Computer-based Examination in Singapore: The Journey So Far

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ABSTRACT

The Singapore Examinations and Assessment Board (SEAB) has successfully conducted its first computer-based examination. In November 2013, about 300 Grade 11 candidates sat for the Mother Tongue Language B Syllabus Examination using a computer-based writing platform to compose a response to either an email or a blog stimulus in one of the Mother Tongue Languages, i.e. either in Chinese, Malay or Tamil Language.

This paper shares SEAB's journey in implementing computer-based examination, focusing on the following aspects: technical, operations, training, communication and support provided to examination personnel. Besides sharing the experiences and success factors, we will also share the challenges faced, as well as the considerations and mitigating measures taken, leading to all candidates successfully completing their computer-based examination.

Keywords. Computer-based Examination, Computer-based Assessment, e-Examination, e-Assessment, Mother Tongue Language Testing, Singapore

INTRODUCTION

Since the first Masterplan for Information and Communication Technology (ICT) in Education in 1997, all schools in Singapore have been leveraging the use of ICT to develop self-directed and collaborative learners. As ICT is now an integral part of the curriculum, there is a coordination of plans to ensure that assessment, including national examinations change in tandem to bring about better alignment with teaching and learning, and allow the assessment of learning outcomes that are pertinent to success in the 21st century.

The Singapore Examinations and Assessment Board (SEAB) has embarked on research into computer-based assessments since 2009. The findings from the research studies informed the implementation of the first national examination in November 2013 which introduced computer-based writing into the Mother Tongue Language B (MTL B) Syllabus for Grade 11 students. About 300 candidates from 19 high schools sat for this examination, where they were required to use a computer-based writing platform to compose a response to either an email or a blog stimulus in one of the Mother Tongue Language (MTL), that is, either in Chinese, Malay or Tamil Language. The feedback received from school personnel and candidates on this first computer-based examination was positive.

This paper shares SEAB’s journey in implementing computer-based examination.

APPROACH

ICT opens many opportunities for assessment, ranging from improving the efficiency of traditional assessment processes to offering new assessment methods that cannot be otherwise realised. Despite the potential of ICT to change the face of assessment, large scale implementation of ICT in assessments, such as in national examinations, still faces technological challenges that require further research and study. In Singapore’s context, national examinations are high-stake assessments where in addition to validity, reliability and fairness considerations, integrity and security are also top priorities. National examinations are hence conducted predominantly in single sessions across the entire cohort of candidates sitting for the same subject.

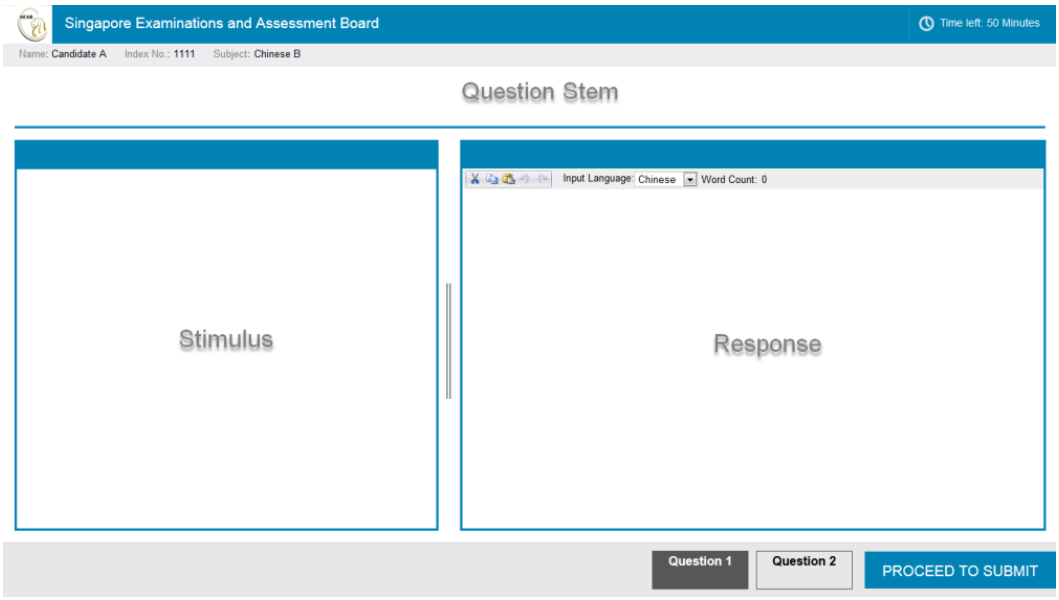
Value-add to Examination. Thus, in planning the computer-based examination journey for Singapore, the approach adopted was strategically calibrated such that the use of ICT would add value to the design, delivery and use of examinations for educational purposes, beyond just reaping the benefits of operational efficiency and still meet the 5 priorities. SEAB is mindful that computer-based examination is a means to support national educational outcomes, and not an end in itself.

The above consideration, as well as the learning from other examination authorities and research findings, influenced the choice of the first subject MTL B for computer-based examination. We will discuss the contributing effects of choosing MTL B as the first subject for computer-based examination later in this paper.

FEATURES OF THE COMPUTER-BASED WRITING PLATFORM

To deliver the MTL B tests electronically, the ICT platform must allow candidates to construct and input open-ended responses in different languages. A software application with multi-language text input capability was thus developed to deliver MTL B tests to candidates and to capture their responses for offline marking and scoring.

The picture below shows the standard template adopted for the test items. The writing stimulus is on the left, and the response pane that functions much like a simplified word processor, is on the right. Basic text input functions are available at the top of the response pane and also accessible through standard keystroke combinations like Control-C for copying text. The design is kept simple to enable students to quickly learn and easily use the format as they would in their typical writing activities at home or at school.



This application was designed to work in a non-networked environment. The electronic test packages comprising MTL B tests and the software application are delivered to schools on USB flash drives. The packages can either be installed and the tests run from computers or the tests can be run entirely off the flash drives. However, for better technical performance, the first method was adopted at schools. Candidate responses are saved on the computer hard disks as well as simultaneously backed up on external flash drives attached to the computers. The application has a function to print the responses in pdf format for offline marking and scoring.

The security features built into the application are login identity and password, 'locked-down' browser to prevent access to unauthorised digital materials during test-taking, and encryption of the tests and responses. The technical security features are complemented by examination standard operating procedures to protect the integrity of the examination.

IMPLEMENTATION OF COMPUTER-BASED EXAMINATION

Coordinated and Systematic Approach. Recognising the complexity of implementing computer-based national examination, the efforts of major stakeholders had to be coordinated at each of the different levels. This coordinated approach was to ensure that all aspects of computer-based examination, from ICT-enabled teaching, learning and assessment to school ICT environment was systematically studied and addressed at both the policy level and the operational level.

A committee for the use of ICT in national examinations, chaired by SEAB with representatives from the Ministry of Education (MOE) was set up to develop and oversee action plans for the delivery of ICT in national examinations with ICT in teaching and learning, as well as to advice on infrastructure needs in schools.

- *ICT-enabled Teaching, Learning and Assessment.* The use of ICT for teaching and learning has become a common feature of classrooms in Singapore schools. New syllabuses developed by MOE emphasise the use of ICT to enhance students' learning of 21st Century competencies. Teachers are supported to harness ICT in helping students learn through professional development programmes. MOE also provides digital resources and digital platforms so that students have sufficient exposure to the use of ICT in daily learning activities. These initiatives pave the way for the use of ICT in national examinations.

- *Baseline ICT Infrastructure*. In 2011, MOE introduced the Schools Standard ICT Operating Environment (SSOE) Programme to provide a baseline ICT infrastructure for schools. This includes the provisioning and management of computing devices and network environment, as well as technical support for schools in order to systematically build a future-oriented ICT environment for teaching and learning. This standard established a basic level of consistency in the ICT environment across schools, and greatly facilitated the implementation of computer-based examinations.

- *Provisioning of Computers*. Under the Masterplan for ICT in Education, schools were provisioned with computers at a ratio of 1:4 for middle and high schools. Hence for a typical high school with approximately 1 600 students, there would be at least 400 computers in the school available for learning and assessment. Each high school was also typically provisioned with 4 computer laboratories equipped with the necessary electrical power support and internet connectivity.

At the operational level, a project team from SEAB planned the end-to-end preparation and implementation of the computer-based examination, supported by the Information Technology Branch (ITB) of the Ministry of Education. The close collaboration with the Ministry of Education was a major success factor in ensuring a consistent implementation of the school ICT environment for computer-based examinations across all schools now and for the future.

Standard Operating Procedures. Standard Operating Procedures (SOPs) ensure the integrity, security and timely availability of the computer-based examination to all candidates.

- *Integrity Consideration.* Examination integrity is of great importance in any high-stakes assessment. While security features to ensure integrity had already been built into the software application, these had to be complemented with physical features and processes. The computer laboratory was designated as the examination venue as it was able to support the power requirement for co-located computers, and in future, internet connectivity for an internet-based delivery model. There were also other details such as distance between candidates and privacy filters for computer screens to attend to.

- *Security Consideration.* To coordinate the preparation for computer-based examinations in schools, a new examination personnel role was created. This role is performed by a teacher appointed by the school to oversee preparations in the school, including managing the security processes.

- *Resiliency Consideration.* To ensure timely availability of tests, only notebooks were used for the computer-based examination. In the event of a power outage, candidates can continue with the examination without disruption due to the backup power from the notebook batteries. Spare notebooks are also available for candidates' use in special circumstances.

Support. A comprehensive plan was established to support school personnel and SEAB in the implementation of the computer-based examination. The support provided are on-site support at schools, off-site support as well as remote support provided by the software developer. For the time-sensitive test-taking period, on-site support officers had to be competent to promptly and calmly assess and address the issues. Possible problem areas were identified and clear SOPs provided to guide the support officers.

Training. Beyond planning, training of the different parties was important to familiarise them with their respective roles and responsibilities, and to equip them with the necessary knowledge and skills. The table shows the different training activities for all parties.

	Instruction Manuals/ Checklists	Briefings	Training Workshops	Practice Sessions
SEAB Test Authors	♦		♦	♦
SEAB Exam Operations Personnel	♦		♦	♦
School Exam Operations Personnel	♦	♦		♦
School Test Administrators / Invigilators	♦	♦		
Candidates				♦

Table: Comprehensive Training Activities

In addition, a number of practice sessions were conducted in the schools to rehearse the end-to-end processes of the computer-based examination. In particular, there would be a minimum of two practices before the actual examination.

Communication with Stakeholders. The communications plan took a holistic approach, informing stakeholders first about the use of ICT in teaching and learning as part of the curriculum in preparing students for success in the 21st Century, and leading on to the use of ICT in assessment and national examinations, so that stakeholders can appreciate the alignment between what is taught and learnt in the classroom, and what is assessed. This aims to assure parents that teachers and students will be adequately supported and prepared for the new mode of examination. The engagement plan also includes senior management in MOE and school leaders, relevant school personnel and the media at suitable intervals to apprise them of the development. A communication resource package was also developed for these purposes.

SUCCESS FACTORS

We believed that success begins with having the right focus in using ICT in assessment, especially in high-stakes national examination, as well as adopting a progressive approach that builds confidence, engenders positive experiences, and manages the risks associated with computer-based examination.

Alignment of Teaching, Learning and Assessment. As the learning of MTLs has shifted to focus on proficient use of the languages in real-life situations, students are exposed to contexts and skills in the classrooms that are related to the modern digital world, such as responding to email and writing a blog in MTL B, both of which are typical tasks done using a computer in real life and hence, better assessed using ICT. To support MTL learning, MOE provides digital resources and digital platforms, including the i-MTL Portal[1] so that all students have equitable access and sufficient exposure to the use of ICT in daily learning activities, thus better preparing them for computer-based examination when introduced. The close collaboration with MOE to ensure alignment of teaching, learning and assessment was a key factor to ensure student readiness for the MTL B computer-based examination.

Value-add to Examination. The requirement to present the MTL B test in 3 different languages, ie Chinese, Malay and Tamil, while a uniquely Singaporean phenomena, also offered opportunities for studies on computer-based writing in extended response items using various text-input software. These studies could pave the way to implement computer-based writing in other language subjects in future, and contributed to the choice of MTL B as the subject for the first computer-based examination.

Start Small. At approximately 300 students annually, the candidature for MTL B at Grade 11 is a manageable size for a first attempt at computer-based examination. Moreover, Grade 11 students would have had more exposure to using ICT in schools and in their daily lives, and hence more comfortable with using computers in examinations. They would also be mature enough to manage the change in examination mode. The manageable size also allowed better control of the new SOPs and multiple practise sessions that yielded critical lessons for the actual examination.

Continuous Improvement of the Robustness of the Examination Solution. Key to a computer-based examination is the robustness of the software application. The prototype of the software application was rigorously field tested in 2011-2012. The enhanced version used for the actual examination in 2013 was further tested during the practice sessions. All technical issues surfaced were addressed before deploying the software application in the actual

[1] A web-based portal that uses multimedia to engage students in authentic learning tasks and strengthen their language skills http://www.moe.gov.sg/media/press/2012/08/new-imtl-portal-to-help-students.php

examination. The approach of starting with the relatively simple delivery mode of using removable storage media was also a key success factor.

Risk Management. While the SSOE programme aims to provide consistent ICT environment in schools, schools have a certain degree of flexibility to customise the ICT environment to their unique teaching and learning needs, for example, installing software in computers for school-based programmes. This flexibility poses risks for computer-based examination. However the centralised approach to provision and management of ICT environment allowed for more effective management of the associated risks and also establishment of a common baseline for computer-based examinations beyond 2013 which balances the consistency requirement for examination with the flexibility consideration for progressive teaching and learning.

Competence and Confidence of People. Another key success factor was systematically building the capacity and capability of the people to conduct the computer-based examinations. The coordinating structures at policy and operational levels facilitated collaboration and teamwork across different functions, and contributed to better oversight of the entire process. The SOPs, support structures and customised training programmes were important to building the competence and confidence of all personnel involved.

Create a Positive Experience. Keeping the ICT experience positive and pleasant was an important consideration in the design of the computer-based examination. The design principles leverage on the potential of ICT to provide authentic experiences, to automate and to simplify, so that users can see the value and experience the benefit of computer-based examination. The positive experience in the smooth conduct of the first computer-based examination will boost confidence in the integrity of such examinations and pave the way for more.

FUTURE CHALLENGES

Scalability of Solution. The non-networked delivery model was labour intensive as examination personnel had to install the electronic test packages into each notebook. Hence the technical solutions for MTL B described above would be difficult to scale up for subjects with large candidature, due to constraints of manpower, equipment, infrastructure and connectivity. Alternative options would need to be explored.

Student Readiness. Finally, particularly for high-stakes examinations, there must be confidence that each and every student has the opportunity to learn the required skills and gain the necessary exposure to participate fairly in a computer-based examination. Therefore, continued close collaboration with MOE to ensure alignment in teaching, learning and assessment, as well as student access and exposure to ICT in daily learning activities is instrumental to prepare students for computer-based examinations.

CONCLUSION

The ‘value-add, start small, start simple’ method used, which focused on the fundamentals of implementing a computer-based examination worked well for SEAB. The learning from the experience was useful in planning for other subjects with larger number of candidates. We will continue to strategically plan for the use of ICT in areas that will add value to examinations in

Singapore, leveraging on the learning from our experience as well as research findings from colleagues all around the world.