

An Evaluation Study on Macao Schools' ICT Integration

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EXECUTIVE SUMMARY

This is an evaluation study commissioned by DSEJ to study the ICT integration in Macao schools. The purpose of this study is to understand the current state of ICT development in schools, how ICT is used for teaching and learning in schools, and provide suggestions for future directions. The findings serve to enhance the education reform in Macao as well as to improve the students' and teachers' experiences with ICT in the global 21st century education landscape. The specific objectives of this study are to:

1. provide an understanding of the status of students' use of ICT for learning,
2. provide an understanding of the status of the teachers using ICT for teaching,
3. evaluate schools' ICT policy for education, their software and hardware resources,
4. evaluate the government's ICT policy and measures,
5. know how families and communities support the use of ICT for education, and
6. provide recommendations for Macao's future ICT education and development.

This report presents the students' experience with ICT, and ICT competencies in learning through effective use of ICT and become discerning and responsible ICT users; Teachers' ICT competencies, capacity to design ICT-enriched learning experiences and facilitate student learning; Schools' vision, management and creating conducive condition to harness ICT for teaching and learning including the schools' ICT infrastructure that supports teaching and learning anywhere and anytime; Government's ICT support, measures and the families and community life related to ICT. Based on the findings of the study and also the experience of Singapore Masterplans, recommendations for Macao future ICT education are suggested.

This study adopts a mixed methods design: A cross-sectional survey design complemented by focus interviews of six selected schools. In phase 1, the cross-sectional design survey that aims to examine the teachers' and students' perceptions towards the extent of achieving ICT integration was administered to 675 school teachers (ICT and non-ICT) and ICT Heads of department and 6718 primary, junior secondary and senior secondary students. In phase 2, school visits, classroom visits and focus group interviews with selected teachers and students were conducted to gain more in-depth understanding of the participants' perceptions, and experiences in learning and teaching with ICT. The data collection methods included student and teacher version online surveys (quantitative), student and teacher focus interviews, school visits, teachers' lesson plans and DSEJ print and online document analysis (qualitative). The design of the survey incorporated DSEJ colleagues' inputs. Additional inputs (e.g., duration of the survey, language sensitivity) were also obtained from

the teachers, and principals. These inputs were incorporated into the survey for use in this study. The main findings and their implications are reported below.

Student-related findings

6718 students (2703 primary, 2103 junior secondary and 1912 senior secondary) were surveyed on their learning experiences with ICT. Students' perceived learning ability with ICT, learning attitude towards ICT and 21st century skills were the three broad categories used to describe students' learning experiences. The following are key findings:

- Primary, junior secondary, and senior secondary students reported favourably of their interests (mean scores above 3.5 of 5) and effectiveness (mean scores above 3.5 of 5) in using ICT for learning. Junior secondary and senior secondary students perceived favourably learning ability (mean scores above 3.5 of 5) except the primary school students (mean score below 3.0 on a scale of 1 to 5). They indicated less opportunity to use ICT for their learning in schools, in particular, among the primary school students (mean scores below 3 of 5). The primary school students also reported the least frequency in using ICT facilities (mean score below 3.0 of 5) in comparison to the junior secondary and senior secondary students. Primary, junior secondary, and senior secondary students generally perceived themselves to be positive towards using ICT for their learning (mean scores above 3.5 of 5). However, in comparison with the other attitude scale, they perceived themselves to be moderately confident in using ICT skills (mean scores below 3 of 5) and this was also reported by students that they had less opportunity to use ICT in schools.
- Primary, junior secondary, and senior secondary students generally perceived themselves to be positive towards using ICT tools for innovation, collaboration, problem solving and self-directed learning (mean scores above 3.5 of 5). Most students perceived themselves to be competent in using ICT tools such as Internet search tools, Communication tools, Social Media tools, Collaboration tools, In-class Assessment tools (e.g., Kahoot), MS Excel and Educational Games. The ICT tools that were more frequently used for school work (mean score above 3.5 of 5) were MS Word, MS PowerPoint, Information tools, Collaboration tools, Assessment tools, and Social Media tools. The less frequently used ICT tools (mean score below 3 of 5) were 3D printing, Interactive whiteboard, MS Excel, Reflection tools, Multimedia Editing tools, Educational Games, and Immersive Virtual and Augmented Reality Environments.
- Primary, junior secondary, and senior secondary students reported favourably their awareness of cyber-wellness issues and engagement in good practices. These students also perceived themselves to be knowledgeable in cyber-wellness (mean score above 4 of 5).

Implications

- The differences across levels in the students' use of ICT for learning suggest more prevalent use of ICT among the senior secondary students; simultaneously, the use of Communication tools and Social Media tools were also more frequent for senior students. Junior secondary students indicated more frequent use of ICT for learning. However, the frequency of ICT use in schools remains consistently low among all levels of students. This could indicate a need to re-examine how ICT infrastructure could be enhanced in schools (e.g., Support, Internet connectivity) to support learning.
- The students' survey responses indicated that students frequently use ICT tools for school work. The students reported frequent use of several ICT tools – Information tools, MS Word, MS PowerPoint, Collaboration tools, and Assessment tools and Social Media tools. This suggests the prevalent use of these tools by students for school work could be supported in schools' ICT integration.
- Primary, junior and senior secondary students reported positive cyber-wellness practices. Findings from the interviews regarding the cyber-wellness also indicated that schools were consistently building students' awareness about net safety and other related issues. This could be the outcome of the ICT syllabus taught in schools. In general, higher level students seemed more susceptible to negative cyber-wellness practices. Given that higher-level students, in general, also indicated higher frequencies of use of ICT for school work, this could mean a need to strengthen students' awareness about cyber-wellness.

Teacher-related findings

675 teachers from 60 primary, junior secondary and senior secondary schools participated in the survey about their teaching and learning experiences associated with ICT. The following are key findings:

- Teachers reported favourably of their ICT competencies, and benefits and attitude towards ICT for teaching and learning were high (mean scores above 3 of 5). They were positive on the skills, opportunity and frequency of ICT use for their teaching and learning. There was an increasing trend of tools used from the primary to senior secondary classes. For educational games, primary school classes experienced more than the other level classes. For the subject specific software, the trend was reversed. For social media tools, junior secondary and senior secondary classes experienced more frequently than primary classes. Among the communication tools, teachers used them more often in communicating with their more senior students and parents. These differences could reflect the appropriateness of tools for different level of teaching and could be considered in planning professional development for teachers.

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- Teachers' knowledge in teaching cyber-wellness was higher than students' (mean score above 3.5 of 5). Teachers' perception was significantly different across levels. HODs ICT had positive perceptions (mean score above 4.5) about various cyber-wellness issues (e.g., security, confidentiality). Teachers reported that cyber-wellness lessons were conducted frequently at primary and senior levels. During the interaction with teachers, teachers shared that cyber-wellness was addressed at the whole school level, where talks and presentations were provided to students. Some common challenges and concerns raised by teachers included cyber-bullying and gaming addictions to online games that a minority of the students are susceptible to.
 - Teachers' challenges and constraints faced in using ICT for teaching and learning are not limited to ICT teachers but also subject teachers who use ICT. These challenges expressed by the teachers include teaching-related obstacles, technology-related obstacles and student-related obstacles that generally reside around the mid-point 2.5 (a lower score is more favourable) in schools.
 - Teaching-related obstacles include teachers' fear and resistance to use ICT for teaching, lack of teacher professional development, lack of teaching resources, and insufficient sharing of good ICT practices and resources. The ICT and non-ICT teachers expressed their awareness of working together to help teachers and students achieve their teaching and learning needs. The ICT teachers also expressed their constant reaching out to the non-ICT teachers by conducting in-house training informally.
 - Technology-related obstacles include schools' Internet connection, upgrading of ICT infrastructure that includes the learning space, equipment and tools as well as technical support team to sustain the ICT integration efforts. During the interviews, teachers expressed the lack of computer labs and the difficulties in using mobile devices carts to be main challenges in using ICT for teaching and learning. Most junior secondary and senior secondary teachers also indicated slow Internet access to be one of their main obstacles.
 - Student-related obstacles include ICT resources for in-class interactions which include the student-to-teacher, peer-to-peer, individual-resources (online and in-class) cognitively and socially. During the interviews, teachers were aware that ICT tools should not be overused in class and they continue to search for the latest tools to manage, enthuse and engage the students during class. Primary school students might not have access to the Internet at home. To overcome this obstacle, the teachers assigned work to be completed in the school computer labs and school library.

Implications

- It would be necessary to re-assess the current deployment plan of ICT and non-ICT teachers for ICT integration in schools. It would be timely for subject teachers to take the ownership to integrate ICT into the subject teaching. The ICT and non-ICT teachers should not be treated separately but be merged as one group. The existing pool of teachers' professional development should focus on the skilful ICT integration training. The current pool of ICT teachers should be retrained to develop their pedagogy needed to support subject teaching under each content department. The bottom line is that pedagogy drives technology.
- Teachers perceived positively of their use of ICT tools for teaching. However, they faced some obstacles. To overcome these obstacles, in addition to upgrading infrastructure, professional development on how to use technology to support pedagogy guided by the TPACK framework can be explored.

School-related findings

This evaluation study also aimed to understand the school vision, the ICT facilities and safety, and the schools' ICT support for teaching and learning. The following are key findings:

- The schools' vision for ICT integration was positive in three aspects: whole school ICT integration management, ICT integration in classroom teaching and learning, and ICT implementation guidelines (all mean score above 3.5 of 5). School leaders provide directions and create conditions for ICT integration in schools. Interviewed teachers perceived favourably school vision for whole school ICT integration management. During the school visits and interviews, some school leaders or key personnel shared their vision, strategy and implementation guidelines, unique school background and culture with the team. Teachers also mentioned that their school leaders had created conditions and provided directions that were conducive for ICT use in their schools.
- Teachers perceived favourably schools' vision for ICT integration in classroom teaching. They were generally happy with the schools' ICT support for teaching and learning (Mean score above 3.5 out of 5). There is regular communication between the subject teachers and the ICT teachers. They try to align the content teaching with the relevant ICT skills to be taught before the semester and during the common lesson preparation time allocated in each school.
- Teachers perceived favourably schools' vision for ICT implementation guidelines (Mean score above 3.5 out of 5). During the interview, the teachers mentioned that ICT and non-ICT teachers were aware of the ICT implementation guidelines in their schools, and how ICT should be included in their lessons. Usually there is no minimum requirement set by the schools that subject teachers should meet for their lessons taught per academic year.
- They perceived their schools' ICT facilities and safety practices less favourably compared to the other aspects of the school surveyed. Some schools were better equipped with the computers than others. The ICT facilities differed in terms of adequacy of the ICT lab environment, tools provision, consistent Internet connectivity and the availability of devices for use in class. This could be due to the types of schools and how well funded the schools were. The schools' Internet connectivity was a common issue that would require more attention. During the interview with students, it was highlighted that the Internet was unstable and lessons were often interrupted. This could have affected the students' experience of learning with computers and limited students' opportunity and frequency of using the computers in schools.

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- During the interview with ICT Head, it was highlighted that they provide technical assistance to teachers, plan and manage the ICT budget. They support subject teachers' ICT integration, implement the school's key ICT projects, and monitor and review the progress of ICT implementation in the school. The junior and senior secondary levels were generally better equipped with more ICT support than the primary school levels. Different types of schools received different amount of funding which depended on how successful they were in writing their proposals. It was also reported that the ICT HOD wrote the proposals for ICT funding (one of the KPIs) with the support of the school management.

Implications

- Teachers' favourable views of the school vision imply that they were positive about the school leaders providing direction and creating conditions for the use of ICT for teaching and learning. Such a finding could be an indication of the sustained collaborative effort by the schools and DSEJ in working towards achieving ICT integration goals and quality education for Macao. To further enhance the ICT integration efforts, school leaders could help to integrate and consolidate school ICT-integrated instructional programmes, ICT teachers' and subject teachers' ICT infused lessons plans and resources, partnership with the industries for more current ICT-enhanced practices, as well as DSEJ ICT initiatives and their sustained effort to enhance the ICT integration effort through more communication platforms. Most importantly, DSEJ could look into conceptualising a more strategic funding structure to help schools meet the technical and infrastructure support for teaching and learning.
- Schools need to become more aware of the learning needs of millennial generation teachers in the current teaching force and work towards meeting the Professional Development (PD) needs. PD for teachers could focus on finding out the needs of these teachers and using tools meaningfully to facilitate students' learning. DSEJ could also identify ways to better support teachers in using appropriate Web based tools for designing meaningful ICT-integrated lessons. Schools could explore developing teachers' knowledge and skills in designing ICT lessons that focus more on strengthening 21st century skills. More PD on engaging students' development of self-regulation could be provided. More PD on helping teachers to design activities that promote productive and collaborative talk among students could also be provided.
- Two main obstacles in using ICT for teaching and learning were the time, and the system change and maintenance. These two constraints were consistently rated as the most challenging issues in schools. DSEJ could work with schools to support teachers in designing more ICT-based lessons and to help teachers conduct ICT lesson more efficiently. There is a need for Macao schools to build a platform for

teachers to share their lesson plans and ICT resources. More systemic effort at DSEJ level could be invested to help teachers identify relevant lesson plans. Workshops conducted by the ‘invited champions’ of the schools could be organised to enhance teachers’ awareness of resources available on the platform and to help teachers adapt the lesson plans. In the interviews, teacher suggested to set aside more time for teachers’ professional development.

Government/Authority related ICT policy and measures

This section summarises the findings on the government ICT policy, and measures. The following are the key outcomes:

- During the interaction with DSEJ personnel and key personnel school leaders, the rationale and goals of ICT integration were clearly articulated and emphasised. They shared vital statistics in terms of annual financial expenditure, manpower training, ICT infrastructure, and organisation of ICT related activities. The extensive financial commitment targeted at the regional ICT integration was high compared to the amount that Singapore government set aside for the first ICT integration implementation in 1997 (about 2 billion Singapore dollars). No exact comparison of the financial figures would be necessary due to different timelines for Singapore's ICT implementation in 1997 (22 years ago) while in Macao the ICT implementation was 2002 (17 years ago), as well as the episodic changes in the global economy and financial status of each country. It would therefore be more meaningful to look at the overall existing ICT strategic areas and whether there were strategic plans that helped to move forward Macao's ICT integration of ICT in teaching and learning and these are:
 1. Infrastructure (Computer hardware, classroom designs, and furniture etc.)
 2. Student development programmes
 3. Teacher PD & training resources
 4. ICT curriculum teaching and learning resources
 5. ICT community outreach programmes
- From the interviews, the teachers reported their awareness of and reasons for ICT integration as a regional initiative. The teachers perceived the need to develop their ICT competencies and skills for ICT teaching.
- During the interviews, it was found that there were no specific measures used by schools to monitor their own schools' ICT practices. In order to enhance school ICT practices, standardised instruments would be necessary. Communication, in particular, sharing of ICT resources among ICT teachers and non-ICT teachers within and across schools were incidental and were left very much to the schools.

Implications

School leaders should continue to communicate the rationale and the steps to take to monitor school level and regional level milestones of the ICT practices and set direction for the next wave of ICT practices.

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- ICT integration is a long term and nationwide initiative for Macao, and it would be timely to set up an office to look into the innovation of ICT integration for Macao in the years to come.
 - Continued bench marking of the ICT integration practices with other countries is one of the strategies for DSEJ and government to consider. The measures of the schools' ICT practices were limited. This is a key area for schools to evaluate their own ICT practices. DSEJ could develop more contextualised measures (from ICT integration research) for schools to use. It is timely for DSEJ to develop strategies for more effective communication channels to look into leading and inspiring schools to share ICT resources, and effective ICT teaching practices and classroom management practices. It may be timely to appoint the 'Master' teachers to lead teachers in professional development and conduct sharing on effective ICT practices for school visits and work with schools

Family and communities support

This section summarises the roles of families and communities in supporting the ICT integration regionally. The following are the key findings:

- Teachers and students perceived the practical uses of ICT favourably (above 2.5 of 5). During the interviews, teachers mentioned the mixed feelings of parents' involvement in supporting students' use of Internet at home. They also mentioned parents' imposition of controls for their children's computer use at home. As a result, the teachers limited students' online assignments mostly to be completed in schools. This will impose on the schools' constant need to provide, upgrade and maintain the ICT facilities available for the students.
- From the statistics files provided by DSEJ, it was observed that the outreach programmes organised related to ICT use compared to other statistics was moderately low in terms of the amount set aside and the frequency.

Implications

- The ubiquitous use of ICT for learning anywhere is hard to achieve because it is limited by the parents of the students. This factor could limit the students' learning experiences with ICT in the long run. Schools need to look into this as this will also limit the teachers' designing of innovative lessons, the link in class and beyond class teaching for ICT integration in Macao.

Singapore Masterplans

Singapore has gone through three 5-year Masterplans for ICT in education starting from 1997 and now at the stage of the 4th Masterplan. Each Masterplan has its specific focus. The 1st Masterplan focused on infrastructure and teachers' professional development; the 2nd focused on fostering students' engaged learning through the use of technology; the 3rd emphasized on students' self-directed learning and collaborative learning; and the recent 4th Masterplan focuses on students' quality learning.

Implications

Using the experience learnt from the Singapore's ICT Masterplans, the following are some recommendations which could be useful for Macao's consideration:

- The successful implementation of ICT in Macao schools may have to go through a few key stages, such as: building the foundation (e.g., infrastructure and teacher training), seeding innovations in a few ICT champion schools (by using the action research approach), strengthening and scaling up to more schools (e.g., sharing best practices).
- There is a need to educate Macao parents on the affordances of ICT tools to support their children's future readiness in the global marketplace. DSEJ and schools may work together to develop strategies to involve parents in using ICT to support students' learning.
- ICT can be more pervasively integrated into all subjects, rather than in the ICT subject only. ICT can be effectively used as a tool to support teaching and learning in various subjects, rather than as a subject to learn. This can be done through professional development of subject teachers, guided by the TPACK framework, which means that the teachers of all subjects must have technological knowledge in addition to the content and pedagogical knowledge. In particular, teachers also must know how to use technology to support specific pedagogical approaches in specific subjects.
- If Macao intends to adopt "infusing basic use of ICT into all subjects", then a new revised ICT baseline standard will have to be developed to provide guidelines to both teachers and students in the early stage of ICT integration. The "ICT infusion" can then be advanced to the next stage of integration based on the schools' requirements and the teachers' competency of TPACK.
- The central idea of ICT-based pedagogy should be to shift from "teacher using technology to teach" to "student using technology to learn". This transition must be done in phases, such as, in Masterplan 1, the focus was to build ICT infrastructure and provide teachers' professional development. In Masterplan 2, the focus was the

pedagogical use of ICT to make lessons more engaging. In Masterplan 3, enhancement of pedagogy continues but added elements of self-directed learning and collaborative learning to better equip students to meet the 21st century workplace demands. In Masterplan 4, the pedagogical use of ICT is further enhanced by encouraging teachers to design innovative lessons that contain the “applied” nature and to maximize the affordances of technology.

Recommendations for ICT development in Macao

The recommendations are given on the following 4 aspects:

- Students’ learning with ICT
- Teacher’s teaching with ICT
- School ICT infrastructure and systemic support
- Future directions

For students’ learning with ICT, Macao may need to re-look into the existing standards to see if they are still relevant or any specific skills should be revised if ICT is intended to be integrated into every subject. Singapore’s new baseline ICT standards can be used as a reference to update the existing standards. In addition, fostering students’ quality learning with the support of ICT should be emphasized. Macao may need to examine the possibility of strengthening the integration of ICT at the primary school level first, and then extend to higher levels by developing sample lesson plans and sharing useful practices. Furthermore, students must be responsible for their ICT use. The Singapore MOE cyber-wellness framework can be used as a reference.

Regarding teachers’ teaching with ICT, a recommendation is that ICT can be more broadly integrated into every subject and every subject teacher must be ICT competent. To achieve this, teachers’ professional development is important. The TPACK framework can be used as a guideline to train Macao teachers on how to incorporate technology into their specific teaching subjects. In particular, the training should focus more on the intersection of the three components (i.e., content, pedagogy, and technology) of the TPACK framework. In addition to the face-to-face training, Macao can also consider creating an online learning community across all schools to share their exemplary lesson plans and other resources, which is also helpful for teachers’ professional development.

With respect to the school ICT infrastructure, Macao may consider examining and updating the schools’ ICT infrastructure for all schools as the current school ICT infrastructure presented rather inconsistent levels of adequacy in terms of access to the latest tools, use of ICT facilities, and degree of ICT integration into teaching. The school may also need to

redefine the roles of the IT support centre by recommending relevant ICT tools, developing digital resources, or conducting PD training for teachers but leave the maintenance to external vendors. Providing systemic support for ICT integration begins with establishing the ICT vision and mission at the regional level. DSEJ can take a more pro-active role in implementing a more focussed and overall integration plan of ICT in education and teacher professional development initiatives.

Following the future directions of other cities or regions, Macao ICT education can focus on using ICT to support smart education and applied learning in the future. Macao is recommended to develop a blueprint or an action plan for guiding the development of smart education in the region, and the smart education can be gradually implemented in three phases: i) building infrastructure and digital resources; ii) creating campuses and classrooms; and iii) developing smart learning platforms to meet the individual needs of students. For applied learning or STEM education, Macao may consider setting up makerspaces in all schools and let students have the opportunities to explore and apply their knowledge and skills from Science and Mathematics. Schools can also work together with external organizations to provide the technology and engineering aspects to support the STEM work for teachers and students. Such an implementation would tend to be more successful if it were to take a “top-down initiative and bottom-up delivery” approach.