SEAB-link

Dear Readers,

The journey for onscreen marking (OSM) in Singapore started in 2015, with the aspiration to transform the markers' experience in marking local papers and add value to the end-to-end process of the marking exercise.

The OSM was piloted for subjects with smaller cohorts. Positive results in terms of the gains in process improvements and markers' experience were observed. These spurred the Singapore Examinations and Assessment Board (SEAB) to pursue the initiative more vigorously and in 2019, we completed the development of the OSM system and rolled out OSM for subjects with larger cohorts across the GCE-level examinations.

In this special issue of the SEAB-link, we bring you insights on SEAB's OSM journey, the markers' experience with the OSM, and the common misconceptions related to OSM.

We hope you will gain a better understanding on how the OSM will add value to the conduct of examinations and markers' experience, while the rigour of marking is maintained to ensure fairness and integrity of the national examinations.

Enjoy the read!

Corporate Communications Department
In collaboration with Assessment Planning & Development Division, Exam Operations Division and Research & Development Division

Contents

Celebrating Change and Transformation

Someone asked me if there are any transformation initiatives in SEAB ? The answer I gave was a resounding "Yes".

Onscreen marking is one of the key transformation projects which will transform local script marking in the next 4-5 years. It is not just about scale (across levels – GCE-levels and PSLE), or about scope (across subjects). It is also about depth (impact) which enhances SEAB staff's work experience and that of our markers.

This transformation is certainly mission driven and customer-centred. Through onscreen marking, the reliability and efficiency of marking is enhanced, thereby safeguarding the integrity of examinations. We engage our markers extensively so that they will have a good experience in marking.

I met a Principal friend one day whilst having breakfast. She is a Chief Marker of a PSLE subject. She shared that she has heard very good comments about our onscreen marking familiarisation runs at the PSLE Higher Mother Tongue Language centre. These comments from the ground are encouraging and gives SEAB the assurance that we have provided markers with quality experience through their engagement with onscreen marking.

Certainly, the journey is not an easy one but our staff had risen to the occasion. We will continue this meaningful transformation journey with a great sense of pride.

Yue Lip Sin

Chief Executive
Singapore Examinations and Assessment Board

Transforming Markers' Experience, Upholding Exam Integrity

An Overview of **On-Screen Marking**

WHAT IS ON-SCREEN MARKING (OSM)?
OSM is marking examination scripts digitally on a computer screen.

WHY IS SEAB IMPLEMENTING OSM?
By leveraging on technology, OSM can enhance marking efficiency and reliability.

BENEFITS OF OSM

Improved quality assurance, i.e. reduction in human error

Increased efficiency in administrative and operational processes

Reduced security risk relating to transporting and handling of scripts

Improved professional development and assessment literacy of markers

Improved data capture to better inform teaching and learning

PAPER-BASED MARKING PROCESS

1. Paper-based examinations
2. Collection of scripts
3. Paper-based marking
4. Recording, transferring and checking of marks. Reconciliation of differences, if any
5. Counting and packing of scripts after marking

ON-SCREEN MARKING PROCESS

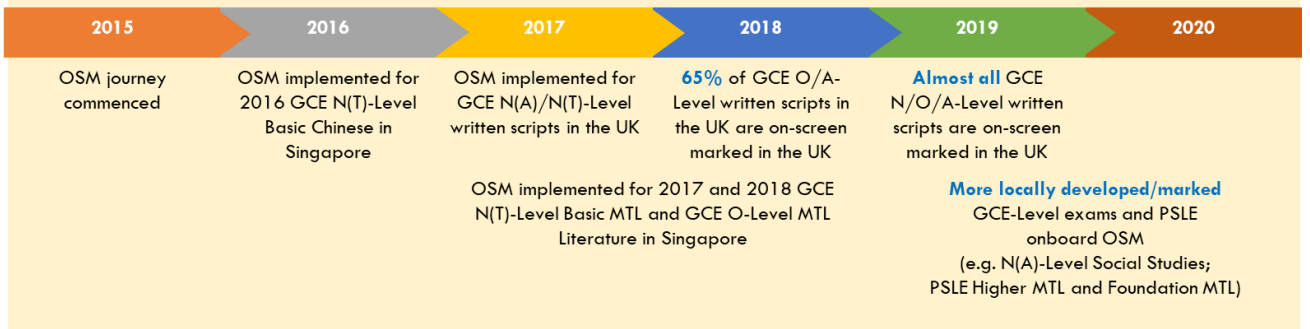1. Paper-based examinations
2. Collection of scripts
3. Scanning of scripts
4. On-screen marking with quality assurance measures

IMPLEMENTATION TIMELINE

2015	2016	2017	2018	2019	2020
OSM journey commenced	OSM implemented for 2016 GCE N(T)-Level Basic Chinese in Singapore	OSM implemented for GCE N(A)/N(T)-Level written scripts in the UK	**65%** of GCE O/A-Level written scripts in the UK are on-screen marked in the UK	**Almost all** GCE N/O/A-Level written scripts are on-screen marked in the UK	

OSM implemented for 2017 and 2018 GCE N(T)-Level Basic MTL and GCE O-Level MTL Literature in Singapore

More locally developed/marked GCE-Level exams and PSLE onboard OSM (e.g. N(A)-Level Social Studies; PSLE Higher MTL and Foundation MTL)

ENHANCED MARKERS' EXPERIENCE

- No more counting of scripts
- No need to match marking sheets and scripts
- No more errors in transferring marks from scripts to marking sheets

- No need to total and write marks on marking sheets
- No more shading or writing on marking sheets
- Better able to monitor own marking speed and progress

OSM transforms the marking of local examination scripts while maintaining the rigour of marking.

Research Studies on Onscreen Marking

Introduction

The use of onscreen marking (OSM) by examination boards and testing agencies to replace paper-based marking is becoming more prevalent around the world. Since the turn of the millennium, they have embarked on the OSM journey by carrying out a series of related research before introducing it to high-stakes examinations. Notable of which are Cambridge Assessment which is part of the University of Cambridge in the UK, Educational Testing Services (ETS) in New Jersey, USA, and Hong Kong Examinations and Assessment Authority (HKEAA) in Hong Kong.

The OSM research of SEAB has also been in full swing since 2015 for the preparation of the OSM rollout in national examinations. It is envisaged that all locally marked GCE-level examinations in Singapore will be on-screen marked by 2021 and the PSLE examinations will follow suit.

OSM offers many benefits over traditional paper-based marking (PBM). However, when transferring from one medium to another, it is crucial to ascertain the extent to which the new medium may alter the nature of traditional assessment practice or affect marking reliability. Since the turn of this century, a huge amount of research effort, therefore, has been put into investigating comparability between PBM and OSM.

One of the unrivalled advantages of OSM over its paper-based counterpart is the capture of detailed massive marking data in situ, which could be used for subsequent data analytics. Different stakeholders of OSM would be able to benefit from such

analytics, for example, a more informed grade-awarding meeting as a result of item-level data analytics; an in-depth markers' quality assurance analytics on different item types; and tailor-made professional training for individual markers derived from markers' analytics.

Research on marking reliability and marking mode comparability

For short-answer scripts, research evidence indicated that markers' onscreen marking is reliable compared to their paper-based marking (Whetton & Newton, 2002; Shaw, 2008). For extended-essay scripts, although research findings in the past suggested that marks from PBM were slightly more reliable than those from OSM due to a lack of markers' computer experience and familiarity (Twing, et al., 2003), many research studies have concluded that PBM and OSM are in general comparable in terms of marking reliability (Bennet, 2003; Johnson, et al.,2009; Johnson & Nadas, 2009). Similar research findings on marking reliability and marking mode comparability for different item types were also confirmed by SEAB (Yim & Chew, 2019).

According to a recent Cambridge Assessment study (Cambridge Assessment website, 2019), although markers appeared to work harder onscreen to achieve similar outcomes to paper marking, others felt energised by particular aspects of onscreen marking, for example, 'seeing the scripts off by a click' and reduced amount of administrative and logistical work. The study concluded that 'markers can mark extended essays just as reliably on screen as they can in the traditional paper mode, if properly done'. This finding certainly has

important implications for assessment. Educational research such as this therefore plays a vital role in the continuous improvement of education and assessment policies and practices.

Research on OSM data analytics on candidates' performance

As the OSM technology has been in use for almost two decades, many technical aspects of the technology have been well established and maintained, e.g., quality of the scanning solution, robustness of the OSM software platform, and different quality assurance mechanisms during marking. For the past few years, SEAB has customised several data analytics' functions with the local context, one aspect of which is the data analytics' reports for candidates. At the completion of a marking session, different item-level data (ILD) reports could be generated from the platform for the Assessment Specialists to examine candidates' performance at sub-item level. ILD reports, on the one hand, could help understand candidates' strengths and weaknesses within the assessment which

will be useful in formulating a strategy for teaching and learning in the future. On the other hand, they could provide additional in-depth information to further reinforce decisions made during grade awarding for candidates.

Research on OSM data analytics on markers' quality assurance

On top of the candidates' analytics, analytics on markers' quality assurance is another area of research which has received much attention in recent years. The OSM software platform, in general, is equipped with quality assurance mechanisms to safeguard marking standards, namely: i) standardisation scripts to ascertain if markers are ready to move onto live marking; ii) quality assurance (QA) scripts to check on marking consistency during live marking; iii) random check by senior markers to sample markers' live marking scripts; and iv) double marking by two markers on the same live script to compare against each other's marks. The generation of markers' analytics on the fly would have been impossible without these inbuilt QA mechanisms in tandem with other statistical algorithms that are programmed either within or outside the OSM software platform. Cheung & Lo (2014) have demonstrated how markers' analytics was able to reduce the time in identifying markers whose marks were too lenient, severe and/or of lingering doubts. Providing timely consultation and early advice to these markers would greatly augment their marking reliability for the rest of their marking. SEAB has recently developed an alternative approach on markers' quality assurance analytics which could help the Assessment Specialist refine his/her strategies of markers' deployment and training for any future OSM exercises (Yim, 2018).

The SEAB OSM research team is committed to exploring new ways to refine this technology for the purpose of assessment. The insights gleaned from the analytics could be applied to strengthen assessment literacies of the teaching fraternity for enhanced teaching and learning. Currently, a few OSM studies on different research topics are in the pipeline, covering disparate areas of the technology.

Reference

Bennet, R (2003), On-line Assessment and the comparability of Score meaning. ETS RM-03-05. Princeton: Educational Testing Service.

Cambridge Assessment website (2019): https://www.cambridgeassessment.org.uk/insights/on-screen-essay-marking-is-reliable/

Cheung, K.M.A. and Lo, Y.K.W. (2014): Role of Assistant Examiners in Marker Behaviour Modification during Onscreen Marking (OSM), 40th IAEA Annual Conference Proceedings, Singapore.

Johnson, M. and Nadas, R. (2009), An investigation into marker reliability and some qualitative aspects of on-screen marking, Research Matters, Issue 8, June 2009, pp. 2-7.

Johnson, M., Nadas, R. and Shiell, H. (2009), An investigation into marker reliability and other qualitative aspects of on-screen essay marking, British Educational Research Association (BERA) Annual Conference Proceedings, Manchester University, Sept 2009.

Shaw, S. (2008), Essay Marking On-screen: implications for assessment validity, E-Learning, Vol.5 Number 3 2008, www.wwwords.co.uk/ELEA

Twing, J.S., Nicholas, P.D., & Harrrison, I. (2003), The comparability of paper-based and Image-based marking of a high stakes, large scale writing assessment, 29th IAEA Annual Conference Proceedings, Manchester, UK.

Whetton, C. & Newton, P. (2002), An evaluation of online marking, 28th IAEA Annual Conference Proceedings, Hong Kong SAR, China.

Yim, L. (2018), Using on-screen marking (OSM) data parameters to gauge markers' performance, 44th IAEA Annual Conference Proceedings, Oxford, UK, pp. 27.

Yim, L. & Chew, K.W. (2019), An introduction to on-screen marking (OSM) in SEAB, 2019 MOE Professional Forum on Research and Practice Proceedings - Symposium Session, Ministry of Education, Singapore, pp. 26.

How Does Onscreen Marking Work?

About 450,000 scripts are marked locally by appointed markers who are school teachers. The pen-based marking mode has served the national examinations well. Advancement in technology has opened doors for SEAB to move pen-based marking to onscreen marking. By leveraging on technology, onscreen marking enhances efficiency and reliability. Let us take a closer look at how onscreen marking is carried out at SEAB and at the marking centres.

What does the OSM System comprise?

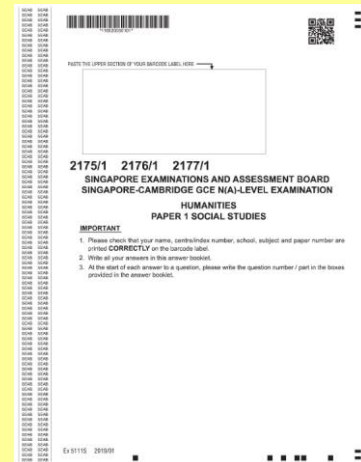Answer Booklet Scanning System, which is made up of a script cutting machine, script jogger and scanner machine.

Onscreen Marking System

How would candidates sit papers that are onscreen marked?

There is no change to the examination format and procedure.

Candidates will sit the examination and write their answers on paper-based question papers. Examination venue and setup remain the same.

At the end of each examination, the hardcopy answer scripts are collected and sent to SEAB for centralised scanning and processing. In order for the scripts to be scanned page by page by the Answer Booklet Scanning System (ABSS), the answer booklets for the subjects that are onscreen marked have been redesigned such that each booklet has the necessary information. For example, each booklet has a barcode, QR Code, candidates' identity sticker, and other technical guides that allow the scanner and software application to identify and process the candidates' papers uniquely.

When the answer scripts arrive at SEAB after the examinations, the spines of the scripts would be cut before they are fed into the scanner. Technology leveraging Artificial Intelligence is used to verify the scanned script for errors. A second layer of verification is then done by SEAB staff. The use of technology as the first layer of verification reduces the amount of human verification work that needs to be carried out before the candidates' scripts are distributed via the OSM system for marking.

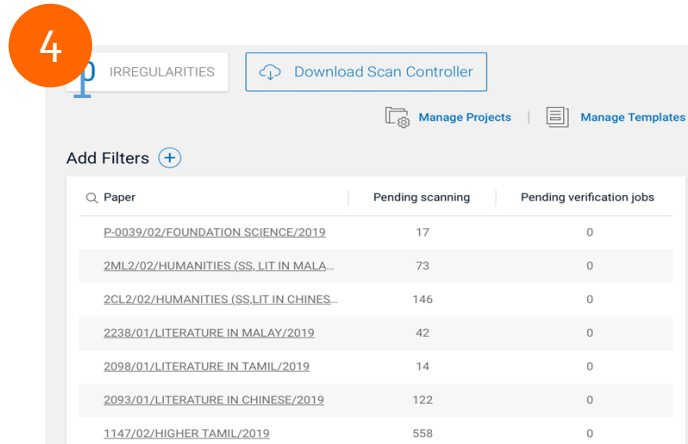Let's see the process in detail:

1

Spines of answer scripts are cut. 1000 scripts (or 16,000 pages) can be cut per hour with 2 cutters.
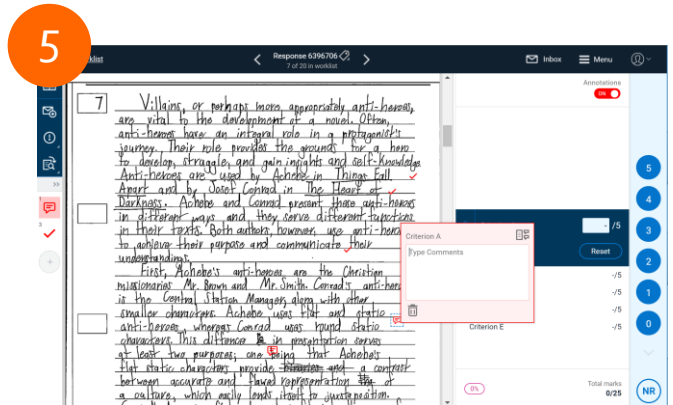

2

"Jog" & "blow" the cut scripts to reduce static between pages for smoother scanning.

3

Scripts are scanned. Each scanner is able to scan 140 scripts (or 12,240 pages) per hour.

4

Irregularities such as errors that are generated due to the scan will be resolved through Artificial Intelligence and human checks.

5

Scanned scripts are randomly distributed to the markers at the respective marking centres.

Similar to marking of physical scripts, markers will participate in a practice and standardisation session before they start marking the 'live' scripts in the OSM system. The candidates' responses are single-marked and augmented with multiple levels of checks to ensure quality of marking. These include random checks by the Key Personnel of the marking team and checks against pre-marked scripts which are known as Quality Assurance Scripts.

How does OSM add value to the conduct of the national examinations in Singapore? Turn over to the next page to find out more!

How Would Onscreen Marking Value Add To The Conduct of Singapore National Examinations?

Key Benefits 4

In 2015, SEAB commenced on its journey to explore the use of onscreen marking in local marking. Since 2016, SEAB had conducted pilot onscreen marking runs and in 2019, SEAB's onscreen marking system was successfully deployed in September for various GCE-level subjects. What benefits have OSM brought to the conduct of national examinations?

Improved quality assurance

As all OSM scripts are entirely anonymous, integrity and fairness in marking are upheld. Conflict of interests are managed via programming logic, hence ensuring that markers do not mark scripts from their own schools. In OSM, a set of pre-marked "Quality Assurance Scripts" are distributed randomly among unmarked live scripts. By comparing and hence monitoring individually marked scripts against these "Quality Assurance Scripts", OSM allows for early identification and guidance of markers which further enhances the marking quality.

Reduced security risk relating to transportation and handling of scripts

There is no need to transport hard copy scripts to and from different marking centres. This reduces the risk of scripts being lost or damaged.

Increased operational efficiency

For markers, time spent on administrative tasks such as counting of paper scripts and recording of marks are reduced. Much of the preparatory work for marking is done without having to physically handle large amounts of paper. Marks are automatically tallied by the system so there are no computational errors that need to be checked and corrected. The use of "quality assurance scripts" obviates the need for double marking of non-essay scripts. Thus, OSM also helps to raise productivity whilst ensuring quality of marking.

Data analytics to enhance marking processes

The data captured via OSM provides greater insight into the marking process (e.g. markers' efficiency and accuracy in marking). This allows for customisation of markers' professional training to strengthen marking accuracy. Richer item-level data on candidates' performances is captured to better inform teaching and learning as well as test development.

Reflections of a Chief Marker

Introduction

SEAB has put in place rigorous and robust processes for the conduct of paper-based marking (PBM) to ensure the good quality of marking, operational efficiency, and secure movement of candidates' scripts. I was very excited when SEAB started to explore onscreen marking (OSM). It was an opportunity for the senior marking personnel to work with SEAB to rethink our marking processes to make marking more productive. I was glad that key marking principles that ensured the fairness and integrity of PBM are featured prominently in the design and conduct of OSM. I would like to share my reflections serving as a Chief Marker in OSM this year, having served in the same role in PBM.

The robust marking processes of PBM are manifested differently and enhanced in OSM

My team and I were glad that the key marking principles and processes in PBM were enhanced with technology in OSM. One was the introduction of Quality Assurance Scripts (QAS). These are scripts that have been pre-marked by my supervisor team, which the system then randomly distributes to the markers during the marking exercise. My supervisors were then able to get timely feedback on their markers' application of the mark scheme using the QAS, which as the name suggests, ensures the quality of marking by allowing inaccuracies to be addressed immediately. Another great feature was specialised marking! The system could 'cut' the candidates' scripts into question item groups (QIGs) and automatically distributed the QIGs to markers assigned to mark them.

This specialisation really helped to hasten the pace of marking and made marking more accurate. While the technology has really changed the way we mark, we were very glad that features that are important in PBM are also available in OSM. For example, while the system allows us to do standardisation in much the same way as in PBM, the system also caters for better selection and categorisation of scripts for use during standardisation. The markers were also glad for the drag-and-drop marking annotations and the automatic totaling of marks awarded. Finally, my team and I agreed that we should continue with face-to-face discussions when guiding our markers, rather than rely only on the communication function in the system. We felt that it was so necessary to keep the engagement and professional bonding as a community.

OSM enhances the operational and administrative efficiency of the marking process

The time spent on administrative tasks such as counting and re-counting of paper scripts, and manual recording and scoring of marks was eliminated! I never thought I could see the day when the markers need only focus on marking of candidates' scripts. I was very happy to see my marking supervisors focused on professional work such as sampling scripts to check on marking accuracy and guiding their teams in applying the mark scheme consistently. My supervisors and I could also use the OSM system functionality to track the progress of individual markers and keep the marking exercise on track without compromising the quality of the marking. I found it extremely

helpful and efficient to have access to data about my team at the click of the mouse! Although the laptops were fitted with blue-light filter to reduce glare, some of us did feel a little tired towards the end of the marking exercise. I encouraged my markers to take frequent breaks to prevent eye fatigue through prolonged staring at the screen.

The OSM system is easy to use

My supervisor team and I were involved in the User Acceptance Test of the system, where we tested out the end-to-end process of OSM. We are glad that our feedback was helpful to make the system useful for future users when OSM is rolled out to other subjects. We, the pioneers, certainly found the OSM system intuitive to use. Instead of a pen, we now hold a mouse. Hmm...perhaps next year, I could bring my tablet PC, then it may just be like marking on paper!

2019 will be a memorable year for my team and I, as pioneers of OSM. The OSM system is easy to use and we certainly did not miss the tedium of shuffling paper scripts around, and recording and totaling scores. We look forward to working together as a team to make OSM an even more enjoyable experience in future marking exercises.

To my Social Studies marking team - thumbs up for making OSM a success!

Voice of OSM Markers

I was a little apprehensive at first as I was wondering how the skills and processes from pen-based marking would be translated to an onscreen marking environment. However, I was prepared well for the onscreen marking. There was a lot of collaboration between SEAB and the markers – SEAB involved the key personnel early and obtained our feedback on how the system and processes can be improved. The pre-marking training and briefing sessions helped to ease the markers into the onscreen marking well. Overall, the onscreen marking did not hamper our markers' professionalism in marking.

I wish to thank SEAB for the well-thought through planning and execution.

- A senior marker

A lot of the fears that we had initially, such as user-friendliness of the system, eye fatigue, were allayed after we have gone through the training and marking. The marking experience did not drastically change as almost everything stays the same generally. It is just a change from pen to mouse!

SEAB did a good job of informing and preparing us early, instead of throwing us into the job on the day of marking.

One good thing about the OSM is that the quality of markers can be checked through the Quality Assurance Scripts. This has helped me to identify the markers who needed more help and I can provide feedback timely to the markers. Another thing I liked about the OSM is that it takes away all the administrative tasks such as counting and packing of scripts, and this allows me and my markers to focus our time on the marking.

- A team leader

I believe the OSM would make the whole marking experience better and so I signed up for the trials with that thinking in mind. I was not disappointed as the OSM system was quite good, in that it is quite intuitive and easy to use.

I liked particularly how SEAB introduced the Quality Assurance Scripts into the OSM where the team leaders can monitor the accuracy of our marking. Ultimately, as markers, we want to be fair to the students and we want to mark accurately. I feel assured with the monitoring as I would be given feedback timely before I move on to the other scripts.

- A marker

Memories of Singapore's Onscreen Marking Journey

It all started with a vision in 2015. Moving forward to 2019, SEAB has developed an OSM that can manage the end-to-end processes of each marking exercise. The photo collage here trails the significant memories of the 2019 OSM journey.

Pioneers in action

**Pioneer OSM Project Team and Markers –
N(A), O and A-Levels**

Pioneers in action

Pioneer OSM Markers – N(A), O and A-Levels

MOE and SEAB Senior Management Walk-Abouts

SEAB Senior Management At OSM Familiarisation Sessions

MOE Senior Management Visits to OSM Marking Centres

Markers In Training – PSLE Higher Mother Tongue Languages

Markers Familiarisation Sessions

Singapore Examinations and Assessment Board

Our Vision:

A trusted authority in examinations and assessment,

recognised locally and internationally.

Our Mission:

We assess educational performance so as to certify individuals, uphold national standards and advance quality in assessment worldwide.

Our Values:

Integrity | Value people | Commitment | Professionalism | Teamwork