The readiness of schools of Macao to integrate IT in education and the extent of actual IT integration

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ABSTRACT

The Portuguese came to Macau in the 16th century, Macao has become part of China again since 1999. Under the strong economic growth in recent years, the Macao government has invested substantial human, material and financial resources for the implementation of IT in education in Macau since 2001. This paper reviewed the development of IT in education in Macao, including hardware development, the integration of IT into teaching and learning and other informal forms of support by the government to the development of IT education. Although the development of Information Technology (IT) in education in Macao has progressed rapidly in the last few years, there are still many problems. The author makes some suggestions alleviating the shortcomings.

Keywords: Information Technology in Education; Information Technology Development; Macao Education Development;

INTRODUCTION

The Portuguese came to Macau in the 16th century, Macao was the first European settlement in the Far East. Macau became a Portuguese colony in 1887. In accordance with an agreement signed by China and Portugal on 13 April 1987, Macao was decolonized in 1999 and became the Macao Special Administrative Region (SAR) of China on 20 December 1999. Macao has a high degree of autonomy, a result of the "one country, two systems" policy that SARs enjoy in their governance. Macao is financially and to a large degree bureaucratically independent from China.

Macao's economy has enjoyed strong growth in recent years on the back of its expanding tourism and gaming sectors. Since opening up its locally financed and operated casino industry to foreign investment and development in 2001, the territory has attracted tens of billions of dollars in foreign investment that has helped transform Macau into the world's largest gaming center. In 2006, Macao's gaming revenue surpassed that of the Las Vegas strip, and gaming-related taxes accounted for 75% of the total government revenue.

In recent years, central and local governments of different countries have sought to promote the development of Information Technology (IT) in education (Kozma, 2003). The policy makers of the Ministry of Education from different countries have pointed to the need to enhance the role of information technology in the process of teaching and learning. They seek a form of integration between information technology and the curriculum which can gradually bring about changes in the presentation of the curriculum, teaching and learning, and the interaction among teachers and students (Ministry of Education, 2001). Many countries in Asia-Pacific regions have been working hard to develop policies and strategies for schools to integrate technology in schools. For instances the "Adelaide Declaration on National Goals for Schooling in the Twenty-first Century" in Australia (MCEECDYA, 2009); the "IT in Education" in Hong Kong (Hong Kong Education Bureau, 2008); the "Smart School Project" in Malaysia (Malaysia Ministry of Education, 1997); the "Master plan 2008 for IT in Education" in Singapore (Singapore Ministry of Education, 2008).

In order to promote the development of education and to be at the forefront of technology and thereby strengthen the impact of IT in education, the Macao government has begun to invest substantial human, material and financial resources in the implementation of IT in education in Macao since 2001. The implementation of IT in primary and secondary schools and the training of teachers have achieved definite results (Fan, 2004a).

Realising the government has invested substantial resources; did Macau really catch up with the impact of the new Information Technology learning culture? This paper mainly reviewed the development of IT in education in Macao, including hardware development, the integration of IT into teaching and learning and how the Macao SAR Government's supports the development of IT education in many specific programs.

RESEARCH METHOD

In this articles, some comparisons have been made between Macau and the neighboring areas, as well as some advanced countries. Since the Macau government did not disclose much of the relevant data for reference, the research method was based on literature review of primary and secondary sources of data such as government information, newspaper, books and research articles. Some data was collected from a meeting with around 40 primary and secondary teachers. The discussed topic included their views on teacher training, curriculum development and education policy issues. The teachers' comments were consolidated and summarized.

MACAO EDUCATION STATISTICS

According to statistics from the Education and Youth Affairs Bureau (DSEJ) in the 2006/2007 and 2007/2008 academic years, the number of students in formal education was 86,821, the number of return students being 3673, and the total number of students 90,494. Compared with the previous academic year, there was an increase of 2.63 percent. The total number of teachers were 5100, a 6.03 percent increase from the last academic year. In general, the class-teacher ratios in various stages of education had increased significantly. In early childhood education, the class-teacher ratio was 1:1.6, an increase of 4.29% compared to the previous year; primary level education was 1:1.8, an increase of 5.88%; secondary education was 1:2.2, an increase of 4.76%; special education was 1:1.7, an increase of 5.26%. The overall teacher-student ratio was 1:17.7, compared to the previous year ratio of 1:18.3. This indicated that the ratio dropped 3.28% per year. This further indicates that teachers now take care of less number of students, meaning more time can be devoted to each individual student. In recent years, the SAR Government has invested substantial amounts of resources in the optimization of the education system, together with the inclusion of measures to reach a teacher-student ratio that is most ideal for the situation; In summary, all these created a better condition for consistently improving the quality of education in Macao (Macao Education and Youth Affairs Bureau, 2008a).

TYPE OF SCHOOLS IN MACAO

Schools in Macao are mainly divided into government, network and non-network private schools. Government schools are run by the government. Network schools are government aided schools and may provide "free education" to certain public sectors; schools must be locally run and be a non-profit organization in order to be "networked". More than 80% of schools in Macao are network schools, some well known ones such as Macao Pui Ching Middle School, Yuet Wah

College, Hou Kong Middle School, Workers' Children Secondary School, and Kwong Tai Middle School Macao are network schools. Non-network private schools receive no subsidies from the government, their revenue mainly coming from tuition fees. Since September 2007, the Macao government has implemented, for fifteen years, free and compulsory formal education, including early childhood education, primary and secondary education. The government of Macau's implementation of "free education" has been defined as exemption of students from tuition fees, additional service fees including other enrollment, and other certificate-related expenses. With the "Non-Tertiary Education Law" promulgated by the 08/09 school year, for a primary and pre-primary of government and network school with class size between 25-35 students, education allowance has been raised from 400,000 MOP (1 MOP is equivalent to 0.13 USD) to 480,000 MOP, for secondary schools with class size between 35-45 students, the allowance raised from 650,000 MOP to 750,000 MOP. For non-network schools, students received an increased allowance of up to 1000 MOP per year. The overall allowance for non-network early childhood and primary schools have increased to 6000 MOP per student per year while secondary school funding has increased to 10,000 MOP in the 2007/08 year. Apart from allowances for schools, the Education Committee has also implemented various measures to reduce the financial burden for parents. This includes the exemption of miscellaneous fees, the increase of school fee subsidies up to 7% for network schools and 40% for non-network schools (Macao Education and Youth Affairs Bureau, 2008b). All these figures demonstrate that government has invested substantially to improve the level of pre-university education in Macao.

IT IN EDUCATION

The development of IT in education refers to the development of material objects of use to humanity, such as machines or hardware, but it can also encompass broader themes, including systems, methods of organization, and techniques so as to improve teaching and learning (Lawless and Pellegrino, 2007). In order to understand the development of IT education in schools, a variety of indicators are used. School hardware development indicators include the ratio of computers to students/teachers, the network development progress and the extent of integrating IT in classroom teaching.

Students and Computers

The number of students that share a computer (Student Computer Ratio) in schools is one of the most widely used indicators to measure the school's hardware resource level to implement IT education (Fan and Zhang, 2004a; Macao Education and Youth Affairs Bureau, 2002). A study from the Information and Communication Technology Education and Research Center in University of Macao, and DSEJ, showed that the computer to student ratio has significantly decreased almost four-fold from "30 to 1" to "8 to 1" in 5 years. For secondary schools, the computer to student ratio has also decreased significantly, from "13 to 1" to "6 to 1" [3] (see table 1) (Fan and Zhang, 2004a)

Table 1: Student Computer Ratio for primary and secondary schools

Region	School Type	2001 Computer-Student Ratio	2002 Computer-Student Ratio	2003-2005 Computer-Student Ratio	2006 Computer-Student Ratio
Macao	Primary	30	21	-	8
	Secondary	13	12	-	6

During 2003-05, the government did not disclose any relevant information, thus there is no data for comparison in Table 1. We can see that the student computer ratio for secondary and primary schools dropped significantly in 2006. In order to raise the overall awareness of IT in education, the Education and Youth Affair Bureau and Macao Foundation implemented an IT in education funding scheme. This scheme involved an expenditure of MOP 70 million which mainly funded schools in Macao to purchase computers and optimize network infrastructures. Under this scheme, each pre-primary school was also offered a maximum of 50 sets of computers. Apart from hardware, this scheme also purchased a total of 28,291 software licenses for schools (Fan, 2004b).

Teachers and Computers

The Teacher-Computer ratio is another widely used indicator to evaluate the access of school teachers to computers (Fan and Zhang, 2004b; Macao Education and Youth Affairs Bureau, 2002). Table 2 shows the Teacher-Computer ratios for different types of schools from 2001 to 2008. As one can see, the Teacher-Computer ratio decreased slowly from 2001 to 2003. Although from 2004 to 2008 no government data disclosing the actual teacher computer ratio was published, the figure was collected from a local newspaper "Macau Daily" published in 2007[4], every teacher has at least one computer to use. This leads to a Teacher-Computer ratio lower than 1.

Table 2: Teacher Computer Ratio for primary and secondary schools

Region	School Type	2001 Teacher-Computer Ratio	2002 Teacher-Computer Ratio	2003 Teacher-Computer Ratio	2008 Teacher-Computer Ratio
Macao	Primary	7	4	-	-
	Secondary	4	4	-	-
	Total	5	4	2	<1

Network Facilities

The school networking system is essential in integrating IT in education and facilitates fast and easy information exchange and resources sharing.

(I) Intranet Construction

The term Intranet describes an "internal" computer network (restricted to specific school or organization) which uses tools and protocols normally associated with the Internet.
Intranet systems can enhance communication between teachers and students. A school intranet can provides an environment for publishing students' project work and teachers' information pages, as well as providing a collaborative "project sharing" environment, supporting a wide variety of traditional learning outcomes.

Table 3 summarizes the percentage of Macao schools with intranet installation. As can be seen from Table 3, in 2002 Macao's one-stop schools[1] have a much higher intranet installation percentage than primary and secondary schools. This can be explained as one-stop schools in Macao are usually more traditional and well established and the government has more resources and facilities allocated. Since 2003, the Government has not published any relevant

data for the public. However, based on the figures from a private survey[2], almost all schools have intranet installations other than small scale schools (e.g.: less than 50 students.)

Table 3: The percentage of schools with intranet installed

Region	Year	Primary	Secondary	One Stop School
Macao	2002	52%	48.3%	84%
	2008	>95%	>95%	>95%

(ii) Internet Construction

The Internet provides a platform for students and teachers to exchange information with people around the world inexpensively and at any time of day. The Internet gives them the ability to connect to peers around the globe. Schools with Internet access can create their own web sites featuring the work of students and staff.

Table 4: The percentage of schools with broadband internet installed

Region	Year	Primary	Secondary	One Stop School
Macao	2002	32.5%	11.1%	46.0%
	2008	>95%	>95%	>95%

Table 4 is based on the data released by Education and Youth Affair Bureau in Macao to calculate the percentage of primary, secondary and one-stop schools that have internet access in Macao. It can be seen that overall, the percentage of internet connected schools exceeds 95% in 2008. In 2003, CTM (the only broadband internet service provider in Macao) launched a plan called "I. Campus" for schools. This plan offers free internet lease line services and devices for schools. The company also offers professional web designers to assist schools in the design new homepages using the existing materials such as school news and students activities. "I. Campus" has also planned to link all the educational resources in Macao together to build a web based educational resource centre so as to allow teachers, students and scholars to use this to search for cases, articles and data charts in order to fulfill their research and study needs.

So far, the majority of schools in Macao already have broadband Internet access. CTM Macao also provides primary and secondary schools with "Easy Learn Net", ELN services. ELN is a learning management system which allows teachers to disseminate their lecture notes, exercises and other educational resources to students via the Internet (CTM, 2003a). In addition, CTM has setup a dedicated "I. Campus" help desk, to answer questions regarding computer usage, internet applications and other IT issues. CTM will work closely with the Macao Government and local education groups to provide comprehensive computer and network management training for teachers. Apart from learning the basic webpage design and production skill, the training also focuses on the importance of networking security and the social and ethical issues on using internet (CTM, 2003b).

Integrating IT into the Curriculum

Integrating IT into the curriculum involves the infusion of technology as a tool to enhance the

learning in a content area or multidisciplinary setting. It includes more than just teaching basic computer skills and software program usage in specific computer classes. Effective IT integration must take place across the curriculum in ways that deepen and enhance the learning experience. The percentage of lessons integrating IT at different intervals of time was measured to access the extent of IT integration into the curriculum (Fan, 2004b).

Table 5: *The percentage of lessons that uses IT in different intervals*

Level Interval	Primary Six (%)	Secondary Three (%)	Secondary Six (%)
Never	4.8	0.6	21.8
2 to 3 times a month	4.0	4.9	4.2
Around once every week	49.3	34.7	20.0
Two or three times a week	34.5	58.2	46.2

Sources: Fan Chun Wai, 2004, p.52

Table 5 shows that over 80% (49.3%+34.5%+7.3%) of primary six classes have integrated IT into their teaching for around once a week. For third grade secondary classes, more than 90% of classes have IT integrated learning at least once a week. It is noteworthy that secondary school students in the sixth grade classroom do not integrate IT as much as grade three and primary classes. This may be due to the needs of preparation for graduation, external examinations and further studies that have changed the curriculum (Fan and Zhang, 2004b).

Macao IT Education Development

In order to promote IT in education in Macao, the Education and Youth Affair Bureau has launched a number of programs to facilitate school based IT education development. These are:

(I) School Development Program

In order to be in sync with the education reform in Macao and to further improve the overall quality of pre-university education, DSEJ launched the "School Development Plan" to finance all types of schools in the development of educational projects and activities.

School Development Plans in Macao are very similar to "Quality Education Funds" in Hong Kong (Quality Education Fund, 1997). Schools are required to write a proposal for the government to approve. However, there is no ceiling in the amount of subsidy. The supported program includes moral education, reading, school health promotion, IT education, leisure activities, liberal studies, vocational and technical training, language learning, student learning promotion, science education, small class teaching, arts education, curriculum and teaching research and creative teaching etc.

In 2007-2008, DSEJ approved a lump sum of 270 million MOP in school development plan funding. There were altogether 60 schools with subsidies of over 1 million MOP. The maximum subsidy provide to a school project was 8.2 million MOP.

Regarding the development of IT education, the funded program must satisfy at least one of the set criteria laid down by DSEJ which includes improving overall IT infrastructure, promoting teachers IT knowledge to support teaching, fostering appropriate IT skills to support school reform and development. The set criteria are:

(1) to improve networking and wireless network infrastructure; to install classroom projectors and screens; to purchase notebook computers for teachers; to improve campus network and classroom settings;
(2) to develop school based teaching/learning or e-learning platform to enhance learning and teaching;
(3) to develop a school management system to improve information exchange and school administration;
(4) to improve the IT competence of teaching staff, administrative staff and students;
(5) to enrich the educational resources. This also includes organizing teachers to purchase teaching materials and educational software to enrich their school resources;
(6) to enhance IT literacy; to cultivate the concepts of decent use of IT; to master the skills for lifelong learning and higher order thinking; to use IT as a tool for information exploration; knowledge acquisition; communication; collaboration and professional development. To equip learners with the ability to discover, analysis, evaluate and solve problem (Macao Education and Youth Affairs Bureau, 2008c).

(ii) Teacher Notebook Computer Program

In order to enable teachers to have more opportunities to use IT and to incorporate IT into their teaching, DSEJ funded network (non-profit-making) private schools to purchase notebook computers for teachers during the academic year 2007-08. The maximum grant for each notebook computer was 13,000 MOP. A formal notice to the government regarding the maximum number of notebook computers that each school purchased was to be submitted. The ownership of the notebook computers remains with the school. However the school must fair allocation of the notebooks to teachers (Macao Education and Youth Affairs Bureau, 2007).

(iii) Teacher Training

In consideration of Macao's large number of non-network schools and lack of uniformity in the curriculum and teacher salaries, it is difficult for DSEJ to implement teacher competence indicators for schools to abide. In order to maintain teachers' standard, there is a series of short term training programs for teachers. In terms of IT education, there are yearly summer courses on "IT education", "Courseware Development", "Web Page Design" and various computer packages (such as PowerPoint, Flash, Premiere). Depending on the needs of individual schools, the Bureau will also fund schools to organize their school based training programs.

In 2008, the Education and Youth Affair Bureau sponsored schools with a maximum of 200,000 MOP per school per year to employ IT administrators. The administrator's job is mainly to assist schools in developing IT in education. To complement these administrators with more education concepts, the Bureau held a series of education-related in-service training courses for them. The total teaching hours are 100 for a period of 3 months starting from May 2008.

The course comprises four modules:

Unit I	The title of this module is "Basic concepts and applications for IT education", the aims of this unit are to equip learners with basic education concepts and theories and education system and regulations in Macao etc.
Unit II	The title of this module is "Integrating IT in teaching and learning – Design and Management". This module mainly trains learners with basic teaching methods and strategies, cultivates learners with knowledge on multimedia and the design and development of courseware. This module also cultivates learners with school IT management skills such as maintaining and supporting learning management systems, classroom and computer laboratory management etc.
Unit III	The title of this module is "IT in School Administration", the aims of this unit are to help learners to get familiar with the school operation or its management style, understand the roles of IT in the school administration, operation and development, and to equip learners with the knowledge to support schools overall IT development, long and short term planning and resource allocations;
Unit IV	The title of this module is "School IT Policy and Management" course, Using a project; this unit aims at allowing learners to apply what they have learned from other units. This could probably suggest a feasible improvement plan in terms of IT policy and management style to the schools they are currently working with.

Source: Macao Education and Youth Affairs Bureau, 2008e.

(iv) Education Resource Centre

In addition to funding schools in developing IT education, the Education and Youth Affair Bureau has also founded the Education Resource Center, ERC, to support the development of education technology. The services of the Education Resource Center mainly targets teachers and special services volunteer. In order to maintain a high quality of education in Macao, ERC provides a large source of teaching aid such as videos, multimedia courseware, teaching aids, equipment and other resources and reference. The ERC also provides full form working areas with the latest equipment and tools to support teachers in creating their own teaching materials.

The Education Resource Center also regularly initiates many programs and competitions such as the Lesson Plan Design Award and Courseware Development Competitions to motivate teachers to create high quality teaching materials. The center also publishes many journals and magazines periodically for teachers' reference. The popular issues are "Teacher Magazine", "Education Digest" and "Teaching Staff Training Newsletter", etc. (Macao Educational Resources Center, 2009).

(vi) IT Education Coordinator Scheme

The IT in Education Coordinator scheme commenced in the 2007/2008 school year. Schools with 900 or more students can be allocated with at least one full time IT coordinator; while schools on a smaller scale could choose to employ a part-time coordinator or pay for relevant services from private companies.

The establishment of the IT Education coordinator Scheme is intended to help schools to promote IT education and to provide the most suitable conditions and environment for integrating IT with teaching and learning. This scheme is also designed to anticipate and improve the overall IT environment in schools, develop an optimized IT learning environment in schools and mitigate the load of teaching staff from a non-teaching job.

The roles of an IT education coordinator include:

(1) to organize and coordinate the activities of IT education in schools and plans;
(2) to support the development and coordination of IT equipment (e.g. network infrastructure) in schools;
(3) to assist schools to realize and develop proper school security policies and mechanisms;
(4) to support and maintain daily system administrative work;
(5) to deal with software installation right to access and promotion of intellectual property rights management;
(6) to promote and assist teaching staff to use IT in teaching;
(7) to promote and assist non-teaching staff in using IT in their daily administration work;
(8) to promote and assist DSEJ to exchange electronic information between schools and the bureau;
(9) to liaise with DSEJ regarding the schools' development and planning (Macao Education and Youth Affairs Bureau, 2008d).

CONCLUSIONS AND RECOMMENDATIONS

The development of IT in education in Macao has progressed over a number of years. In 2002, the change in policy by the Macao SAR government addressed the importance on development of IT education, and significant progress has been made in this area. Macao schools have progressed significantly, especially in terms of network infrastructure and computer hardware development. However, in compare with other western and advanced countries, the development of IT education in Macao still has long way to go.

The following paragraphs summaries the shortcomings and suggestions for promoting IT in education in Macao.

Teacher Empowerment

As noted in earlier sections, there are regular training courses offered by DESJ to teachers with the proper IT training and skills. However, in organizing these training courses, there is a lack of comprehensive planning and a standard curriculum. Based on the researcher private interview many teachers, they reported that these courses are either redundant or cannot cater to their needs. It is recommended that the Macao government should aware the approaches of Hong Kong, Singapore or other western developed countries to formulate a long term systematic training scheme for teachers (Wong, 2008). This scheme should state clearly its long and short term goals. The scheme may include the formulation of different IT competence levels that require teachers to achieve in different timeframes.

Curriculum Development

Although DSEJ has laid down a set of curriculum documents for schools to follow, most of these schools do not adhere strictly to that curriculum. The reasons are primarily because the curricula are not updated very often. For instances, the set of curricula in government web site have been released since 1999 and hence, most teachers consider that the syllabi cannot really satisfy the

students' needs. Since there is a need of a set of standard curricula to provide choices and flexibility, DSEJ will have to face problems to promote new reforms and development. It is recommended that the DSEJ should take a more active role in implementing unified school curricula which in sync with the overall integration of IT in education and teacher training initiatives.

Education Policy

Since the policy promulgated in 2002 focuses on IT education, the development of IT education has became the key reform area for the education authorities. Plenty of resources have been invested in optimizing the hardware and infrastructure. However, as the focus shifts to other subject areas such as language teaching, moral teaching, in subsequent policy addresses, the development of IT education has also slowed down. It is recommended that the education authorities when proposing or implementing new policy directions should formulate a clear set of goals with a consistent investment policy instead of blindly trying to fulfill the needs of every educational institute.

Education Research

In order to facilitate educational reform and policy making, a comprehensive set of education statistics is essential. In Macao, the education data is far from complete or not released to the public. Especially in IT in education, many education data was only collected in 2002 and no relevant data can be referred to in subsequent years. It is recommended that the Government should collect data on all aspects of education regularly and publish on the education website so that interested parties can easily access it.

END NOTES

1   One-stop school is a very common type of school in Macao. This kind of school provides primary and secondary school education in the same campus.

2   The data collected from a meeting between the researcher and 40 computer administrators from different types of schools in Macau in July 2008. This number represents around 25 percentages of the schools in Macau.

3   The 2006 figure on "Student Computer Ratio" are based on an article titled "Macao Fund Sponsor 75 Million MOP to sponsor schools in purchasing computers" from Macao Daily dated 5 Dec 2005

4   The 2008 figure on "Teacher Computer Ratio" are based on an article titled "Macao Government Sponsor 150 Million MOP to improve Information Technology in Education" from Macao Daily dated 5 Sept 2007

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