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Relevance of Multiple Mini Interview in Ophthalmology Postgraduate Students' Performance; A Multi-Centre Study

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ABSTRACT

There is a lack of data on candidate selection for Ophthalmology postgraduate training programmes, underscoring the need to explore the use of admissions tools in this process. This study examines the validity evidence of the Multiple Mini Interview (MMI) implemented by the Malaysia Universities Conjoint Committee of Ophthalmology and its association with candidates' performance in the setting of Ophthalmology. A mixed-method triangulation design was utilised, where secondary candidate exam data and MMI score were analysed using Pearson correlation on intake of 2017-2020, alongside open-ended comments using a phenomenological approach to explore stakeholders' experience. There was a positive correlation between the total MMI score and the total Part 2 score ($r=0.232$, $p<0.05$). When components of the exam were separated, this positive correlation was stronger with Part 2B, long case and short case components ($r=0.306$, $p<0.001$). There was no significant correlation between pre-entrance basic science examination (BSE) scores with total MMI scores ($r=0.132$, $p=0.112$). Overall, the stakeholders believed the MMI improved the student selection process but suggested omitting simulated patients, standardising marking criteria and having frequent updates of the MMI questions. The MMI has shown a significant association with Ophthalmology postgraduate students' performance. This provides further evidence of its utility in improving the selection methods currently practised for advanced specialty training in Ophthalmology Malaysia.

Keywords: *Student selection, multiple mini interview, postgraduate admissions, ophthalmology training*

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INTRODUCTION

There is ongoing debate on the optimal design of the process for selecting postgraduate medical candidates. Ideally, candidates are selected based on the most reliable determinants of success throughout the training programme (1, 2). Researchers have studied the correlation of candidates' postgraduate exam scores with the hospitals or universities from which they applied, their letters of reference from their superiors, their undergraduate performance as medical students and their national examination scores (3–5). Alternative assessments have been incorporated to reduce the effects of bias and subjectivity in traditional student selection interviews. Evidence has shown that objective approaches are more transparent, efficient and predictive (6).

Based on this, admissions programmes across various training centres have implemented a more comprehensive range of assessments, such as situational judgment tests (SJTs), multiple mini-interviews (MMIs), the CanMEDS and clinical problem-solving tests (7–9). Students are then ranked to determine the most trainable candidates and those likely to graduate as competent practitioners.

In ophthalmology, the *British Medical Journal* has reported a significant correlation between the final university exam decile position and success in ophthalmology specialist training (1). Although the use of the CanMEDS in ophthalmology postgraduate training selection has been reported (10), there is still limited data on the correlation between newer admissions assessments and candidate performance.

In Malaysia, postgraduate ophthalmology training is provided as a four-year programme or a parallel pathway programme. The Malaysian Universities Conjoint Committee of Ophthalmology (MUCCO) is the national board that has governed postgraduate ophthalmology training since 2008. The local master's degree in ophthalmology is awarded by one of the four main Ministry of Higher Education (MOHE) university teaching centres: International Islamic University Malaysia (IIUM), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM) or Universiti Malaya (UM). The Ministry of Health's (MOH) parallel pathway programme incorporates examinations by the Royal College of Ophthalmologists in the UK.

The annual selection process is conducted via a national recruitment programme. As with all healthcare training selection processes, the aim is to identify candidates who are best suited as future ophthalmologists from a pool of high-achieving individuals. A unique aspect of candidate selection within healthcare sciences is the value of noncognitive variables, or soft skills, which are detailed in the National Postgraduate Medical Curriculum for ophthalmology (11). These have been studied extensively in undergraduate student selection (12, 13), but limited data are available on their role in postgraduate training.

In 2016, MUCCO introduced MMIs alongside the traditional interview process to improve candidate selection. The traditional interviews conducted by the MOH were retained to filter through the same pool of candidates and identify those prepared to serve the nation as specialists. The pre-entrance Basic Sciences Examination (BSE), a multiple-choice question (MCQ) paper and a procedural logbook are used to evaluate cognitive skills and experience in ophthalmology, while the main objective of MMIs is to assess noncognitive skills deemed vital for postgraduate training. Following the implementation of MMIs, it has become necessary to examine their role and effect.

The widely adopted Messick validity framework, which provides a comprehensive model for examining different sources of validity evidence for assessments, including MMIs, identifies five key aspects of validity evidence: the content, response process, internal structure, relationship to other variables and consequences (14). Content validity examines the extent to which the MMI content

aligns with the assessed domains (noncognitive skills), while response process validity investigates the cognitive and behavioural processes that candidates and examiners engage in during interviews (15). Internal structure validity evaluates the relationships between MMI domains and the underlying construct, and the relationship to other variables' validity explores the associations between MMIs and related measures of the construct, such as BSE scores (14). Finally, consequential validity considers the impacts MMIs, including candidates' future performance in training (14).

In a study conducted to examine the content validity, response process and internal structure of the MMIs implemented by MUCCO, the authors reported the assessment to be a positive experience for the interviewers, and the candidates felt it was able to portray their skills accurately, although they reported slightly more anxiety than with traditional interviews (16). MUCCO's MMIs had an overall reliability of 0.51 (16) – lower than the acceptable optimal reliability of 0.6 cited in the literature (17).

This study aims to examine MUCCO's MMI validity evidence and its association with candidates' performance. Its specific objectives include investigating the relational validity of the MMIs with pre-entrance BSE scores, exploring the consequential validity between the MMI domains and candidates' performance indicators measured in their summative exams and gathering stakeholders' input on the relevance of MMI competency to ophthalmology training.

METHODS

This study utilised a mixed-methods triangulation design (18), as shown in Figure 1. Secondary data analysis was conducted to investigate evidence of MMI validity. Via a phenomenological design, a combination of semi-structured in-depth interviews and open-ended comments was used to explore stakeholders' experiences of the relevance of MMI competency to ophthalmology training (18). Data from both study designs were merged to form a thorough understanding of MMI validity in the MUCCO student selection process, as shown in Figure 1. Ethical clearance was sought from the Universiti Malaya Research and Ethics Committee and permission was requested from MUCCO to access student selection data.

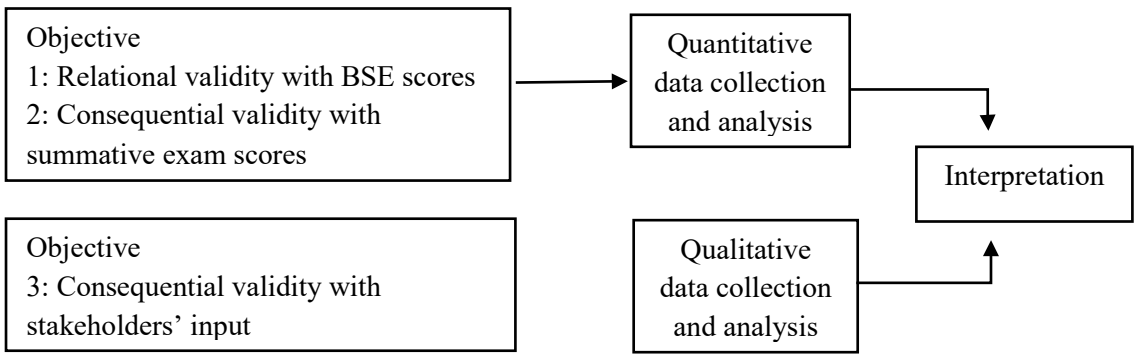

Figure 1: Mixed method triangulation design

The quantitative phase examined MMI relational validity with pre-entrance BSE scores and the consequential validity between MMI domains and candidates' performance in summative exams. This involved secondary data on student selection collected over four years, from 2017 to 2020.

The inclusion criteria were MOH applicants who had undergone the national recruitment programme and had been accepted into the Universiti Malaya and Universiti Kebangsaan Malaysia Ophthalmology Master's programme (n = 149). MOHE applicants were excluded (n = 2) because they undergo separate selection criteria, set by the academic faculties of their respective universities, to assess their potential as lecturers. Since they are preselected as trainees before participating in the national recruitment programme, this may confound their performance.

The total and breakdown scores of the first attempts at Parts 1 and 2 were tabulated. Part 3 scores were omitted because they are calibrated and graded differently between the two centres. Data analysis of the candidate MMIs and exam scores was conducted using SPSS version 29.0. Pearson correlation between MMIs and other variables was conducted. Assumptions for parametric testing were met, including data being of normal distribution and variance being similar across all cohorts. The range of Pearson correlation was as follows: very strong (0.8–1.0), strong (0.60–0.79), moderate (0.40–0.59), weak (0.20–0.39) and very weak (<0.20) (19, 20).

In the qualitative phase, a phenomenological approach was used to explore the experiences of stakeholders and heads of departments from the MOH and MOHE Ophthalmology Service Units. Close-ended questions were used to investigate the MMIs' acceptability and usability and suggestions for improving it, while open-ended questions assessed opinions for improvement (21). The interview protocol, open-ended questions and neutral language were used to minimise interviewer bias. The interviewees were identified via a nominated sampling technique from stakeholder representatives, all of whom had been involved in student selection and had previously used MMIs. These stakeholder representatives were invited to participate in the study via e-mail. Written consent using was obtained e-signatures. Data were collected via semi-structured phone interviews using the following protocol:

A. General

1. What is your opinion of MMIs since they were implemented in 2017 until now?

2. Do you think the results of MMIs have changed or influenced the student selection process?

3. What do you or your colleagues think of the specific domains tested in MMI stations?

4. Which component (experience, cognitive or noncognitive) should be given the most weight?

5. Have you or your colleagues encountered resistance to the implementation of MMIs in your department, and why?

B. Candidates in training

1. MMI tests candidates' noncognitive components (soft skills). What are your views on preparation for this process?

2. How have recent graduates of the MMI process (2017–2020 cohorts) fared as practicing ophthalmologists compared to cohorts before MMIs?

C. Suggestions for improving the student selection process

1. Describe how you would improve the current student selection process, if at all.

2. How can the barriers to MMIs be overcome?

Stakeholder representatives who were unavailable for phone interviews were given the option to answer similar open-ended questions via Google Forms. The sample size was estimated using data saturation principles (22–24). The results were transcribed and served as the primary data source for the content analysis. Research investigator triangulation was incorporated to increase credibility and trustworthiness. Two investigators coded the data independently and then sorted them into themes.

RESULTS

Participant statistics

Candidates

There were 147 candidates in the four studied cohorts, of whom 44 were male (29.9%) and 103 were female (70%). Of these candidates, 58 were Malay (39.5%), 55 were Chinese (37.4%) and 34 were Indian (23.1%). Eighty students (54.4%) were from UKM and 67 (45.6%) were from UM. All had sat the pre-entrance BSE and MMIs. Candidates who had left the master's programme due to extenuating circumstances (n = 3) or, at the time of writing, had not yet completed all parts of the Part 2 exam (n = 15) were excluded. The data analysed for the MMIs, BSE and Part 1 and 2 examinations are shown in Table 1.

Table 1: Number of candidate data analysed

Cohort	Data analysed for MMI and BSE	Data analysed for Part 1 examination	Data analysed for Part 2 examination
2017/2018	37	34	34
2018/2019	37	37	36
2019/2020	36	36	36
2020/2021	37	37	25
Total	147	144	129

Stakeholders

All 51 stakeholders' representatives had been involved in MMIs and the national recruitment programme more than once. Their years of service as ophthalmologists and involvement in training doctors ranged from 5 to 15 years. Of the stakeholders, 72.5% were from the MOH and 27.5% were from the MOHE.

General Outcomes

The results of the Pearson correlation analysis revealed an insignificant very weak positive correlation between the MMI scores and total Part 1 scores (r = 0.121, p = 0.149). A significant weak positive correlation was detected between total MMI scores and total Part 2 scores (r = 0.232, p = 0.008). When the master's exam was broken down into separate components, there was a weak positive correlation between total MMI scores and Part 2B scores (i.e. long case and short case components) (r = 0.306, p < 0.001). In contrast, the correlations with the other exam components were very weak and insignificant (Table 2).

Table 2: Correlation between MMI total score and components of the Part 1 and Part 2 exam scores

	Part 1A: Essay and MCQs	**Part 1B: OSCE Ophthalmology and Viva**	**Part 1C: OSCE Optics and Refraction**	**Part 2A: Essay, KFQ and MCQ**	**Part 2B: Long case and short case**	**Part 2C: Viva**
MMI Score	0.067	0.104	0.159	0.033	**0.306*** **	0.137

p-value is significant at 0.05 level; **p-value is significant at 0.01 level; ***p-value is significant at 0.001 level

Relational Validity

MMI results with BSE results

There was a non-significant weak positive correlation between BSE scores and total MMI scores (r = 0.132, p = 0.112).

Consequential Validity

MMI competency results with summative exams

The analysis of MMI competency against exam components revealed weak but significant positive correlations between critical and ethical thinking (r = 0.192, p = 0.029), empathy (r = 0.239, p = 0.046) and professionalism (r = 0.289, p = 0.027) and the long case and short case components (Part 2B). Additionally, weak positive correlations existed between communication skills and the Objective Structured Clinical Examination (OSCE) optics and refraction component (Part 1C) (r = 0.207, p = 0.013) as well as between empathy and the viva component (Part 2C) (r = 0.240, p = 0.045). Conversely, significant negative correlations were detected between health education and Part 2A (i.e. MCQs, Key Feature Questions and essay) (r = -0.389, p = 0.002) and Part 1A (i.e. essay and MCQs) (r = -0.236, p = 0.044) components (Table 3).

Table 3: Correlation of MMI competencies with components of exam

	Part 1A: Essay and MCQs	Part 1B: OSCE Ophthalmology and Viva	Part 1C: OSCE Optics and Refraction	Part 2A: Essay, KFQ and MCQ	Part 2B: Long case and short case	Part 2C: Viva
Critical and Ethical Thinking	0.122	0.062	0.101	0.097	**0.192***	0.028
Communication Skills	0.127	0.130	**0.207***	0.015	0.132	0.137
Empathy	0.014	**0.289***	0.005	0.013	**0.239***	**0.240***
Health Education	**-0.236***	-0.223	-0.004	**-0.389****	0.064	-0.054
Professionalism	-0.039	-0.050	0.020	0.132	**0.289***	0.237

*p-value is significant at 0.05 level; **p-value is significant at 0.01 level; ***p-value is significant at 0.001 level

Stakeholders' opinions on MMIs

The participants unanimously expressed positive opinions regarding the implementation of MMIs. Coded phrases denoting approval appeared 21 times throughout the transcripts. As shown in Table 4, recurring themes included objectivity, effective use of time, good structure and wide content coverage. None of the stakeholders experienced resistance to implementing MMIs among their departments.

There were mixed views when discussing how those who had recently gone through the MMI process fared as practising ophthalmologists compared to their predecessors. Fifteen stakeholder representatives thought that they had shown some positive traits compared to those before them. The phrase 'more confident' was used by two stakeholders. Most stakeholder representatives were unable to compare the graduates or felt that there had been no changes since MMI implementation, saying 'I do not see much difference' or similar. A few respondents stated that while MMI graduates may have demonstrated improved communication skills, their academic performance remained variable. Others felt it was challenging to compare graduates before and after MMI implementation because their training circumstances had changed significantly.

Regarding suggestions to improve the MMIs, the recurring themes were standardisation of marking, simpler stations and more frequent question updates. Two stakeholder representatives highlighted difficulties or 'inconsistencies' with the examiner or interviewer's understanding of the marking system. They suggested that a more thorough explanation of the marking scales during the workshop could clarify this and improve variability among interviewers.

Table 4: Summary of the stakeholder input of the MMI

What is your opinion of the MMI since it has been implemented from 2017 until now?		
Theme	**Code**	**Number**
Objectivity	"more objective" "less biased" "fair" "standardised"	7 stakeholders
Effective use of time	"needs less time" "larger number of candidates"	4 stakeholders
Better structure	"well-structured" "good format" "well-organized"	2 stakeholders
Wide content coverage	"covers more content" "tests many aspects"	3 stakeholders
How do the recent graduates of the MMI process (cohorts 2017-2020) fare as practicing ophthalmologists compared to previous cohorts before MMI?		
Theme	**Code**	**Number**
Positive traits	"more confident" "more mature" "motivated" "better" "improvement" "more well prepared"	15 stakeholders
Unable to compare	"same" "similar" "no difference" "no change" "cannot compare" "vary" "unfair to compare" "different circumstances"	20 stakeholders
Negative performance	"more complaints" "self-centered"	5 stakeholders
Describe how you would improve the current MMI		
Theme	**Code**	**Number**
Better standardization of marking	"transparency" "non biased marking" "examiner understanding" "improve marking" "more briefing/ workshop"	4 stakeholders
Simpler stations	"simpler" "simplified"	2 stakeholders
Frequent updates	"new or change questions"	1 stakeholder

DISCUSSION

This is the first study to explore the relational and consequential validity of MMIs in the national recruitment programme for master's in ophthalmology postgraduate training in Malaysia. The findings demonstrated a non-significant correlation between MMI scores and BSE scores, significant but weak correlations between MMI scores and Part 2 scores and broadly positive opinions among the stakeholders. The observed MMI correlations were weak in all of the results. This could be because cognitive constructs are weighted more in postgraduate summative examinations, and a narrow band of MMI and summative examination scores may have weakened the strength of the correlations.

Relational Validity

MMI results with BSE results

Similar to MMIs, it was found that CanMEDS residency interviews conducted with prospective postgraduate ophthalmology candidates in Montreal could retrieve additional information about the candidates not available from their application records (10). One objective of this study was to investigate the relational validity of MMIs compared to other variables in candidate selection – namely, BSE or pre-entrance cognitive MCQ scores. The lesser correlation between the pre-entrance BSE and MMIs solidifies the role of these approaches in selecting different attributes for prospective speciality trainees. It emphasises MMIs' ability to isolate noncognitive skills, irrespective of the candidate's academic potential. This supports the synchronous use of MMIs and the BSE. Previous findings have demonstrated that MMIs do not correlate with pre-entrance Medical College Admissions Tests (MCATs) (25) but correlate positively with pre-entrance OSCEs conducted to assess clinical skills (26). In a study comparing MMIs to SJTs, there was a significant positive correlation with the subdomains involving clinical knowledge, suggesting that MMIs are not entirely independent of cognitive components (27). This could explain why there was a weak positive correlation between MMIs and the BSE, albeit not significant.

Consequential Validity

MMI competency results with summative exams

Consequential validity ensures that MMI assessments result in their intended outcomes. The findings of this study support the initial hypothesis and align with other studies showing MMI results to be better predictors of OSCE or clinical-based assessments but poor predictors of theoretical exams, such as MCQs (9, 25, 28–30). In a study of GP trainees in Australia, MMIs had a positive correlation with all summative assessments, specifically a strong correlation with the OSCE but a weak correlation with Key Feature Questions (9). Hofmeister et al. (2009) found a weak correlation between MMIs and both Part 1 exams comprising medical knowledge, clinical skills and attitudes and clinical Part 2 exams among Canadian family medicine trainees, although none of these findings were significant (31).

In the United States, a study found that MMI scores related to overall performance in the first year of postgraduate emergency medicine training (32); however, the first-year examination scores included Accreditation Council for Graduate Medical Education core competencies and noncognitive skills such as patient care, communication and professionalism. In Malaysia's master's in ophthalmology programme, noncognitive skills are assessed only in the OSCE optics and refraction component (Part 1C) of the first-year exam. This explains why this was the only Part 1 component with a significant weak positive correlation ($r = 0.207$, $p = 0.013$) with the communication skills domain in MMIs.

The weak but significant positive correlations of critical and ethical thinking (r = 0.192, p = 0.029), empathy (r = 0.239 p = 0.046) and professionalism (r = 0.289, p = 0.027) with Part 2B reinforce the role of MMIs in selecting students who have personal qualities deemed essential for future ophthalmologists, as outlined by MUCCO (11) and other student selection admissions programmes globally (33). Additionally, MUCCO's selected competencies, outside of the health education domain, are among the most extensively studied in the academic literature (34).

An interesting finding was the significant negative correlations of the health education domain with Part 2A (r = -0.389, p = 0.002) and Part 1A (r = -0.236, p = 0.044) scores. This suggests that this domain has no practical predictive value for summative exam scores. Furthermore, the role of current postgraduate ophthalmology trainees as health educators is not assessed in either the Part 1 or Part 2 exams. However, it is worth noting that the sample size for this domain was small (n = 59), since the domain was tested only in two cohorts before it was removed from newer versions of MUCCO's MMIs. Thus, there is a likelihood that a nonexistent relationship was detected or that the results could have been significantly skewed by a few outliers. If these findings were reproduced in a larger study, this could imply regression towards the mean or even a selection–training mismatch.

Stakeholder opinions of MMIs

The stakeholders' feedback on implementing MMIs was generally positive. They agreed that they were an improvement on the traditional interview system and that they significantly influenced student selection. Similar to other studies on the acceptability of MMIs, our respondents considered MMIs to be an effective means to assess a large number of candidates in a short time (6, 35, 36). Compared to the traditional method, which would take approximately 16 hours to interview 50 candidates, MMIs reduce this to 4 hours (assuming one circuit has four students simultaneously), equating to a 75% reduction.

Calls for improvement included better transparency and standardisation in marking candidates during stations. Similarly, although Roberts et al. found MMIs to be a moderately reliable assessment for selection in speciality training, they showed that the interrater reliability among interviewers was a significant source of errors (27). Sebok et al. (2015) presented the differences in how individual raters associated the various attributes within a station as another area of concern with MMIs (37). This supports the suggestion of clarifying the objectives of each station and the scales used for marking prior to a circuit.

The stakeholders found it difficult to compare MMI graduates with cohorts from before the implementation of MMIs. The study data were collected four years ago, and at the time of writing, the final cohort had yet to complete their postgraduate training. This may explain the complexities in gauging students' performance so early in their careers. If some stakeholders were unclear about the purpose of MMIs, they might have been assessing clinical competence rather than the noncognitive ability of the newer graduates. Additionally, the competencies assessed through the MMIs may have been less visible in routine clinical interactions, especially among superiors with limited direct interactions.

Strengths and limitations

The strengths of this study include its multi-centre and mixed-methods design, which integrated quantitative and qualitative data to form a more comprehensive understanding. The addition of the interviews allowed the perspectives of those involved with MMIs to be explored, offering insights for improvement. The quantitative analysis supports the hypothesis that MMIs are independent of cognitive skills but holds some value for summative examinations. Still, the qualitative data revealed

notable variability in how interviewers assessed candidates across MMI stations, highlighting concerns about scoring consistency and the need for a more structured marking rubric.

A marked limitation was that the design of the MMIs implemented by MUCCO, which consist of only four stations, has a reliability index of 0.51, which is lower than the acceptable 0.6 (16). Validity and reliability are known to be higher with more – at least six – stations (17). MUCCO would need to balance the feasibility and cost effectiveness of its MMIs to find the ideal structure for our national recruitment programme.

The candidate demographics showed a significant disparity between males (29.9%) and females (70%). This gap was inverse and larger than that in MOH data from 2021, in which male doctors accounted for 56% and female doctors accounted for 44% (38). The effect of gender split in the MMIs and summative examination results was not examined and could potentially be a source of gender bias in the selection of candidates (39). The number of attempts made by the candidates using MMIs was not considered in this study, although it may have shown a significant learning effect that may have potentially influenced the results. Subsequent correlations of the separate domains had different sample sizes, as not all domains were tested in every cohort. Thus, the strengths of the correlations should be interpreted with caution. Quantitative analysis was limited to correlation with convenience sampling; hence, no causal relationship could be established.

In the present study, the stakeholder representatives involved were interviewers from the MOH and the MOHE. Future student selection processes could be improved by having patients or members of the public on MMI interview panels for health education or communication skills competencies, among others.

Future research

The four year duration of the study, from 2017 to 2020, were chosen because in 2021, the format of assessments for ophthalmology trainees was revised to the new National Postgraduate Medical Curriculum (11). Hence, it would be wise to evaluate the consequential validity of MMIs using the new summative exam format or to perform a longitudinal study on the original cohorts.

Unlike others, this study did not account for any reported professional behaviour concerns or misconduct throughout training (40, 41). A review of MMIs against the new National Postgraduate Medical Curriculum should include this to see if they fail to filter such candidates. Language proficiencies in English and Bahasa Malaysia should also be examined since they could influence candidate performance.

Incorporating the health education domain into future MMIs could be warranted to further investigate its utility, particularly since student selection programs do not commonly assess this aspect (34).

CONCLUSION

The MMIs implemented by MUCCO correlated with Part 2 exam scores. The competencies tested in the present MMIs, such as critical and ethical thinking, professionalism and empathy and communication skills, correlated with the clinical components of the Part 2 exam. Although the correlations were weak, these findings justify using MMIs as a complement to Malaysia's current selection approach for ophthalmology training. The evidence spotlights specific areas, such as scoring consistency and interviewer training, for the MMI process to be refined and improved.

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