

ORIGINAL ARTICLE

Stage-locked Microscope in Anatomy OSPE: Perception From Malaysian Preclinical Students

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ABSTRACT

Introduction: Anatomy education is fundamental in medical training, necessitating innovative methodologies like the Objective Structured Practical Examination (OSPE) and advanced technologies such as the stage-locked microscope. Despite their potential benefits, limited research exists on student perceptions of the stage-locked microscope in Malaysian medical education. This study explores preclinical medical students' perceptions of the stage-locked microscope during anatomy OSPE to understand its effectiveness and impact on learning. **Materials and methods:** A cross-sectional cohort study with universal sampling involved 106 Year 2 medical students at Universiti Putra Malaysia (UPM). Participants engaged in OSPE cycles using the stage-locked microscope. Data on image clarity, structural identification, user comfort, microscopic effectiveness, and overall satisfaction were collected via a validated questionnaire. Statistical analyses included the Mann-Whitney U test and Kruskal-Wallis test to assess demographic variations in perceptions. **Results:** The study achieved a 93.4% response rate with 99 participants. The questionnaire demonstrated high reliability (Cronbach's alpha = 0.974). Students reported positive perceptions overall, with Image Clarity receiving the highest mean scores. The stage-locked microscope was perceived to significantly enhance visual acuity and understanding of anatomical structures. **Conclusion:** This study provides valuable insights into preclinical medical students' perceptions of the stage-locked microscope, confirming its potential to improve anatomical learning. The findings support its integration into anatomy education, offering guidance for educators and curriculum developers. The successful implementation at UPM positions it as a potential benchmark for global anatomy education, highlighting the promise of this innovative approach in advancing medical training worldwide.

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INTRODUCTION

Anatomy education stands at the core of medical training, providing the foundational knowledge essential for understanding the intricacies of the human body (1, 2). Among the innovative methodologies employed to bridge the gap between theoretical learning and practical application is Objective Structured Practical Examination (OSPE) (3). This method not only evaluates the proficiency of preclinical medical students in practical skills but also assesses their ability to apply anatomical knowledge in clinical scenarios. The significance of anatomy OSPE lies in its capacity to simulate real-world medical situations, offering a comprehensive evaluation

that extends beyond traditional written assessments.

Integral to the anatomy learning experience is the utilisation of advanced technologies, particularly microscopes (4). The stage-locked microscope emerges as a cutting-edge tool, holding promise for revolutionising the way preclinical medical students engage with anatomical structures. Its precision staging capabilities provide a unique advantage, allowing students to explore microscopic details with unprecedented clarity. This microscope's relevance to anatomy education lies in its potential to enhance visual acuity and deepen understanding, marking a significant stride in advancing teaching methodologies.

Despite the central role of anatomy education in medical training and the potential benefits of advanced technological tools, there is limited research on the perceptions and effectiveness of the stage-locked

microscope among preclinical medical students during OSPE. Furthermore, it remains unclear how factors such as gender and ethnicity might influence students' experiences and satisfaction with this innovative microscope. Addressing this gap is crucial for enhancing educational practices and ensuring equitable learning experiences for all student demographics.

A comprehensive exploration of the literature reveals a robust body of research on anatomy OSPE and its effectiveness in assessing practical skills and anatomical knowledge among medical students (5). Previous studies underscore the advantages of OSPE, highlighting its ability to provide a holistic evaluation that mirrors the complex challenges faced by healthcare professionals (6). As medical education evolves, the emphasis on practical competencies becomes increasingly vital, making anatomy OSPE an integral component of modern curricula.

The role of microscopes in anatomy education has been extensively discussed in the literature, emphasizing their contribution to the development of spatial understanding and visual acuity among medical students (7). Microscopic examination enhances the learning experience by allowing students to delve into the intricacies of tissues and organs.

The purpose of this study is to explore the preclinical medical students' perception on stage-locked microscope usage during Anatomy OSPE, with a specific focus on its pioneering application in Malaysia. Exploring differences in perceptions based on gender and ethnicity helps to ensure that educational innovations like the stage-locked microscope provide equitable benefits to all student groups. Understanding these differences can inform targeted interventions to enhance learning experiences across diverse populations. The research aims to unravel how the integration of the stage-locked microscope influences students' learning experiences and perceptions within the unique context of Malaysian medical education. The importance of this investigation extends beyond the confines of a single institution, offering insights that could shape the future of anatomy education in Malaysia and potentially serve as a benchmark for similar settings globally.

MATERIALS AND METHODS

A comprehensive cohort of 106 Year 2 medical students from the academic year 2023/2024 at the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, formed the basis of our universal sampling approach via a cross-sectional study. Gender and ethnicity were included as variables in our analysis to investigate potential differences in perceptions of the stage-locked microscope. This approach aligns with prior research indicating that demographic factors can influence educational experiences and outcomes,

thereby ensuring a comprehensive understanding of the microscope's impact on all student groups (2, 8). These students were systematically distributed into eight groups, each representing a cycle of the Objective Structured Practical Examination (OSPE), as in Fig. 1. Each OSPE cycle comprised 14 stations featuring homogeneously prepared slides, viewed through the sophisticated new stage-locked microscope. Notably, this microscope, equipped with dual lock screws on its upper and lower stages, facilitated the secure fixation of X and Y axis movements (Fig. 2).

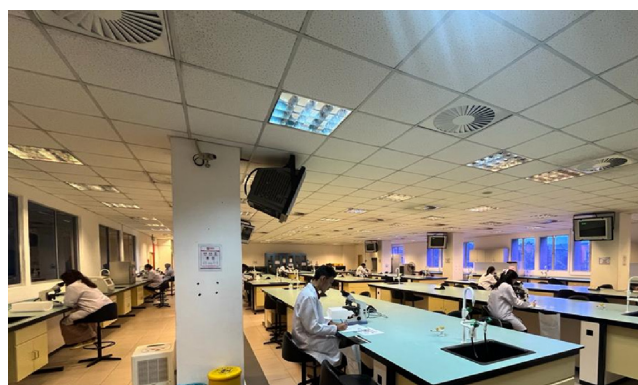


Fig. 1: The operational setting of the OSPE, conducted within a laboratory encompassing 14 stations. Each station features a uniform adrenal slide, and the duration of each session is set at 6 minutes. This examination is specifically administered to second-year medical students at UPM, taking place upon the conclusion of the endocrine module.

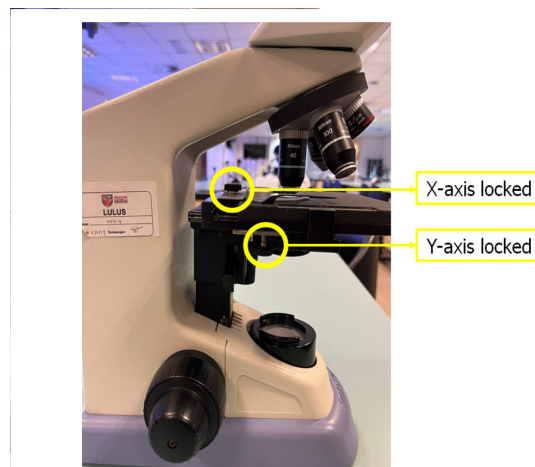


Fig. 2: The innovative Stage-locked microscope, equipped with XY movement, securely fastened to prevent inadvertent adjustments by students during the OSPE.

The OSPE, a pivotal component of the Endocrine Module assessment, took place at the conclusion of the module. The examination focused on a singular 5-mark question related to a specific zone in the adrenal gland. Stringent measures were implemented during the OSPE, with two invigilators stationed in the exam hall and an additional two in the quarantine room. Students were allocated six minutes per station, during which they could solely adjust the focusing and eyepieces, and strict signage prohibited any stage manipulation. While the majority

of the process unfolded seamlessly, a single station was identified with an exceptionally distant focus, potentially disturbed by a preceding student.

After the OSPE, students proceeded to a designated room after each cycle to participate in a questionnaire-based feedback session facilitated by a provided QR code. The questionnaire, meticulously crafted with reference to existing literature, underwent validation by three anatomical experts (9). The analysis of the 25 items revealed that the S-CVI/Avg (scale-level content validity index based on the average method) achieved 0.96 for the total of 5 sections in the questionnaire (10). Out of 25 items, 3 failed to achieve an I-CVI (item-level content validity index) value of 1; hence, they were not included for subsequent evidence of validity evaluation in the response process.

The five sections encompassed image clarity, structural identification, user comfort and adaptability, microscope effectiveness in examination, and overall satisfaction, in addition to capturing sociodemographic data (gender and ethnicity). A 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), assessed each subcomponent within the sections, with four to five questions per subcomponent. The reliability of the questionnaire was evaluated using Cronbach's alpha (11).

Upon confirming that the data deviates from normal distribution due to the utilisation of a 5-point Likert scale, we analysed SPSS version 29. The assessment of variations in perceptions between genders was conducted using the Mann-Whitney U test, while differences among various ethnicities were examined through the Kruskal-Wallis test (12).

RESULTS

A robust response rate of 93.4% was achieved as 99 respondents actively participated in the survey. Among them, 24 individuals identified as male, constituting 24.2% of the respondents, while 75 participants, making up 75.8%, identified as female. The ethnic distribution revealed that Malay respondents comprised the majority at 59.6%, followed by Chinese students at 14.1%, and Indians at 26.3% (Fig. 3).

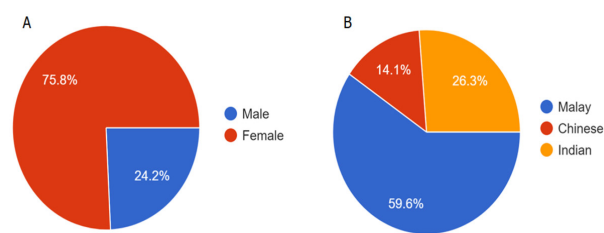


Fig. 3: The distribution of sociodemographic factors, including gender (A) and ethnicities (B).

Demonstrating a commendable level of internal consistency, Cronbach's alpha yielded a high reliability score of 0.974, affirming the reliability of the questionnaire. Upon scrutinizing the mean scores across various assessment parameters, the Image Clarity section received the highest ratings, ranging between 4.39 to 4.57. Structural Identification garnered mean scores within the range of 4.00 to 4.20, while User Comfort and Adaptability achieved mean scores spanning from 4.05 to 4.24. In contrast, the Microscopic Effectiveness in Examination received slightly lower mean scores, ranging from 3.83 to 3.99. The overall satisfaction mean scores fell within the range of 4.09 to 4.20 (Fig. 4A to 4E).

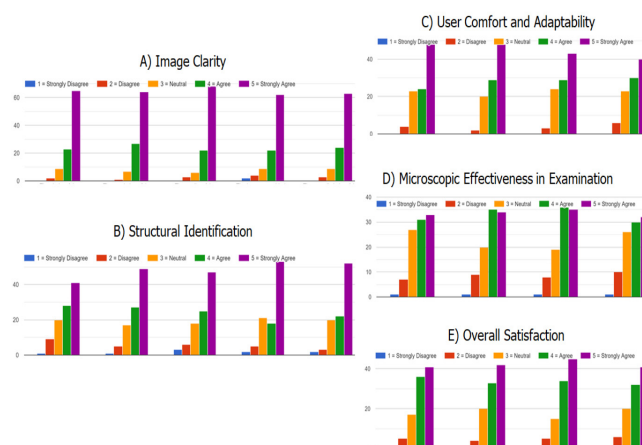


Fig. 4: The mean scores across the five sections reflecting the perception of the stage-locked microscope among second-year medical students at UPM during the Anatomy OSPE.

Furthermore, a rigorous examination of variations in perception among diverse genders and ethnicities was undertaken. The normality test revealed that all

parameters exhibited significance (<0.05) in both the Shapiro-Wilk and Kolmogorov-Smirnov tests, indicating a deviation from normal distribution (13).

The results of the Mann-Whitney U test indicate notable gender-related variations in the perceptions of preclinical medical students regarding the stage-locked microscope across multiple dimensions (Table I). In terms of Image

Clarity, female students expressed higher satisfaction compared to their male counterparts in various aspects. Specifically, the resolution of images allowing clear visualisation, the quality of microscopic images meeting expectations, and overall clarity facilitating identification were all significantly rated higher by female students (p < 0.05).

Table I: A Mann-Whitney U test revealed significant differences among genders in the perceptions of the Staged-lock Microscope during the Anatomy OSPE, specifically in a few sections on Image Clarity and Microscope Effectiveness.

	Gender (n)	Mean Rank	Z	Sig
Image Clarity				
The clarity of the microscopic images was satisfactory	Male (24)	41.67	-1.947	0.052
	Female (75)	52.67		
The resolution of the images allowed for clear visualization	Male (24)	39.31	-2.487	0.013*
	Female (75)	53.42		
The quality of the microscopic images met my expectation	Male (24)	40.48	-2.288	0.022*
	Female (75)	53.05		
The images provided a clear representation of anatomical structures	Male (24)	41.60	-1.909	0.056
	Female (75)	52.69		
The overall clarity of the images facilitated identification	Male (24)	40.75	-2.125	0.034*
	Female (75)	52.96		
Structural Identification				
I found it easy to identify histological structures using the microscope	Male (24)	45.23	-0.987	0.324
	Female (75)	51.53		
The microscope adequately helped me in identifying histological elements	Male (24)	46.63	-0.716	0.474
	Female (75)	51.08		
The images assisted me in distinguishing between different structures	Male (24)	44.75	-1.103	0.270
	Female (75)	51.68		
It was easy to precisely identify structures using the microscope	Male (24)	47.25	-0.591	0.554
	Female (75)	50.88		
The microscope facilitated accurate identification of specified histological parts	Male (24)	43.46	-1.402	0.161
	Female (75)	52.09		
User Comfort and Adaptability				
I felt comfort while using the microscope during the examination	Male (24)	47.08	-0.617	0.538
	Female (75)	50.93		
My familiarity with microscope use positively influenced my comfort level	Male (24)	45.44	-0.968	0.333
	Female (75)	51.46		
Using the microscope during the exam was a comfortable experience	Male (24)	49.81	-0.039	0.969
	Female (75)	50.06		
I felt confident and at ease using the microscope throughout the exam	Male (24)	45.63	-0.907	0.364
	Female (75)	51.40		
Microscope Effectiveness in Examination				
Using the microscope enhanced my ability to answer exam questions	Male (24)	44.29	-1.172	0.241
	Female (75)	51.83		
The microscope usage significantly improved my examination performance	Male (24)	42.52	-1.539	0.124
	Female (75)	52.39		
The microscope was essential for adequately responding to exam queries	Male (24)	41.90	-1.674	0.094
	Female (75)	52.59		
My exam responses were better due to using the microscope	Male (24)	39.50	-2.146	0.032*
	Female (75)	53.36		
Overall Satisfaction				
I am satisfied with the overall microscope experience during the exam	Male (24)	42.44	-1.584	0.113
	Female (75)	52.42		
I am content with the contribution of the microscope to the examination	Male (24)	44.17	-1.220	0.223
	Female (75)	51.87		
I am satisfied with the usefulness of the microscope in the exam	Male (24)	42.48	-1.587	0.112
	Female (75)	52.41		
Overall, the microscope positively influenced my examination impression	Male (24)	42.42	-1.578	0.115
	Female (75)	52.43		

*p<0.05

Moving to Structural Identification, although no significant differences were observed, it is worth noting that female students tended to have slightly higher mean ranks in all aspects. This implies a subtle trend towards greater ease and effectiveness in identifying histological structures using the microscope among female participants. The assessment of User Comfort and Adaptability revealed no significant gender differences in perceived comfort, familiarity, or confidence while using the microscope during the examination. Both male and female students reported similar experiences in terms of comfort and ease of use.

In the domain of Microscope Effectiveness in Examination, female students exhibited higher mean ranks in multiple aspects. Notably, the microscope's usage enhancing their ability to answer exam questions and contributing to better exam responses were areas where female students

outperformed their male counterparts ($p < 0.05$). Finally, exploring Overall Satisfaction, no significant differences were found between male and female students. Both groups expressed satisfaction with the microscope experience during the exam, its contribution to the examination, usefulness, and overall positive influence on the examination impression.

Table II presents the outcomes of the Kruskal-Wallis test, designed to discern any noteworthy disparities in the perceptions of the stage-locked microscope among different ethnicities during the Anatomy OSPE. Within the Image Clarity section, the Kruskal-Wallis test failed to unveil statistically significant variations among Malay, Chinese, and Indian ethnicities. Despite variations in mean ranks across these parameters, the p-values exceeded the conventional significance threshold of 0.05, indicating an absence of substantial differences.

Table II: The Kruskal-Wallis test revealed no significant differences among ethnicities in the perceptions of the Staged-lock Microscope during the Anatomy OSPE.

	Ethnicity (n)	Mean Rank	Z	Sig
Image Clarity				
The clarity of the microscopic images was satisfactory	Malay (59)	48.51	2	0.065
	Chinese (14)	40.71		
	Indian (26)	58.38		
The resolution of the images allowed for clear visualization	Malay (59)	49.03	2	0.390
	Chinese (14)	44.75		
	Indian (26)	55.04		
The quality of the microscopic images met my expectation	Malay (59)	50.19	2	0.411
	Chinese (14)	43.00		
	Indian (26)	53.33		
The images provided a clear representation of anatomical structures	Malay (59)	48.25	2	0.353
	Chinese (14)	46.36		
	Indian (26)	55.92		
The overall clarity of the images facilitated identification	Malay (59)	49.06	2	0.559
	Chinese (14)	46.25		
	Indian (26)	54.15		
Structural Identification				
I found it easy to identify histological structures using the microscope	Malay (59)	47.94	2	0.574
	Chinese (14)	49.96		
	Indian (26)	54.89		
The microscope adequately helped me in identifying histological elements	Malay (59)	50.20	2	0.794
	Chinese (14)	45.86		
	Indian (26)	51.77		
The images assisted me in distinguishing between different structures	Malay (59)	49.31	2	0.723
	Chinese (14)	46.71		
	Indian (26)	53.33		
It was easy to precisely identify structures using the microscope	Malay (59)	49.42	2	0.523
	Chinese (14)	44.61		
	Indian (26)	54.21		
The microscope facilitated accurate identification of specified histological parts	Malay (59)	50.05	2	0.547
	Chinese (14)	43.71		
	Indian (26)	53.27		

CONTINUE

Table II: The Kruskal-Wallis test revealed no significant differences among ethnicities in the perceptions of the Staged-lock Microscope during the Anatomy OSPE. (CONT.)

	Ethnicity (n)	Mean Rank	Z	Sig
User Comfort and Adaptability				
I felt comfort while using the microscope during the examination	Malay (59)	0	2	0.698
	Chinese (14)	46.54		
	Indian (26)	53.		
My familiarity with microscope use positively influenced my comfort level	Malay (59)	50.98	2	0.469
	Chinese (14)	42.00		
	Indian (26)	52.08		
Using the microscope during the exam was a comfortable experience	Malay (59)	49.61	2	0.661
	Chinese (14)	45.39		
	Indian (26)	53.37		
I felt confident and at ease using the microscope throughout the exam	Malay (59)	50.26	2	0.342
	Chinese (14)	41.07		
	Indian (26)	54.21		
Microscope Effectiveness in Examination				
Using the microscope enhanced my ability to answer exam questions	Malay (59)	47.15	2	0.233
	Chinese (14)	47.36		
	Indian (26)	57.88		
The microscope usage significantly improved my examination performance	Malay (59)	47.28	2	0.191
	Chinese (14)	45.96		
	Indian (26)	58.35		
The microscope was essential for adequately responding to exam queries	Malay (59)	48.89	2	0.458
	Chinese (14)	44.89		
	Indian (26)	55.27		
My exam responses were better due to using the microscope	Malay (59)	46.51	2	0.174
	Chinese (14)	48.79		
	Indian (26)	58.58		
Overall Satisfaction				
I am satisfied with the overall microscope experience during the exam	Malay (59)	48.27	2	0.249
	Chinese (14)	44.00		
	Indian (26)	57.15		
I am content with the contribution of the microscope to the examination	Malay (59)	48.46	2	0.652
	Chinese (14)	48.71		
	Indian (26)	54.19		
I am satisfied with the usefulness of the microscope in the exam	Malay (59)	47.75	2	0.393
	Chinese (14)	48.11		
	Indian (26)	56.13		
Overall, the microscope positively influenced my examination impression	Malay (59)	46.64	2	0.279
	Chinese (14)	51.82		
	Indian (26)	56.65		

Likewise, the evaluation of Structural Identification revealed no substantial differences among the three ethnic groups. The mean ranks for these parameters suggested akin experiences and perceptions. The scrutiny of User Comfort and Adaptability also indicated a lack of statistically significant variations among Malay, Chinese, and Indian ethnicities. Participants from diverse ethnic backgrounds reported comparable levels of comfort and confidence during the OSPE.

In the Microscope Effectiveness in Examination section, the Kruskal-Wallis test did not pinpoint significant differences among ethnicities. Mean ranks indicated consistent perceptions of the microscope's effectiveness across Malay, Chinese, and Indian students. Lastly, within the Overall Satisfaction section, the Kruskal-Wallis test failed to disclose significant differences among ethnicities. Malay, Chinese, and Indian students conveyed analogous levels of satisfaction and perceived benefits derived from the stage-locked microscope during the Anatomy OSPE.

DISCUSSION

The integration of innovative methodologies in anatomy education is crucial for preparing preclinical medical students for the challenges of practical application in clinical settings. OSPE has emerged as an effective tool, offering a comprehensive evaluation that goes beyond traditional written assessments (3). In our study, the use of the stage-locked microscope in conjunction with OSPE aimed to enhance the anatomical learning experience. Our findings shed light on the perceptions of preclinical medical students regarding this pioneering approach in the context of Malaysian medical education.

The active engagement of participants, reflected in the robust response rate, suggests a high level of interest in the study's subject matter among the students. This engagement supports the reliability of our findings, as a diverse and representative sample enhances the credibility and applicability of the results. The notable gender distribution, with a higher proportion of female

respondents, and the significant representation of Malay students highlight the importance of considering demographic factors in educational research. These demographic insights are crucial as they can influence how educational tools are perceived and utilised, potentially guiding more tailored and inclusive educational strategies (14).

The high Cronbach's alpha for our questionnaire indicates strong internal consistency, which validates the reliability of our measurement instrument. This reliability is essential for ensuring that the perceptions captured are consistent and dependable across different student groups. The high mean scores in areas such as image clarity and structural identification reflect the students' positive reception of the stage-locked microscope. These findings suggest that the advanced features of the microscope are effective in enhancing the learning experience. However, slightly lower scores in microscope effectiveness indicate areas for improvement, suggesting that while the tool is beneficial, there might be aspects that need further refinement to fully meet the students' needs. These insights are valuable for guiding future enhancements in educational technology and methodologies (15).

Notably, the Image Clarity section received the highest ratings, emphasizing the students' positive reception of the microscope's visual capabilities. This aligns with the literature highlighting the pivotal role of microscopes in enhancing spatial understanding and visual acuity among medical students (16).

Structural Identification, User Comfort and Adaptability, and Overall Satisfaction garnered commendable mean scores, indicating a positive perception of the Stage-locked Microscope across various dimensions. However, the Microscopic Effectiveness in Examination received slightly lower mean scores. This suggests that while students appreciate the microscope's overall functionality (15), there may be room for improvement in terms of its effectiveness in facilitating detailed examination, an aspect worth exploring in future studies.

The analysis of gender perceptions unveiled no significant variances across parameters, except for particular subcomponents where female scores exceeded those of their male counterparts. This indicates that, on average, female students perceived the visual elements of the stage-locked microscope more favourably than their male peers during the anatomy OSPE (17). Our findings revealed significant gender differences in perceptions of image clarity and microscope effectiveness, with female students reporting higher satisfaction. These results are consistent with studies that have shown gender differences in visual-spatial tasks and perceptions of technology in education. Understanding these differences is crucial for tailoring educational tools and practices to meet the needs of all students. The lack of

significant differences among ethnicities suggests that the stage-locked microscope is broadly effective across diverse cultural backgrounds, which is encouraging for its wider implementation (18, 19). In terms of overall satisfaction, both cohorts conveyed contentment with the microscope experience throughout the examination. This underscores a shared consensus among both genders concerning the stage-locked microscope's significance and influence on the anatomy OSPE, underscoring its efficacy in providing a gratifying learning experience for all students.

The Kruskal-Wallis test demonstrated overall non-significant values across ethnicities, suggesting a consistent positive reception among diverse student demographics (20). This aligns with the goal of our study to investigate its potential benefits and challenges in the Malaysian preclinical medical education landscape. The findings indicate that the pioneering application of the stage-locked microscope is well-received across diverse student demographics, supporting its integration into anatomy OSPE sessions.

Challenges and Opportunities

Integrating innovative tools like the stage-locked microscope may encounter resistance or challenges in implementation due to the requisite infrastructure, training, and resource needs. The preclinical medical education systems might face resistance to change, especially when introducing cutting-edge technologies. Faculty and students may require time to adapt to the new learning methodologies. The adoption of advanced technologies often necessitates significant financial investments. Institutions may confront challenges in allocating budgets for the acquisition and maintenance of such equipment. The use of sophisticated equipment, such as the stage-locked microscope, may pose technical challenges, including maintenance issues.

In terms of opportunities, the stage-locked microscope has the potential to significantly enhance the learning experience. It offers a unique chance to revolutionise the anatomical learning process, providing students with a detailed understanding of anatomical structures.

Moreover, this study holds the promise of establishing Malaysian medical education as a global exemplar for integrating cutting-edge technologies like the stage-locked microscope in anatomy OSPE. Such a recognition could attract international acknowledgment and foster collaborative efforts. The positive reception from students creates an avenue for curriculum enhancement, serving as a model for refining anatomy education not only within Malaysia but on a global scale.

The findings from this study open up new avenues for further research. By exploring areas where the stage-locked microscope may require improvement, future research can contribute to the ongoing refinement of

educational tools. Additionally, the insights gained from this study have the potential to influence educational policies, encouraging institutions to invest in advanced technologies that enhance anatomy education. This influence could have a lasting impact on medical education frameworks both nationally and internationally.

Recommendations for Enhancing Microscope Usage in Anatomy OSPE

Several recommendations will be feasible, such as implementing faculty training programs. It is suggested to introduce comprehensive training programs for faculty members to ensure the effective use and integration of the stage-locked microscope in anatomy education. To address resistance, a phased approach to the integration of the stage-locked microscope is recommended, gradually incorporating it into existing curricula to allow for a smoother transition.

Establishing collaborations with international institutions experienced in utilising advanced technologies for anatomy education is also advised. This collaboration can facilitate knowledge exchange and provide valuable insights. Furthermore, regularly assess the effectiveness of the stage-locked microscope in achieving the learning objectives. Ongoing feedback from students and faculty is gathered to make continuous improvements.

Promoting awareness about the benefits of advanced technologies in anatomy education is also recommended. Advocacy campaigns to garner support from stakeholders, including students, faculty, and administrators, will be developed.

CONCLUSION

In conclusion, our study contributes valuable insights into the perceptions of preclinical medical students regarding the usage of the stage-locked microscope during anatomy OSPE. The commendable response rate, reliable questionnaire, and consistent positive perceptions across various dimensions underscore the potential of this innovative tool in enhancing the anatomical learning experience. The findings from our study can inform educators, curriculum developers, and medical institutions about the efficacy of integrating advanced microscopy technology into anatomy education, particularly in the Malaysian context. This pioneering approach holds promise not only for the future of anatomy education at Universiti Putra Malaysia but also as a potential benchmark for similar institutions globally.

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REFERENCES

1. Jalani SAM, Rushlan MAA, Yen SGS, Hadie SNH, Minhat HS, Abas R. Medical Students' Perception of Anatomy Education Environment in Universiti Putra Malaysia. *Malaysian Journal of Medicine & Health Sciences*. 2021;17(4).
2. Yen SGS, Jalani SAM, Rushlan MAA, Hadie SNH, Minhat HS, Abas R. Anatomy Education Environment among Pre-Clinical Medical Students in Universiti Putra Malaysia Using Anatomy Education Environment Measurement Inventory. *Education in Medicine Journal*. 2021;13(3). DOI: 10.21315/eimj2021.13.3.3
3. Bhat D, Pushpalatha Muruges P. Objective structured practical examination: As an assessment tool in newly introduced competency based anatomy curriculum. *Indian Journal of Clinical Anatomy and Physiology*. 2020;7(1):81-6. DOI:10.18231/j.ijcap.2020.018
4. Eng-Tat A, Liu P, RL S, Lian WQD, Huppertz B, Khamuani M, et al. The challenges of histology education. *Clinical Anatomy*. 2023;36(2):308-14. DOI: 10.1002/ca.23989
5. Sakaran R, Omar NA, Omar N, Sanip S, Noor KMKM, Ngatiman MH, et al. Application and Relevancy of Anatomy Curriculum in the Clinical Years: A Malaysian university Experience. *Education in Medicine Journal*. 2021. DOI: 10.21315/eimj2021.13.2.2
6. Thamke SG, Vaidya YP, Kurwe M. A Trial of the Objective Structured Practical Examination in Anatomy. *European Journal of Molecular & Clinical Medicine (EJMCM)*. 2021;8(04):2021.
7. Chapman JA, Lee LM, Swailes NT. From scope to screen: the evolution of histology education. *Biomedical Visualisation: Volume 8*. 2020:75-107.
8. Abas R, Minhat HS, Saliluddin SM, Basir R, Razak NIA, Zainal NHM, et al. Medical Students' Mental Health Status and Coping Strategies in Their Quarantine Period During COVID-19 Pandemic in Universiti Putra Malaysia. *Education in Medicine Journal*. 2021;13(4). DOI: 10.21315/eimj2021.13.4.6
9. Yusoff MSB. ABC of content validation and content validity index calculation. *Education in Medicine Journal*. 2019;11(2):49-54. DOI: 10.21315/eimj2019.11.2.6
10. Hadie SNH, Hassan A, Ismail ZIM, Asari MA, Khan AA, Kasim F, et al. Anatomy education environment measurement inventory: A valid tool to measure the anatomy learning environment. *Anatomical sciences education*. 2017;10(5):423-

32. .DOI 10.1002/ase.1683
11. Sürücü L, Maslakci A. Validity and reliability in quantitative research. *Business & Management Studies: An International Journal*. 2020;8(3):2694-726. DOI: <http://dx.doi.org/10.15295/bmij.v8i3.1540>
 12. Schober P, Vetter TR. Nonparametric statistical methods in medical research. *Anesthesia & Analgesia*. 2020;131(6):1862-3. DOI: 10.1213/ANE.0000000000005101
 13. Khatun N. Applications of normality test in statistical analysis. *Open Journal of Statistics*. 2021;11(01):113. DOI: 10.4236/ojs.2021.111006
 14. Adam SK, Mazlan NA, Selvakumar S, Teh XH, Idris F. Undergraduate students' perception on assessment experience in a Malaysian medical school: Comparison among gender, ethnicity and phase of study. *IUM Medical Journal Malaysia*. 2021;20(3). DOI: <https://doi.org/10.31436/imjm.v20i3>
 15. Hosapatna M, Ankolekar VH, Kotian SR, Souza AD, Souza ASD. Impact of overall teaching program of anatomy in learning: a students perspective. *Advanced Science Letters*. 2017;23(3):1826-9. DOI: <https://doi.org/10.1166/asl.2017.8523>
 16. Yaqinuddin A, Zafar M, Ikram MF, Ganguly P. What is an objective structured practical examination in anatomy? *Anatomical sciences education*. 2013;6(2):125-33.
 17. Kharb P, Samanta PP, Jindal M, Singh V. The learning styles and the preferred teaching—learning strategies of first year medical students. *Journal of clinical and diagnostic research: JCDR*. 2013;7(6):1089. DOI: 10.7860/JCDR/2013/5809.3090
 18. Minhat HS, Abas R, Zakariah SZ, Ibrahim R, Mohamed Razali CSM, Salleh M. Effectiveness of a Musical-based Learning Approach on Knowledge and Happy Index Related to Anatomy Syllabus: A Quasi-Experimental Pilot Study. *Malaysian Journal of Medicine & Health Sciences*. 2024;20(2). . DOI:10.47836/mjmhs19.2.28
 19. Romli MH, Yunus FW, Hamzah SA, Abas R, Foong CC. Self-Regulated Learning of Nursing Students: A Cross-Sectional Study. *Education in Medicine Journal*. 2023;15(2). DOI: 10.21315/eimj2023.15.2.2
 20. Behjat S, Chowdhury MS. Emotional intelligence, self-efficacy and diversity receptiveness of university students: A correlation study. *International Journal of Academic Research in Business and Social Sciences*. 2012;2(4):301.