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Dual-Track Complementarity in PhD Education: An Empirical Study of Traditional Mentorship and Online Collaborative Learning

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Abstract: Against the backdrop of globalization and multicultural integration in Southeast Asia, PhD education is transforming from traditional mentorship to online collaborative learning. This study examines four Malaysian universities through surveys of 80 PhD students and 20 supervisors, exploring the application, complementarity, and challenges of both models. Results show online collaborative learning significantly enhances research output and international participation, while traditional mentorship remains irreplaceable for personalized guidance. The hybrid integration of both models is optimal for high-quality PhD education in Southeast Asia's multicultural context.

Keywords: PhD education; Mentorship system; Online collaborative learning; Teaching innovation; Southeast Asia; Multiculturalism

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1. Introduction

As the apex of higher education, PhD education cultivates innovative talents and drives national research capabilities. In Southeast Asia, globalization, digitalization, and multicultural integration are transforming PhD education systems. The limitations of traditional mentorship have grown prominent, while online collaborative learning is expanding rapidly; their interplay and integration now shape the development of high-quality PhD education [1]. As a multi-ethnic Southeast Asian nation, Malaysia merges Eastern educational traditions with Western academic norms, making it an ideal context for studying the transformation of multicultural PhD education [2].

Existing research has focused on single-country or single-model studies, with few empirical analyses examining the complementarity of dual models in Southeast Asia's multicultural setting. This study addresses this gap by examining the application effects of dual models in Malaysia through surveys of 80 PhD students and 20 supervisors at four major universities. Using SPSS for quantitative analysis, it focuses on research

capabilities, interdisciplinary cooperation, and international academic integration, thereby providing an empirical reference for educational innovation in developing countries.

2. Research design

This study employed stratified random sampling across four Malaysian universities (public and private), collecting valid questionnaire data from 80 PhD students and 20 supervisors. The sample maintained a student-supervisor ratio of 1:2 to 1:4, with ethnic distribution reflecting Malaysia's demographics: Malay 45% (36), Chinese 35% (28), and Indian and others 20% (16). Academic backgrounds included 35% natural sciences, 40% social sciences, and 25% humanities (**Table 1**). A structured questionnaire with a 5-point Likert scale was used, achieving a Cronbach's Alpha of 0.85, which indicates high reliability. After expert review and pilot testing, the questionnaire covered mentorship experience, online learning usage, research capability improvement, and cross-cultural adaptability.

Table 1. Sample characteristics

Characteristic	Percentage	*n*
Natural Sciences	35%	28
Social Sciences	40%	32
Humanities	25%	20
Published International Papers	60%	48

3. Traditional mentorship in Malaysia's PhD education

3.1. Advantages and core functions of traditional mentorship

Traditional mentorship remains dominant in Malaysia's doctoral education system. It integrates Eastern tutorial culture with Western academic norms, providing one-on-one academic guidance to PhD candidates within a multi-ethnic context. Supervisors assist students in research topic selection, literature review, theoretical synthesis, and data analysis. The survey indicates that 60% of students communicate with supervisors on a weekly basis, with an overall satisfaction rating of 4.2 out of 5 for guidance received. By discipline, natural science students report the highest satisfaction at 4.3, followed by humanities students at 4.1. Influenced by academic heritage culture, Chinese students engage in more active communication. Regarding practical support, 85% of students acknowledge supervisors' guidance on research methodologies, 80% affirm their role in career planning, and 65% obtain effective recommendations for interdisciplinary projects. In conclusion, traditional mentorship is irreplaceable in personalized training, academic development, and career advancement.

3.2. Limitations and bottlenecks of traditional mentorship

Despite its strengths, the traditional tutorial model exhibits notable limitations in internationalized and diversified doctoral education. Constrained by regional resources, supervisors' networks, and offline interactions, students encounter developmental bottlenecks in international outlook and interdisciplinary expansion. As shown in **Table 2**, 75% perceive insufficient international academic resources, 65% lack interdisciplinary collaboration channels, and 60% engage in fewer than two monthly academic exchanges.

Additionally, 55% face constraints related to time and distance, particularly off-campus and part-time students. Supervisors' academic networks tend to be locally focused, making it difficult for students to access global theories and research teams. These shortcomings fail to meet the multicultural and international development needs of Southeast Asian doctoral education, underscoring the necessity for complementary online learning models.

Table 2. Limitations of traditional mentorship

Limitation dimension	*n* (%)	Ethnic perception (mean)
Lack of international resources	60 (75%)	Chinese 4.5, Malay 4.3, Indian 4.4
Lack of interdisciplinary cooperation	52 (65%)	Chinese 4.2, Malay 4.1, Indian 4.3
Low interaction frequency	48 (60%)	Chinese 4.0, Malay 3.9, Indian 3.8
Time/geographic constraints	44 (55%)	Chinese 3.8, Malay 3.7, Indian 3.9

4. Online collaborative learning: Application and challenges

4.1. Current application of online collaborative learning

Online collaborative learning is increasingly prevalent in Malaysia's PhD education amid digitalization. Eighty percent of doctoral students use at least one online platform for academic discussion, data sharing, and joint research. Zoom (70%) and Microsoft Teams (65%) predominate due to stable operation and multilingual functions suited to Malaysia's multi-ethnic education; Tencent Meeting and DingTalk facilitate China-Malaysia cross-border research collaboration.

Ethnic disparities exist in online learning acceptance: Chinese students show the highest utilization (85%), followed by Malay (78%) and Indian students (75%). Digital platforms overcome temporal and geographical barriers, enabling international scholarly communication and global network expansion. Statistics indicate average annual international project participation per student increased from 1.2 to 2.1, with 70% completing transnational cooperation via online tools (**Table 3**).

Table 3. Online collaborative tools and research impact

Tool/Impact	Usage/Rate	Satisfaction	Key feature
Zoom	70%	4.0	Stable, multilingual
Microsoft Teams	65%	3.9	Office integration
International projects	2.1/year	—	Up from 1.2
Interdisciplinary cooperation	65%	—	Cross-ethnic

4.2. Advantages and existing challenges

Online collaborative learning offers advantages in flexible scheduling, international outreach, and interdisciplinary integration by providing open academic resources, fostering diverse interactive environments, and addressing limitations of traditional one-on-one supervision. Within Southeast Asia's multicultural context, it enhances cross-cultural awareness and interdisciplinary research capabilities, supplementing conventional PhD training and aligning with constructivist learning theory, which emphasizes knowledge construction through social interaction and experience [3].

Implementation challenges include technical barriers, limited in-depth academic discussion and

emotional interaction, and cross-cultural misunderstandings in team collaboration (30% due to cultural/cognitive differences). Additionally, 55% of supervisors note incomplete online assessment systems, with current mechanisms failing to scientifically measure students' online learning investment and research performance, impeding standardized, sustainable development of online collaborative education.

5. Dual-track complementarity and integration

The complementarity between traditional mentorship and online collaborative learning reflects the combination of constructivist and social learning theories. Traditional mentorship offers personalized knowledge construction and maintains cultural identity, while online learning creates social interaction platforms and promotes cross-cultural integration [4]. This dual-track approach optimizes educational resource allocation, combining supervisors' local expertise with global digital networks to meet personalized and international academic demands. Empirical data prove the superiority of the integrated model. As **Table 4** shows, dual-track users produce 2.8 papers per year compared to 1.5 (traditional alone) and 2.1 (online alone). International project participation is 85% (vs. 55%, 70%), and interdisciplinary cooperation is 78% (vs. 45%, 65%). Supervisor satisfaction is 4.5/5 under the dual-track model. Chinese students are good at international participation (3.2 projects/year), Malay students at interdisciplinary cooperation (82%), and Indian students show the greatest output improvement (2.5 papers/year), showing the model's adaptability to diverse ethnic needs.

Table 4. Comparative analysis: Single vs. dual-track models

Dimension	Traditional alone	Online alone	Dual-track integrated
Papers/year	1.5	2.1	2.8
International project rate	55%	70%	85%
Interdisciplinary rate	45%	65%	78%
Supervisor satisfaction	3.8	3.6	4.5

Implementation strategies include: (1) flexible dual-track guidance, with traditional mentorship dominant in early research and online collaboration increasing later; (2) multicultural platforms for multilingual switching and cross-cultural adaptation; (3) comprehensive evaluation systems covering both models; (4) digital literacy and cross-cultural training; and (5) regional Southeast Asian PhD education cooperation networks for resource sharing and academic talent mobility.

6. Conclusion and recommendations

This study empirically demonstrates that the dual-track integrated model of traditional mentorship and online collaborative learning is optimal for high-quality PhD education within Southeast Asia's multicultural context. Traditional mentorship excels in personalized guidance (satisfaction 4.2/5) and career support, while online learning enhances international participation (projects increased from 1.2 to 2.1 annually) and interdisciplinary collaboration. The integrated model yields superior outcomes: 2.8 papers per year, 85% international project participation, 78% interdisciplinary cooperation, and adaptability to diverse ethnic needs.

Policy recommendations include: national governments should incorporate the dual-track model into higher education plans and fund digital infrastructure; universities should establish PhD innovation centers and reform evaluation systems; supervisors should enhance digital literacy and expand international networks; students should actively engage in cross-ethnic collaboration; and regional networks should promote resource sharing across Southeast Asia. Future research should increase sample sizes, adopt longitudinal designs, conduct cross-country comparisons, and explore policy-level institutional barriers to validate and refine the dual-track model for multicultural developing countries.

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