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Differential Student Perceptions of Blended Learning Advantages and Disadvantages in Applied Exercise Rehabilitation: A Multicampus Comparative Study

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Abstract

This study examined differences in perceived blended learning (BL) advantages and disadvantages among Applied Exercise Rehabilitation Students across four Universiti Teknologi MARA (UiTM) campuses in Malaysia. A cross-sectional survey included 212 students from Faculty of Sport Science and Recreation (FSR) campuses: FSR UiTM Shah Alam (n=87), FSR UiTM Samarahan (n=40), FSR UiTM Seremban (n=37), and FSR UiTM Arau (n=48). Chi-square analysis with adjusted residuals identify statistically significant differences (p<.001) across campuses for both BL advantages and disadvantages. FSR UiTM Shah Alam students reported higher preferences for combinations involving access to online materials, ability to record meetings, and class interactivity. FSR UiTM Arau students showed stronger endorsement for flexible learning pace combined with staying at home. For disadvantages, FSR UiTM Shah Alam reported more technical difficulties and self-distraction issues, while FSR UiTM Arau students emphasized lack of face-to-face interactions and social isolation. Campus-specific factors shape students of BL in Applied Exercise Rehabilitation, indicating the need for tailored implementation addressing local infrastructure and learning context.

Keywords: distance learning, e-learning, exercise science, face-to-face, Malaysia sports science

1. Introduction

The COVID-19 pandemic prompted the adoption of blended learning (BL) in higher learning institutions worldwide, forcing educators to rapidly embrace online learning alongside traditional face-to-face instruction (Crawford et al., 2020; Selvanathan et al., 2023). In Malaysia, the government announced the Movement Control Order during the pandemic, prompting an immediate transition to emergency remote teaching (Chung et al., 2020; Nordin & Nordin, 2020). Now that BL has become as an established approach, many institutions face the challenge of integrating it into their regular practices. Understanding student perceptions of these modalities is critical for evidence-based curriculum design and improved institutional planning.

Campus differences matter both pedagogically and institutionally for several interconnected reasons. Pedagogically, variations in local infrastructure, laboratory resources, qualified clinical instructors, and student demographics directly shape the quality and effectiveness of BL delivery even when the curriculum is standardized across sites. A BL approach that leverages interactive online tools and strong internet connectivity at an urban main campus cannot be assumed to yield the same learning experience at a rural or satellite campus where connectivity is limited and clinical simulation resources are fewer. Institutionally, multi-campus universities like Universiti Teknologi MARA (UiTM) face the challenge of maintaining equitable educational standards across geographically dispersed faculties that serve demographically distinct student populations. Implementing a uniform BL model without accounting for these campus-specific realities risks widening existing disparities in student experience and learning outcomes. Empirically, Jafar et al. (2022; 2023) documented significant geographic variation in e-learning challenges across Malaysia, demonstrating that students in different regions face distinct barriers related to internet infrastructure, connectivity, and learning environment (Jafar et al., 2023; Jafar et al., 2022). Similarly, research has shown that BL benefits vary substantially by institutional context and student characteristics (Cao, 2023; De Bruijn-Smolders & Prinsen, 2024), underscoring the need for campus-sensitive implementation strategies rather than blanket policy adoption

Despite growing interest in BL effectiveness in the modern digital education era, research comparing perceptions across different BL configurations remains scarce in Malaysia. In Sports Science programmes, applied exercise rehabilitation is a subject that requires hands-on practical training and theoretical knowledge for working with injured athletes. Practice-based learning is essential for students to develop the understanding and skills needed to conduct exercise assessment and intervention. Therefore, this study addresses these gaps by examining student perceptions of BL in Applied Exercise Rehabilitation across multiple UiTM campuses (Shah Alam, Samarahan, Seremban and Arau) at the Faculty of Sports Science and Recreation (FSR). This study makes three contributions to the blended learning literature. First, it provides empirical evidence from Malaysia, a context underrepresented in BL research for applied rehabilitation disciplines where geographic, infrastructural, and demographic diversity across campuses creates a particularly rich setting for examining intra-institutional variation. Second, while student perceptions of BL advantages and disadvantages are well studied, existing research predominantly treats institutions as homogeneous units and measures perceptions as unidimensional constructs. This study advances the field by capturing perceptions as co-occurring combinations within a standardised curriculum, revealing campus-specific perception profiles that averaged or item-level analyses would obscure. Third, the multi-campus comparative design within a single institution where curriculum, learning objectives, and assessment standards are held constant provides a methodologically clean natural experiment for isolating campus context as the differentiating variable, a design strength rarely achieved in comparative BL research. This study has two objectives: (1) to identify which combinations of BL advantages students perceive as most beneficial for learning Applied Exercise Rehabilitation and whether these

perceptions differ across campuses, and (2) to identify which combinations of BL disadvantages students perceive as most problematic for developing rehabilitation competencies and whether these perceptions differ across campuses. The specific structure of BL delivery for this course across FSR UiTM campuses is described in the Methods section.

2. Literature Review

BL combines online activities and in-person instruction, offering flexible learning and pacing, accessibility of materials, and reduced commuting requirements (Garrison & Kanuka, 2004; López-Pérez et al., 2011). Research demonstrates BL can positively impact student engagement and learning outcomes when implemented effectively (Cao, 2023; De Bruijn-Smolders & Prinsen, 2024), though benefits vary by institutional context and student characteristics.

Applied Exercise Rehabilitation presents a particularly challenging case for BL implementation. The course integrates theoretical knowledge of exercise physiology and rehabilitation principles with practical clinical skills including patient assessment and hands-on therapeutic techniques. Physical therapy literature raises concerns about whether psychomotor skills, and professional formation can develop in a largely online environment (Bilyeu et al., 2024; Gagnon et al., 2020). While theoretical components may suit online delivery through video demonstrations and e-learning modules, clinical reasoning and motor skills demand supervised practice and real-time feedback that online environments struggle to replicate (Ballouk et al., 2022).

Multi-campus institutions face additional complexity. Different campuses vary in laboratory facilities, simulation equipment, and qualified clinical instructors. Research in Malaysia has documented significant geographic variations in e-learning challenges, with students in different regions facing distinct barriers related to infrastructure, connectivity, and learning environment (Jafar et al., 2023; Jafar et al., 2022).

This study examined differential perceptions of BL advantages and disadvantages among students enrolled in Applied Exercise Rehabilitation across four campuses of UiTM. The following research questions guide this investigation: (1) What campus-differential perceptions of BL advantages do students report in Applied Exercise Rehabilitation, and do these perceptions differ significantly across campuses? (2) What campus-differential perceptions of BL disadvantages do students report in developing rehabilitation competencies, and do these perceptions differ significantly across campuses?

2.1. Blended Learning Perceptions as Multidimensional and Interactive

Existing BL research has predominantly measured student perceptions through single-item ratings or averaged scale scores, implicitly treating satisfaction or attitude toward BL as a unidimensional construct (Cao, 2023; López-Pérez et al., 2011). However, this approach obscures a fundamental reality of how students actually experience BL: the advantages and challenges they encounter do not operate in isolation but co-occur, interact, and compound one another in ways that vary by individual circumstance and institutional context. A student who simultaneously values flexible pacing and the ability to record lectures is expressing a qualitatively different learning orientation from one who values flexible pacing and the ability to stay at home even though both responses include "flexible pacing." Similarly, a student who experiences both technical difficulties and self-distraction faces a compounding disadvantage that is meaningfully distinct from experiencing either barrier alone.

This multidimensional, interactive nature of BL perception aligns with Garrison and Kanuka's (2004) foundational argument that BL is not merely a delivery format but a redesign of the learning experience across cognitive, social, and technological dimensions (Garrison & Kanuka, 2004). When students evaluate BL, they are simultaneously weighing online accessibility against social presence, technological affordances against infrastructure reliability, and self-regulatory demands against environmental constraints all at once. Reducing this to a single advantage score or a single disadvantage score collapses these interactions and loses the pedagogically meaningful variation within them.

In multi-campus contexts, this multidimensionality is further complicated by campus-specific moderating factors. Differences in laboratory infrastructure, internet connectivity, student demographic backgrounds, and exposure to clinical practice settings mean that the same BL design can generate different perception profiles not merely different average satisfaction scores across campuses (Jafar et al., 2023; Jafar et al., 2022). A campus with strong connectivity infrastructure may shift student concerns away from technical access toward self-regulation, while a campus with limited clinical simulation resources may heighten concerns about interpersonal and patient interaction deficits. These are not differences of degree but of kind; they represent structurally different combinations of perceived experience.

This conceptual understanding directly justifies the combination-based analytical approach adopted in this study. Rather than treating each advantage or disadvantage as an independent variable to be summed or averaged, the analysis captures the co-occurrence patterns of perceptions that students actually report, which preserves the multidimensional, interactive nature of BL experience. Chi-square analysis with adjusted residuals applied to these response combinations then allows identification of which profiles are significantly over or under-represented at specific campuses, revealing how campus context shapes not just the intensity but the structure of student BL perception. This approach thus provides a more ecologically valid and institutionally actionable picture of differential BL experience than single-dimension comparisons can offer.

3. Research Method

3.1. Research Design

This cross-sectional descriptive study employed a survey design to examine student perceptions of BL in the Applied Exercise Rehabilitation course across four FSR UiTM campuses: Shah Alam (main campus), FSR UiTM Samarahan (Sarawak), FSR UiTM Seremban (Negeri Sembilan), and FSR UiTM Arau (Perlis). These campuses represent geographic diversity across Peninsular and East Malaysia while delivering the same standardised curriculum for Applied Exercise Rehabilitation.

3.2. Participants

A total of 212 undergraduate students participated: FSR UiTM Shah Alam (n=87, 41.0%), FSR UiTM Samarahan (n=40, 18.9%), FSR UiTM Seremban (n=37, 17.5%), and FSR UiTM Arau (n=48, 22.6%). Purposive sampling was utilised to recruit students who had experienced BL delivery of this course. Inclusion criteria required participants to be currently enrolled in or to have recently completed the Applied Exercise Rehabilitation course delivered through BL format. The demographic information of the respondents is presented in Table 1.

Table 1

Demographic Characteristics of Respondents by Campus (N = 212)

		Total (N = 212) n (%)	FSR Shah Alam (n = 87) n (%)	FSR Samarahan (n = 40) n (%)	FSR Seremban (n = 37) n (%)	FSR Arau (n = 48) n (%)	Sig.
Age (years)	18 – 22	55 (25.9%)	22 (25.3%)	1 (2.5%)	8 (21.6%)	24 (50.0%)	.001
	23 – 25	140 (66.0%)	62 (71.3%)	31 (77.5%)	23 (62.2%)	24 (50.0%)	
	26 – 28	17 (8.0%)	3 (3.4%)	8 (20.0%)	6 (16.2%)	0 (0.0%)	
Sex	Male	126 (59.4%)	53 (60.9%)	25 (62.5%)	21 (56.8%)	27 (56.3%)	.908
	Female	86 (40.6%)	34 (39.1%)	15 (37.5%)	16 (43.2%)	21 (43.8%)	
Ethnicity	Malay	169 (79.7%)	75 (86.2%)	18 (45.0%)	35 (94.6%)	41 (85.4%)	.001
	Sarawakian	21 (9.9%)	4 (4.6%)	16 (40.0%)	0 (0.0%)	1 (2.1%)	
	Sabahan	22 (10.4%)	8 (9.2%)	6 (15.0%)	2 (5.4%)	6 (12.5%)	
Education Background	Malaysian Higher School Certificate (Sijil Tinggi Persekolahan Malaysia [STPM])	103 (48.6%)	47 (54.0%)	18 (45.0%)	17 (45.9%)	21 (43.8%)	.042
	Matriculation	38 (17.9%)	20 (23.0%)	3 (7.5%)	9 (24.3%)	6 (12.5%)	
	Diploma	71 (33.5%)	20 (23.0%)	19 (47.5%)	11 (29.7%)	21 (43.8%)	

Note. FSR = Faculty of Sports Science and Recreation; UiTM = Universiti Teknologi MARA; n = frequency; % = percentage. Sig. = chi-square significance value. Significance set at α = .05.

3.3. Blended Learning

To contextualise the instrument design and participant selection criteria, this section describes the BL implementation of Applied Exercise Rehabilitation as delivered across FSR UiTM campuses during the study period. Applied Exercise Rehabilitation is a core sport science course that prepares students for careers in exercise rehabilitation and sports therapy. The course covers musculoskeletal assessment, exercise prescription, therapeutic modalities, and evidence-based practice. Under BL delivery, theoretical content including anatomy review, pathophysiology, and rehabilitation principles were delivered via online lectures while practical laboratory sessions and clinical simulations were conducted face-to-face.

3.4. Instrumentation

The instrument comprised two structured checklists: Advantage dimensions and Disadvantage dimensions, respectively. For Advantage dimensions, there were six (6) items: (1) Access to online materials; (2) Learning at your own pace; (3) Ability to stay at home; (4)

Class interactivity; (5) Ability to record meetings; and (6) Comfortable surroundings. Disadvantage dimensions were also made up of six (6) elements: (1) Lack of face-to-face interactions; (2) Technical difficulties (limited access to resources and support, e.g., poor internet connection); (3) Lack of interactions with students/patients; (4) Unconducive learning environment; (5) Self-distraction (deliberately doing other things during class time); and (6) Social isolation. Participants could select multiple dimensions simultaneously, producing multi-response combinations that reflect the co-occurring nature of actual BL experience.

The six advantages and six disadvantages dimensions were derived from the established BL literature to ensure content validity (Ballouk et al., 2022; Gagnon et al., 2020; Garrison & Kanuka, 2004; López-Pérez et al., 2011). Prior to full deployment, the instrument underwent expert content review by three academics with expertise in BL and sports science education, who confirmed the relevance and completeness of the dimensions for the Applied Exercise Rehabilitation context. Face validity was further established through a preliminary review with five students who confirmed the clarity and comprehensibility of item wording. As the instrument produces categorical multi-response data rather than continuous scale scores, traditional internal consistency reliability indices are not applicable; content validity through theoretical grounding and expert review constitutes the appropriate validation procedure for this instrument type (DeVellis & Thorpe, 2021).

3.5. Data Collection

Data were collected through online survey distribution via institutional learning management systems and student communication channels. Participation was voluntary, and informed consent was obtained from all participants. The survey was administered following completion of the BL delivery of Applied Exercise Rehabilitation to ensure students had sufficient experience with the modality to provide informed responses. Ethical approval was obtained from the institutional research ethics committee prior to data collection.

3.6. Data Analysis

Descriptive statistics including frequencies and percentages were calculated for all response combinations. Chi-square tests of independence were conducted to examine associations between campus location and reported advantages/disadvantages. Given the naturally unequal enrolment sizes across campuses reflecting actual programme distribution rather than sampling design, adjusted standardized residuals were prioritised as the primary inferential tool over omnibus chi-square values alone. Adjusted residuals correct for differences in marginal frequencies and provide robust cell-level inference in contingency tables with unequal group sizes (Agresti, 2013), making them particularly appropriate for the present multi-campus comparative design. Adjusted standardized residuals were computed to identify specific cells contributing to significant chi-square results (Agresti, 2013). Adjusted residuals greater than +1.96 or less than -1.96 indicated statistically significant over- or under-representation at the $p<.05$ level, while values exceeding +2.58 or -2.58 indicated significance at the $p<.01$ level.

Rather than treating the resulting response combinations as isolated data points, the adjusted residual patterns were interpreted through thematically coherent perception clusters and identified through statistically significant adjusted residual patterns, providing the thematic framework for the findings.

All analyses were performed using SPSS version 26.0, with the significance level set at $\alpha=.05$.

4. Findings and Discussion

4.1. Findings

Before presenting the findings, a brief note on the analytical structure is warranted. The instrument captured student perceptions through two sets of six dimensions each, six BL advantage dimensions and six BL disadvantage dimensions, theoretically derived from the literature and validated through expert review (see Section 2.4). Participants could select multiple dimensions simultaneously, producing response combinations that reflect the co-occurring nature of real BL experience. Chi-square analysis with adjusted standardised residuals was then applied to these combinations across the four campuses. This approach is methodologically appropriate because it preserves the multidimensional, interactive structure of student perceptions rather than collapsing them into averaged scores, and because adjusted residuals provide robust cell-level inference in contingency tables with unequal group sizes (Agresti, 2013). The findings below are organised thematically by campus-distinctive perception clusters, with full combination-level data available in the appendices.

A total of 212 undergraduate students participated across four FSR UiTM campuses: Shah Alam (n=87, 41.0%), Arau (n=48, 22.6%), Samarahan (n=40, 18.9%), and Seremban (n=37, 17.5%). Chi-square analysis revealed significant demographic differences across campuses for age (p=.001), ethnicity (p=.001), and education background (p=.042), while sex distribution was consistent across all campuses (p=.908). The majority of respondents were aged 23 to 25 years (n=140, 66.0%) and male (n=126, 59.4%). Ethnically, the sample was predominantly Malay (n=169, 79.7%), though FSR UiTM Samarahan was notably distinct with the lowest proportion of Malay students (45.0%) and the highest proportion of Sarawakian students (40.0%), reflecting its East Malaysian location. Regarding education background, Malaysian Higher School Certificate (Sijil Tinggi Persekolahan Malaysia [STPM]) was the most common entry qualification (n=103, 48.6%), followed by Diploma (n=71, 33.5%) and Matriculation (n=38, 17.9%), with Samarahan recording the highest proportion of Diploma holders (47.5%) and Shah Alam the highest proportion of STPM and Matriculation entrants (54.0% and 23.0% respectively). These demographic variations across campuses particularly in age, ethnicity, and prior qualification provide important contextual grounding for interpreting the campus-differential BL perception patterns reported in Table 1.

4.1.1. Campus-Differential Perceptions of BL Advantages in Applied Exercise Rehabilitation

Table 2.

Key BL Advantage Combinations by Campus (Significant Adjusted Residuals Only)

Perception Cluster	Key Combination	Campus	%	Adj. Res.
Technology-Interactive	Access to online materials + Stay at home + Class interactivity + Record meetings	Shah Alam	4.7	+3.1
Technology-Interactive	Access to online materials + Own pace + Stay at home + Record meetings	Shah Alam	4.7	+2.1
Technology-Interactive	Access to online materials + Own pace + Stay at home + Class interactivity	Shah Alam	2.8	+2.0
Technology-Interactive	Access to online materials + Own pace + Class interactivity + Record meetings	Shah Alam	3.3	+1.3

Perception Cluster	Key Combination	Campus	%	Adj. Res.
Flexibility-Home	Access to online materials + Own pace + Stay at home	Arau	5.7	+3.1
Flexibility-Home	Access to online materials + Stay at home + Record meetings	Arau	5.7	+3.1
Flexibility-Home	Own pace + Stay at home + Class interactivity	Arau	2.4	+3.1
Flexibility-Home	Access to online materials + Stay at home + Class interactivity	Arau	1.9	+3.7
Comfort-Recording	Record meetings + Comfortable surroundings	Seremban	1.4	+3.1
Comfort-Recording	Stay at home + Class interactivity + Record meetings	Seremban	0.9	+2.3
Accessibility-Comfort	Access to online materials + Stay at home + Comfortable surroundings	Samarahan	0.9	+2.1
Accessibility-Comfort	Access to online materials (standalone)	Samarahan	0.9	+2.9

Note. Only combinations with adjusted residuals ≥ ±1.96 are displayed. Full combination-level data are provided in Appendix A. F2F = Face-to-face; BL = Blended Learning; Adj. Res. = Adjusted Standardized Residual.

The chi-square analysis revealed significant differences across campuses in perceived BL advantages ($p<.001$), with 46 distinct response combinations identified, rather than treating the resulting response combinations as isolated data points, the adjusted residual patterns were interpreted through four thematically coherent campus-distinctive perception clusters (Table 2).

FSR UiTM Shah Alam Technology-Interactive Cluster: Shah Alam students were significantly over-represented in combinations that integrate online materials access, class interactivity, and recording capabilities the "Technology-Interactive" cluster. The highest-frequency significant combination was "Access to online materials + Stay at home + Class interactivity + Record meetings" (4.7%, adjusted residual=+3.1), followed closely by "Access to online materials + Own pace + Stay at home + Record meetings" (4.7%, adjusted residual=+2.1). This cluster reflects students at the main campus which capitalises on superior technological infrastructure and accumulated BL implementation experience, valuing BL most when it simultaneously offers digital resource access, live engagement, and archival recording, a profile consistent with technologically mature BL adoption (Bilyeu et al., 2024; McCutcheon et al., 2018).

FSR UiTM Arau Flexibility-Home Cluster: Arau students showed the strongest and most consistent over-representation in combinations emphasising flexible pacing and home-based learning the "Flexibility-Home" cluster. Four combinations were significantly over-represented, with "Access to online materials + Stay at home + Class interactivity" yielding the highest adjusted residual in the entire advantages table (+3.7, 1.9%). This cluster reflects students at this northern campus, who are predominantly from rural backgrounds with limited prior exposure to campus-based rehabilitation facilities (Jafar et al., 2022), valuing BL primarily for removing geographic and commuting barriers rather than for its interactive technological features.

FSR UiTM Seremban Comfort-Recording Cluster: Seremban students were distinctively over-represented in combinations pairing comfortable surroundings with recording capabilities. The standalone combination "Record meetings + Comfortable surroundings" reached significance (1.4%, adjusted residual=+3.1), alongside "Stay at home + Class

interactivity + Record meetings" (adjusted residual=+2.3). This cluster suggests that Seremban students value BL primarily as an environment that combines sensory comfort with the ability to revisit material — a pattern consistent with self-paced review as a compensatory strategy for students managing technically challenging learning conditions.

FSR UiTM Samarahan Accessibility-Comfort Cluster: Samarahan students, who represent a demographically distinct East Malaysian population with a higher proportion of mature students and Diploma holders, were over-represented in combinations centring on basic online access and comfortable surroundings. The standalone selection of "Access to online materials" was significantly over-represented (0.9%, adjusted residual=+2.9), and "Access to online materials + Stay at home + Comfortable surroundings" reached significance (adjusted residual=+2.1). This cluster reflects a foundational valuation of BL for basic accessibility gains rather than advanced interactive features, consistent with documented e-learning infrastructure challenges in Borneo-based campuses (Jafar et al., 2023; Jafar et al., 2022).

4.1.2. Campus-differential Perceptions of BL Disadvantages in Developing Rehabilitation Competencies

Table 3.

Key BL Disadvantage Combinations by Campus (Significant Adjusted Residuals Only)

Perception Cluster	Key Combination	Campus	%	Adj. Res.
Social Isolation	Lack of F2F interactions + No student/patient interaction + Social isolation	Arau	4.2	+4.8
Social Isolation	Unconducive environment + Self-distraction + Social isolation	Arau	6.6	+5.3
Social Isolation	Lack of F2F interactions + No student/patient interaction + Unconducive environment + Social isolation	Shah Alam	2.8	+2.4
Technical-Behavioural	Technical difficulties + Unconducive environment + Self-distraction + Social isolation	Shah Alam	1.4	+2.1
Technical-Behavioural	Lack of F2F interactions + Technical difficulties + Unconducive environment + Self-distraction	Shah Alam	3.8	+2.6
Technical-Behavioural	Technical difficulties + No student/patient interaction + Unconducive environment + Self-distraction	Shah Alam	1.9	+2.4
Technical-Distraction	Technical difficulties + Self-distraction	Seremban	1.4	+3.1
Technical-Distraction	Technical difficulties + Self-distraction + Social isolation	Seremban	0.9	+3.1
Technical-Distraction	Technical difficulties + Unconducive environment + Social isolation	Seremban	0.9	+3.1
Peer-Environment	Lack of F2F interactions + Technical difficulties + Self-distraction	Samarahan	2.4	+2.6
Peer-Environment	Lack of F2F interactions + Technical difficulties + No peer/patient interaction + Unconducive + Self-distraction	Samarahan	1.9	+2.3

Note. Only combinations with adjusted residuals ≥ ±1.96 are displayed. Full combination-level data are provided in Appendix B. F2F = Face-to-face; BL = Blended Learning; Adj. Res. = Adjusted Standardized Residual.

Chi-square analysis for BL disadvantages also revealed significant differences across campuses ($p<.001$), with 52 distinct combinations reported. Three thematically distinct campus-distinctive challenge clusters emerge from the adjusted residual patterns (Table 3).

FSR UiTM Arau — Social Isolation Cluster: Arau students were most distinctively over-represented in disadvantage combinations centred on interpersonal and social deficits, thereby forming the "Social Isolation" cluster. The combination "Lack of face-to-face interactions + Lack of student/patient interactions + Social isolation" produced the highest adjusted residual in the entire disadvantages table (+4.8, 4.2%), while "Unconducive learning environment + Self-distraction + Social isolation" produced an even higher adjusted residual (+5.3, 6.6%). These findings reflect a consistent and acute concern, with the erosion of professional and social community under BL conditions a concern particularly salient in a campus serving rural students with limited access to clinical practice environments and peer learning networks (Gagnon et al., 2020; Smith & Crocker, 2017).

FSR UiTM Shah Alam Technical-Behavioural Cluster: Despite their advantages in infrastructure, Shah Alam students were significantly over-represented in complex disadvantage combinations involving technical difficulties co-occurring with behavioural and environmental challenges — the "Technical-Behavioural" cluster. Notably, "F2F absence + Technical difficulties + Unconducive environment + Self-distraction" (3.8%, adjusted residual=+2.6) and "Technical difficulties + No student/patient interaction + Unconducive environment + Self-distraction" (1.9%, adjusted residual=+2.4) were both over-represented. This suggests that even at the best-resourced campus, the self-regulatory demands of BL in a practical clinical discipline remain significant, and that technical interruptions compound attentional challenges in ways consistent with distraction research in online learning contexts (Deng et al., 2024; Flanigan & Titsworth, 2020).

FSR UiTM Seremban Technical-Distraction Cluster: Seremban students showed a distinctive co-occurrence pattern of technical difficulties and self-distraction, identified as the "Technical-Distraction" cluster, with three separate combinations reaching significance (all adjusted residual=+3.1). This compounding pattern, where connectivity problems appear to increase susceptibility to off-task behaviour, suggests a cascade effect; when technical barriers interrupt the learning flow, students are more likely to disengage, creating a dual challenge that is qualitatively more disruptive than either barrier alone (Wang, 2022).

FSR UiTM Samarahan Peer-Environment Cluster: Samarahan students were over-represented in combinations involving technical difficulties co-occurring with lack of peer interaction and unconducive learning environments. The combination "F2F absence + Technical difficulties + Self-distraction" (2.4%, adjusted residual=+2.6) and a five-way combination involving all interpersonal and environmental barriers (adjusted residual=+2.3) reflect the compounded disadvantage of geographic isolation, East Malaysian infrastructure limitations, and reduced peer learning opportunities that characterise the Samarahan context (Jafar et al., 2023; Jafar et al., 2022).

4.2. Discussion

This study addressed two research questions: (1) what combinations of BL advantages students perceive as most beneficial for learning Applied Exercise Rehabilitation, and whether these perceptions differ across campuses; and (2) what combinations of BL disadvantages students perceive as most problematic for developing rehabilitation competencies, and whether these perceptions differ across campuses. The significant chi-square results ($p<.001$) for both advantages and disadvantages confirm that campus location is a meaningful moderator of BL perception, not merely a demographic variable but a structural determinant of how students experience the same standardised curriculum delivered through blended modalities. The discussion below addresses each research

question in turn, situating findings within the existing literature and drawing explicit implications for institutional policy and curriculum design.

4.2.1. Perceived BL Advantages and Campus-Differentiated Curriculum Design

The advantage perception clusters identified across the four campuses reveal a theoretically coherent progression from foundational access needs to sophisticated interactive engagement, a progression that closely maps onto Garrison and Kanuka's (2004) community of inquiry framework, which posits that effective BL must simultaneously address cognitive presence, social presence, and teaching presence (DeVellis & Thorpe, 2021; Garrison & Kanuka, 2004). Critically, the present findings demonstrate that different campuses are at structurally different points along this progression, with direct implications for how BL curriculum should be designed and resourced at each site.

FSR UiTM Shah Alam students' strong endorsement of the Technology-Interactive cluster combinations, integrating online materials access, class interactivity, and recording capabilities, indicates that students at the main campus have moved beyond basic access concerns toward valuing BL for its capacity to support active, multimodal, and archival learning simultaneously. This aligns with McCutcheon et al.'s (2018) finding that students in well-resourced BL environments increasingly expect synchronous interaction and content replay as complementary rather than alternative affordances (McCutcheon et al., 2018). It also resonates with De Bruijn-Smolders and Prinsen's (2024) systematic review, which found that student engagement with BL is highest when technological affordances support both real-time interaction and independent review, which is precisely the combination Shah Alam students valued most (De Bruijn-Smolders & Prinsen, 2024). For curriculum design, this profile indicates that Shah Alam is ready for advanced BL implementation: flipped classroom models, live simulation debriefs recorded for review, and interactive case-based online modules that leverage existing infrastructure investment. However, the concurrent over-representation of Shah Alam students in Technical-Behavioural disadvantage clusters, combining technical difficulties, unconducive environments, and self-distraction, suggests that technological sophistication does not automatically produce self-regulation. This is consistent with Ballouk et al.'s (2022) systematic review, which found that self-regulation of learning is the primary determinant of BL success, independent of infrastructure quality, and with Flanigan and Titsworth's (2020) evidence that digital distraction increases proportionally with device availability (Ballouk et al., 2022; Flanigan & Titsworth, 2020). Institutionally, this implies that Shah Alam's BL curriculum should incorporate structured self-regulation check-ins, session segmentation to reduce sustained screen time, and explicit digital distraction management protocols, not merely more technology.

FSR UiTM Arau students' dominant Flexibility-Home cluster, their consistent valuing of combinations of flexible pacing, home-based attendance, and online materials access reflects what Frankola (2001) identified as the primary motivational driver for distance and blended learners from rural and geographically peripheral contexts: the removal of logistical barriers as a prerequisite for academic participation (Frankola, 2001). The distinctively high adjusted residuals at Arau (+3.7 for the four-advantage combination) indicate that flexibility is not merely one valued feature among many but the structural precondition through which BL delivers value for this population. This is corroborated by Jafar et al.'s (2022) geospatial analysis of Malaysian e-learning challenges, which documented that students in northern Peninsular Malaysia face disproportionate commuting and infrastructure barriers that make asynchronous and home-accessible learning qualitatively more valuable than in urban centres (Jafar et al., 2022). For curriculum design at Arau, this profile argues against a BL model that centres on live synchronous sessions as the primary engagement mechanism since these replicate the time-boundedness of face-to-face attendance without its social benefits. Instead, an asynchronous-first BL model, with richly structured self-paced modules, flexible assessment windows, and recorded rather than live-only instruction, would align BL

delivery with the actual advantage profile of the student population. Institutionally, university policy should recognise that applying a uniform synchronous BL schedule across all campuses effectively penalises students at peripheral campuses whose primary reason for valuing BL is schedule flexibility.

FSR UiTM Seremban students' Comfort-Recording cluster pairing comfortable surroundings with the ability to record and revisit sessions-points to a learning orientation consistent with what Cao's (2023) meta-analysis identified as deliberate practice-based engagement: students who structure their learning environment and use replay capabilities to review complex material multiple times (Cao, 2023). In Applied Exercise Rehabilitation, where procedural content such as assessment protocols and therapeutic technique demonstrations benefits from repeated viewing, this profile suggests that Seremban students are strategically using BL's archival affordances to compensate for the reduced face-to-face demonstration time. López-Pérez et al. (2011) found that student-perceived BL effectiveness correlates with the degree to which online components complement rather than replace practical instruction; Seremban students appear to be constructing this complementarity themselves through selective replay (López-Pérez et al., 2011). Curriculum design implications for Seremban include prioritising high-quality recorded demonstration content narrated procedural videos, annotated assessment walkthroughs, and segmented technique breakdowns over live-streaming formats, and structuring assessment to reward evidence of iterative self-directed review.

FSR UiTM Samarahan students' Accessibility-Comfort cluster with the standalone selection of "Access to online materials" reaching the highest adjusted residual among Samarahan advantage combinations (+2.9) indicates a foundational valuation of BL that reflects the demographic distinctiveness of this campus. With 47.5% of students holding Diploma qualifications and a higher proportion of mature students from East Malaysian backgrounds, Samarahan's student profile aligns with what Jafar et al. (2023) identified as a population for whom basic digital access represents the primary equity gain of BL adoption not interactive features or technological sophistication, but the simple availability of materials outside scheduled contact hours. This has direct institutional policy implications: before investing in interactive BL technologies at Samarahan, the university should prioritise reliable content delivery infrastructure, offline-accessible materials, and low-bandwidth-compatible platforms that ensure basic access equity for students in East Malaysian connectivity contexts.

4.2.2. Perceived BL Disadvantages and Campus-Differentiated Intervention Strategies

The disadvantage perception clusters reveal that the challenges students experience in BL delivery of Applied Exercise Rehabilitation are not generic or uniform, but campus-specific in both their composition and their underlying drivers with direct implications for how universities should design targeted support interventions rather than institution-wide remediation policies.

FSR UiTM Arau's Social Isolation cluster produced the highest adjusted residuals in the entire study (+5.3 for the three-way combination of unconducive environment, self-distraction, and social isolation; +4.8 for the combination involving lack of face-to-face and patient interactions), indicating a level of over-representation that goes beyond statistical significance to represent a pervasive and structurally embedded challenge. This finding directly extends the work of Gagnon et al. (2020), who identified social and professional community formation as the most vulnerable dimension of BL implementation in health science education (Gagnon et al., 2020), and Smith and Crocker (2017), who argued that clinical reasoning and therapeutic touch competencies are fundamentally social accomplishments that cannot be developed through individual online engagement (Smith &

Crocker, 2017). For Applied Exercise Rehabilitation students at Arau, who face both reduced access to clinical practice settings and the social isolation effects of home-based learning, BL is experienced as a compound deficit: they are separated simultaneously from peers, from patients, and from the professional community of practice that clinical training is meant to provide. Institutionally, this argues for a deliberate redistribution of face-to-face contact hours toward Arau, specifically for clinical simulation and supervised practical components, even if this increases delivery cost. University BL policy should recognise that equity in BL does not mean uniformity of online-to-face ratios across campuses, it means ensuring that all students receive sufficient clinical contact to develop professional competencies, which may require higher face-to-face proportions at campuses with fewer clinical simulation resources.

FSR UiTM Shah Alam's Technical-Behavioural cluster reveals a paradox consistent with the broader BL literature: superior technological access does not eliminate self-regulation challenges and may intensify them. The co-occurrence of technical difficulties with self-distraction and unconducive environments at the best-resourced campus challenges the assumption that infrastructure investment is the primary lever for improving BL outcomes. This is directly consistent with Ballouk et al.'s (2022) finding that self-regulation deficits are the dominant predictor of BL disengagement across all resource levels (Ballouk et al., 2022), and with Deng et al.'s (2024) evidence that multitasking and distraction escalate in proportion to device availability (Deng et al., 2024). For curriculum design, this profile recommends implementing structured engagement protocols in Shah Alam's BL sessions mandatory participation checkpoints, timed task-switching to prevent sustained passive screen time, and peer accountability structures alongside the technical support infrastructure already in place. The institutional implication is that BL professional development for Shah Alam instructors should emphasise pedagogical design for self-regulation as much as technological tool competency.

FSR UiTM Seremban's Technical-Distraction cluster with three distinct combinations of technical difficulties and self-distraction each reaching adjusted residuals of +3.1 provides the clearest empirical evidence in this study of a cascade effect: connectivity failures disrupt the learning flow, and disrupted students are significantly more likely to disengage and direct attention elsewhere. This compounding dynamic is theorised by Wang (2022) as a negative feedback loop in which technical interruptions undermine motivational continuity, making re-engagement effortful and off-task behaviour the path of least resistance (Wang, 2022). For curriculum design at Seremban, this argues for structuring BL sessions to be interruptible without catastrophic consequence chunked into short, self-contained learning units that can be paused and resumed without losing continuity, with downloadable materials available as a connectivity backup. Institutionally, this finding supports investment in connectivity infrastructure at Seremban as a direct academic outcome intervention, not merely a facilities upgrade.

FSR UiTM Samarahan's Peer-Environment cluster combining technical difficulties with lack of peer interaction, unconducive learning environments, and self-distraction reflects the compounded disadvantage of geographic isolation, East Malaysian infrastructure limitations, and the reduced incidental peer learning that occurs naturally in on-campus settings. This profile is consistent with Jafar et al.'s (2022; 2023) geospatial documentation of disproportionate e-learning barriers in East Malaysian contexts and extends their infrastructure-level analysis to identify the specific pedagogical consequence: Samarahan students do not merely face technical barriers but experience these barriers as social and professional isolators (Jafar et al., 2023; Jafar et al., 2022). Curriculum design for Samarahan should prioritise structured peer learning mechanisms, assigned study dyads, moderated asynchronous discussion forums with clear participation expectations, and peer-assessed clinical observation tasks that build social learning infrastructure independently of synchronous connectivity.

4.2.3. Institutional Policy Implications: Toward Differentiated BL Strategies

Taken together, the findings of this study challenge the prevailing assumption in Malaysian higher education that BL policy can be implemented uniformly across multi-campus institutions without attending to campus-specific infrastructure, demographic, and geographic contexts. The evidence presented here demonstrates that a single BL design applied uniformly across Shah Alam, Arau, Seremban, and Samarahan will systematically advantage some student populations while amplifying the disadvantages experienced by others.

Three institutional policy recommendations follow directly from the findings. First, universities should conduct campus-level BL perception audits prior to system-wide BL policy implementation, using combination-based analysis of the kind demonstrated here to identify campus-specific advantage and disadvantage profiles rather than relying on aggregate satisfaction scores that mask within-institution heterogeneity. Second, BL implementation guidelines should be differentiated by campus context, specifying minimum face-to-face clinical contact hours appropriate to each campus's simulation resources, flexibility requirements for asynchronous delivery at peripheral campuses, connectivity contingency provisions for East Malaysian campuses, and self-regulation support protocols for technologically sophisticated campuses. Third, resource allocation decisions for infrastructure investment, instructional design support, and student support services should be guided by the specific disadvantage profiles of each campus rather than distributed uniformly, ensuring that investment addresses the structural roots of differential student experience rather than providing identical resources to unequal contexts.

These recommendations align with Cao's (2023) meta-analysis conclusion that BL effectiveness is maximised when implementation is contextually adapted (Cao, 2023), and with De Bruijn-Smolders and Prinsen's (2024) finding that institutional responsiveness to student context is a stronger predictor of BL engagement than any specific technological feature (De Bruijn-Smolders & Prinsen, 2024). For Applied Exercise Rehabilitation and analogous clinical and practice-based disciplines, where the stakes of inadequate competency development are professional rather than merely academic, campus-differentiated BL strategy is not a logistical preference but a professional education imperative.

4.2.4. Implications of the Study

This study makes several meaningful contributions to the advancement of knowledge in BL research. First, it addresses a documented gap in the BL literature by providing empirical evidence of intra-institutional variation, demonstrating that students at different campuses of the same university, enrolled in the same course under the same curriculum, develop meaningfully different perceptions of BL advantages and disadvantages. Most prior BL perception studies treat institutional or national context as a homogeneous variable; this study shows that even within a single institution, campus-level factors such as geographic location, infrastructure, student demographics, and access to clinical resources are powerful mediators of student BL experience. Second, the study contributes subject-specific knowledge by situating BL perception within Applied Exercise Rehabilitation, a discipline where the tension between online delivery and the psychomotor, clinical, and interpersonal demands of practice-based learning is particularly acute. This extends the BL literature beyond generic academic settings into health and sports science education, where hands-on competency development is non-negotiable. Third, the multi-campus comparative design itself offers a methodological contribution: by applying chi-square analysis with adjusted residuals to multi-response combination data across four campuses, the study provides a replicable framework that other researchers and institutions can use to map BL perception heterogeneity within complex, distributed university systems. Collectively, these

contributions move the field beyond asking whether students perceive BL positively or negatively, toward understanding who perceives it how, where, and why, thereby producing knowledge that is essential for designing equitable, context-sensitive BL policies in multi-campus higher education institutions.

4.2.5. Limitations

The use of purposive sampling, while appropriate for capturing the experiences of students who had directly engaged with BL delivery of the course, limits statistical generalisability to the broader UiTM student population or to Malaysian higher education at large. The findings are best understood as analytically generalisable, offering campus-specific perception profiles and a methodological framework replicable by future researchers rather than inferentially generalisable to all BL contexts.

5. Conclusion

This study advances BL knowledge by demonstrating that students' BL perceptions are not uniform, even within a single institution delivering a standardised curriculum. Instead, BL perceptions are structurally shaped by campus-specific combinations of infrastructure, geography, student demographics, and clinical resource availability. These findings move the BL literature beyond the binary question of whether BL works, toward a more institutionally actionable understanding that BL effectiveness is a campus-level phenomenon requiring differentiated responses. Specifically, the study makes three key contributions: empirical evidence of intra-institutional perception heterogeneity in a Malaysian multi-campus context, disciplinary extension of BL research into Applied Exercise Rehabilitation, where online delivery tensions with psychomotor and clinical competency development are especially consequential, and a methodological demonstration of combination-based chi-square analysis as a replicable framework for revealing perception profiles that scale-based analyses would obscure. Several limitations should be acknowledged, including purposive sampling that limits statistical generalisability beyond the study population, a cross-sectional design that precludes examination of how profiles evolve in response to infrastructure or pedagogical changes, and a structured checklist instrument that, while literature-grounded and expert-validated, does not capture the depth of student reasoning behind combination selections, with the study further bounded to one subject area within one Malaysian public university. Future research should pursue longitudinal designs to establish whether campus-specific clusters are stable or responsive to intervention, qualitative follow-up studies to explain the mechanisms underlying high-residual clusters particularly the Social Isolation pattern at Arau and the Technical-Distraction cascade at Seremban, replication of the combination-based framework across other practice-based health disciplines, and intervention studies testing campus-differentiated BL strategies to translate the diagnostic findings presented here into evidence-based institutional improvement.

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Data availability statement/ supplementary data: The data that support the findings of this study were collected through an online survey administered to undergraduate students enrolled in Applied Exercise Rehabilitation across four FSR UiTM campuses. The dataset is not publicly available due to ethical restrictions and the confidentiality of participant responses as per the conditions of ethical approval granted by the UiTM Research Ethics Committee (FERC/04/2023(UG/MR/0186, UG/MR/0191, UG/MR/01888)). Data are available from the corresponding author, Rahmat Adnan (rahmatadnan@uitm.edu.my), upon reasonable request and subject to institutional ethical clearance requirements.

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