring that students were able to use technology in a safe way and were able to take responsibility for their own well-being were important. As a result, cyber wellness was a main focus of the outcome goal as well.

To make self-directed and collaborative learning a common practice for students, there would be significant implications on infrastructure requirements, teacher capacity, and factors that school leadership influenced such as the school's ICT vision, culture, the structure of classes and the school day, and the mode of assessment in the school curriculum. School leaders played an important role in casting a vision for the use of ICT in teaching and learning in the school, and also in creating the culture and conditions for teachers and students to use ICT in a meaningful way. The needs for teachers to have the ability and capacity to plan and deliver ICT-enabled learning experiences and lessons that would encourage self-directed and collaborative learning among students as well as to guide the students in using ICT safely and responsibly were essential. The ICT infrastructure also needed to be improved further in order to support more self-directed and collaborative learning, where learning could take place anywhere and anytime. The broad strategies of the third Masterplan were to strengthen integration of ICT into curriculum, pedagogy and assessment in order to enhance learning and develop competencies for the 21st century, provide teachers with differentiated professional development that was more practice-based, model the usefulness of ICT in helping students to learn better, improve sharing of best practices and successful innovation, and improve the ICT provisions in schools to support the implementation of the third masterplan. These strategies were implemented through 5 key strands:

a) ICT in curriculum, pedagogy and assessment

ICT was extensively integrated into the planning, design and implementation stages of the curriculum, assessment and pedagogy. Students' learning outcomes were greatly aligned to 21st century skills such as ICT skills and the ability to communicate persuasively and collaborate effectively. A core set of subject-specific ICT-enriched learning experiences were defined and embedded into the various syllabuses. ICT in assessment was piloted for a few identified subjects to expand the repertoire of tools used in measuring students' learning beyond the standard testing methods. The Ministry of Education also created a set of baseline ICT standards for students. It consisted of core ICT skills that were required to support engaged learning and to prepare them for the future. These baseline ICT standards were integrated into core subjects such as English, Mathematics and Science to ensure that every student would be able to benefit from an ICT-enriched learning environment. An online testing tool was provided to schools to review whether their students had attained the baseline standards.

b) Cyber wellness

Schools implemented cyber wellness lessons and programmes based on a framework developed by the Singapore Ministry of Education in 2008. Relevant resources were developed and training workshops were conducted to guide and support cyber wellness co-ordinators in the planning and implementation of cyber wellness lessons and programmes in their schools. Relevant cyber wellness topics were also embedded into the syllabus of Civics and Moral Education as well as other appropriate subjects. All these would ensure that every student would acquire the essential cyber wellness skills and values by the end of his or her primary and secondary education. The Education Technology Division would conduct a research on students' behavioural patterns in cyber space and this research aimed to surface new cyber wellness issues that might be affecting students and would help to identify useful strategies and methods to help students, teachers and parents cope with them. To monitor the progress, an online evaluation tool was developed for schools to review the impact of the cyber wellness programmes on their students. The Education Technology Division also launched the Cyber Wellness Student Ambassador Programme in November 2009. This programme aimed to use positive peer influence to raise cyber wellness awareness in schools. A conference was held annually for these student ambassadors to share and learn good practices in promoting cyber wellness.

c) Professional development (PD)

An ICT-PD Framework had been developed to define the roles and responsibilities, and a corresponding set of knowledge and skills for the different groups of school personnel. This framework helped to guide schools in the planning and development of various professional development programmes and also helped schools understand how the roles of the different school personnel contribute to achieve the goals of the third masterplan. A learning roadmap was also developed to help teachers learn how to integrate ICT effectively in their lessons. A pool of teachers with strong pedagogical groundings was selected and trained on effective teaching practices that incorporate ICT-enriched learning in the classroom. These teachers who were appointed as the ICT mentors would cascade effective ICT practices in and across schools and to raise the level of ICT use in schools. These ICT mentors would serve as mentors to teachers on the usage of ICT for learning and teaching in their respective subjects, provide knowledge and advice on planning and delivering of ICT-enriched learning experiences and lessons, champion best practices, and facilitate the sharing of ICT resources created by teachers. The Singapore Ministry of Education continued to provide ICT consultancy and support to schools by offering customised professional development programmes, workshops and teacher work attachments, and conducting conferences to promote sharing of good ICT practices among schools. There were also award programmes to recognise the innovative practices and efforts of teachers and such recognition programmes facilitate the sharing of good practices among the larger community of teachers. The ICT Connection website was developed and it served as a key platform that supported the growth of ideas and innovations

from schools by facilitating dialogue among schools on the effective use of ICT in education. The Ministry of Education would capture and distil examples of good practices that illustrate meaningful use of ICT in education through this website.

d) Research and development

The Singapore Ministry of Education supported the establishment of a network of educational labs where innovations could be prototyped and tested. These labs were equipped with the latest technologies to promote exploration of new learning possibilities. The Singapore Ministry of Education partnered with industry and schools to conduct research on ways to strengthen teachers' pedagogical understanding of ICT use, study the benefits and impact of using Interactive and Digital Media based learning environments (e.g. educational games, immersive virtual environments), tools and content to support engaged learning of students, and understand the development of Interactive and Digital Media media-literacy required in learners. EduLab was built and served as a platform to draw ideas from the ground and develop them into ICT-infused lessons and product prototypes through the provision of centrally-coordinated expertise and support. The FutureSchools@Singapore programme continued to push the frontiers of teaching and learning using ICT at a school-wide level to fully harness ICT to engage students in learning. These schools served as test-beds for research and development on emerging ICT in education. The knowledge gained would then be shared and adapted for implementation in other schools.

e) ICT infrastructure

Accessibility of ICT to students was increased through more flexible and mobile infrastructure provisions such as wireless internet access around the school area, 1-notebook-to-1-pupil ratio in more schools and internet with higher data bandwidth. Internet bandwidth was upgraded with the installation of fibre network to support the use of rich media resources, e.g. audio/video files recorded by students, educational games and interactive digital media for learning. Student-computer ratio was improved to facilitate more independent, collaborative and customized learning. To facilitate flexible learning environments, the provision of more mobile devices like notebooks to be used by students within and outside classrooms was considered. With the use of Learning Management Systems (LMS) in all schools, the Singapore Ministry of Education established a set of LMS features and service standards to facilitate interoperability of contents and ensure a minimum service level from all LMS vendors.

The main focus of the third masterplan was that students developed competencies for self-directed and collaborative learning. In order to achieve this outcome goal, I realised that all teachers and school leaders needed to have a clear and better understanding of what was the definition of self-directed learning and collaborative learning. Workshops had been conducted for Heads of Department and ICT mentors to guide them on understanding the goals and give advice on strategies to achieve the outcome goals of the third masterplan. Useful resources and examples regarding self-directed and collaborative learning had also been uploaded onto the

sharing platform to guide and help teachers in understanding the goals and support them in planning and delivering of ICT-enriched lessons that incorporate self-directed and collaborative learning. With these resources, teachers found it easier to plan and implement ICT-enriched lessons that incorporate self-directed and collaborative learning. The implementation of the ICT mentors programme had greatly benefited the teachers as well. These ICT mentors provided guidance, advice and support for teachers when they faced difficulties in designing and delivering ICT-enriched lessons and so teachers became more confident and comfortable in carrying out ICT-enriched lessons.

The Ministry of Education developed a set of guideline and resources for cyber wellness lessons and schools were allowed to use all the resources or to make modification according to the school profile and environment. Being the cyber wellness co-ordinator for the school that I was teaching at, I found it easier to plan and carry out the school cyber wellness lessons and programme, and could ensure that all students would acquire the essential cyber wellness skills and values to become safe, respectful and responsible ICT users.

4. Fourth Masterplan for ICT in Education

The fourth masterplan for ICT in Education started in 2015 and it focuses on quality learning. The vision of the fourth masterplan is to nurture future-ready and responsible digital learners. The outcome goal of the fourth masterplan is to put “Quality Learning in the Hands of Every Learner - Empowered with Technology”. The enablers of the fourth masterplan will be based on teachers as designers of learning experiences and environments and school leaders as culture builders. As designers of learning experiences and environments, teachers can bring about engaged learning by designing quality learning experiences with technology to develop 21st century competencies and deepen subject disciplinarity. As culture builders, the school leaders empower the school team to bring about teachers’ ownership in the use of ICT for education. ICT will be used productively to develop knowledge through subject mastery, skills through 21st century competencies, and attitudes through responsible digital citizenry. The Fourth Masterplan for ICT in Education has 4 approaches: deeper ICT integration in curriculum, pedagogy and assessment, sustained professional learning, translational research, innovation and scaling, and connected ICT learning ecosystems.

a) Deeper ICT integration in curriculum, pedagogy and assessment

The focus will be on the end-to-end integration of ICT into curriculum, pedagogy and assessment of subject disciplines and supporting resources as this will ensure that ICT is appropriately embedded at the design and development stages of the curriculum. The proposed strategies aim to achieve a systematic end-to-end integration of ICT into subject disciplines, harness technology possibilities for assessment and national examinations, include ICT beyond the mainstream curriculum and educate the digital learners. These strategies include the integrating of ICT into national curriculum, designing and providing quality online learning resources for students, including ICT in assessment and deepening digital learning in cyber

wellness and new media literacy.

b) Sustained Professional Learning

The Fourth Masterplan will focus on a greater coherence of a core knowledge-base to effect quality teaching and learning with the usage of ICT and take a more systematic view of the various capacity building efforts for ICT in teaching and learning for teachers' training. The proposed strategies that aim to bring about sustained professional learning are building the capacity of the school team, developing good ICT practices and strengthening the network of the learning communities for technology in learning.

c) Translational Research, Innovation and Scaling

Translational research, innovation and scaling in the fourth masterplan aim to form a culture of innovation and reflective practice across schools. In order to achieve this, it is important to involve schools and teachers in experimentation and innovation efforts as this will allow teachers to engage in professional discussion, learn, reflect and explore together, thus deepen their practice and improve their craft. Through translational research, successful ICT teaching and learning practices in classroom will be identified and scaled up to benefit other schools. The proposed strategies are to look out for educational technology-related issues and applications, seed innovations across schools and translate research findings into classroom practices, and share successful ICT practices for adoption across schools.

d) Connected ICT Learning Ecosystem

Connected ICT learning ecosystem refers to both a connected physical infrastructure and a connected socio-cultural ecosystem. A connected physical infrastructure provides flexibility for policies on quality teaching and learning with ICT to be implemented quickly and cost effectively. A connected socio-cultural ecosystem will be created through multiple partnerships among the Ministry of Education and schools to leverage external partners and organisations, and to strengthen home-school-community collaborations. The proposed strategies are to provide physical infrastructure that support anytime and anywhere learning and cultivate socio-cultural ecosystem for partnerships with stakeholders.

Building on the foundation and achievement of the first three masterplans, the fourth masterplan is implemented to focus more on the quality of the learning and I feel that it can be brought about with the support of technology in this fast-changing technological world. It greatly involves the creating of ICT-enriched learning experiences and lessons that can enable learners to develop skills, attitudes and competencies for the 21st century effectively. Learning experiences and lessons that stimulate learning, promote thinking and discussion, facilitate demonstration of new learning and advancement of learning are designed. These learning experiences will greatly enhance the self-directed and collaborative learning effectively, thus improving the quality of learning.

CONCLUSION

With reference to the information mentioned in the case study of integrating ICT into education in Singapore written by UNESCO Asia and Pacific Regional Bureau for Education (2004) and the information provided by the Singapore Ministry of Education(2009, 2010), together with the feedbacks gathered and personal experiences, the following observation and personal opinions are concluded.

The implementation of the masterplans for ICT in education in Singapore has greatly benefited the students as well as the teachers. Based on the results obtained from the online ICT baseline standards testing tool, students are competent in the use of basic ICT tools like email, internet, word processing, spreadsheet and presentations. ICT-enabled learning environments have improved the learning process of the students, making it more interesting as it will stimulate the interest of the learners and better engage the learners. Thus, students are motivated to learn beyond the syllabus and curriculum, nurturing life-long learners. Complex theories can be easily explained and real-word contexts can be represented and stimulated with the support of multi-media resources.

ICT-enabled learning environments support the development of self-directed learning and collaborative learning easily. ICT enables students to learn at their own pace, take full ownership of their own learning, and demonstrate new learning and knowledge. ICT tools can also facilitate online discussion that will promote thinking, enable students to reflect on feedbacks gathered for improvement and enhance communication skills. The use of ICT communication platforms has also enabled students to collaborate with students from other countries in working on a same project, and thus allowing them to gain richer perspectives and knowledge from communicating and interacting with the students from other countries.

As ICT training is being provided to all teachers, teachers' ICT competency level has been greatly raised. Useful and relevant online resources can complement with textbooks to enhance the learning process. ICT technology enables teachers to explore new teaching possibilities and strategies that will enrich the learning process of the students. ICT sharing platforms also promote the exchange and sharing of knowledge, ideas and resources among teachers to facilitate designing of ICT enriched lessons, and enable teachers to engage in discussion dialogue to develop good ICT practices in the classroom. Teachers are also given opportunities to work with industrial organizations to develop relevant online educational tools and resources.

To evaluate the effectiveness of the ICT integration process, teachers will carry out action-research to develop ICT practices, provide insights on learning gains and identify pedagogical patterns. Action-research can enable teachers to reflect on the processes and practices and make changes or improvement for future-use.

ACKNOWLEDGMENTS

This work was supported by JSPS KAKENHI Grant Number 26282052 and 17H01994.

We thank prof. Oliver Mayer for comments on English expressions.

REFERENCES

Educational Technology Division, Ministry of Education. (2010). <http://ictconnection.moe.edu.sg/masterplan-4>

Ministry of Education. (2009). <http://ict.moe.edu.sg/baseline/index.html>

UNESCO Asia and Pacific Regional Bureau for Education. (2004). Integrating ICT into Education: A Collection Case Study of Six Asian Countries: Indonesia, Malaysia, Philippines, Singapore, South Korea, Thailand [PDF file]. Retrieved from <http://unesdoc.unesco.org/images/0013/001355/135562e.pdf>