**Abstract**

Blended learning, which mixes online and in-person training and takes advantage of both traditional and digital learning environments, has emerged as a promising educational strategy. However, educators and instructional designers confront a huge difficulty in finding the best balance between online and in-person training. By examining the factors that affect the blend, analysing the effects of various instructional ratios on student engagement and learning outcomes, and offering evidence-based recommendations for efficient design and implementation of blended learning models, this research seeks to close this knowledge gap.

Qualitative information was acquired through focus groups and interviews with knowledgeable educators and administrators in blended learning using a mixed-methods research methodology. Key contributing elements for the blend were identified through thematic analysis of the qualitative data and included student profiles, educational goals, technical considerations, and pedagogical tactics. The second quantitative step was built on these qualitative observations.

A broad sample of students participating in blended learning courses received a survey questionnaire. The links between instructional ratios, student involvement, and learning outcomes were investigated using quantitative analysis, which included descriptive statistics, correlation analysis, and regression analysis. The results showed that the integration of face-to-face and online training had a substantial impact on student engagement levels and learning outcomes.

This study offers a thorough grasp of the ideal blend of online and in-person training in blended learning environments by merging the qualitative and quantitative data. These research findings have led to the development of evidence-based recommendations that can help educators and policymakers create and implement blended learning models that maximise student engagement and promote successful learning outcomes.

To conclude, this study makes a contribution to the field of blended learning by filling in the knowledge gap and providing insightful information on instructional design choices. The results serve as a basis for improving instructional strategies and as guidance for developing and perfecting a successful blended learning model. In blended learning environments, educators can create engaging and memorable learning experiences that support student achievement by maximising the integration of online and face-to-face training.

**CHAPTER 1: INTRODUCTION**

Higher education has seen a rise in the use of blended learning, which blends online and in-person instruction. Due to institutions' increased need for adaptable and engaging learning environments, the COVID-19 pandemic has expedited the spread of blended learning. Optimising blended learning for the benefit of students is crucial in Malaysia, since higher education has a substantial impact on national growth.

It is crucial to comprehend the influence of blended learning on student engagement and academic results as Malaysian educational institutions adopt it. Blended learning has the potential to provide a number of advantages, including more adaptability, individualised learning opportunities, and easier access to information. However, the thoughtful planning and execution of each component is essential to the success of blended learning. The opinions and experiences of students and teachers about blended learning have been the subject of numerous studies. During the COVID-19 epidemic, students in India usually had favourable impressions of online and blended learning, according to a research by Bordoloi, Das, and Das (2021). Similar to this, Heilporn, Lakhal, and Bélisle (2021) investigated teachers' methods for encouraging students' participation in blended learning in higher education, highlighting the significance of active learning, interaction, and technological integration. These studies offer insightful information on the potential advantages of blended learning, but they also emphasise the need for more research in the Malaysian context.

The effect that blended learning has on learning outcomes is an important consideration. In their evaluation of blended learning in the public healthcare education course, Kang and Kim (2021) paid particular attention to the flipped classroom with team-based learning. They discovered that blended learning strategies had a favourable impact on learning outcomes, such as knowledge retention and problem-solving abilities. Additionally, Xu, Yuan, and Liu's (2021) investigation on the prediction of student performance using blended learning suggests that well-designed blended learning models can greatly boost students' academic success. Another important element in successful blended learning settings is engagement. According to research, more student involvement influences learning results. In their systematic study of blended learning in higher education, Müller and Mildenberger (2021) discovered that these methods boosted student engagement and active learning. Furthermore, Salas-Rueda (2020) investigated the impact of the WampServer application in blended learning and emphasized the importance of data science, machine learning, and neural networks in enhancing engagement.

It is essential to take into account the distinctive qualities of the local context in order to optimise blended learning for Malaysian higher education students. Singh, Steele, and Singh (2021) stressed the significance of modifying educational methodologies to fit the post-pandemic reality and presented a hybrid and blended learning strategy to overcome the problems given by the COVID-19 pandemic. Additionally, Wang, Huang, and Omar (2021) highlighted the potential for technology-driven approaches in the Malaysian setting by analysing the implementation of a blended learning model utilising text mining techniques.

The improvement of blended learning can also be significantly aided by predictive analytics. In their 2019 study, Musabirov, Pozdniakov, and Tenisheva focused on data science minors and looked at the factors that predict academic success in blended learning. Using multi-source data and learning analytics, Chango, Cerezo, and Romero (2019) and Van Goidsenhoven et al. (2020) investigated the prediction of student achievement in blended learning environments. These studies highlight how crucial it is to use data-driven insights to improve the development and use of blended learning models.

In Malaysian higher education settings, blended learning has immense potential to optimise student engagement and improve academic achievements. Using concepts from research conducted in various contexts, this study project aims to examine the appropriate ratio of online and face-to-face components in blended learning for Malaysian students. By taking into account the unique characteristics of the Malaysian higher education system and utilising technological advancements, this study seeks to contribute to ongoing efforts to enhance the quality of blended learning experiences for students in Malaysia.

* 1. **Research Background Problem Statement**

Higher education institutions in Malaysia have seen a substantial increase in the use of blended learning as a way to create flexible and interesting learning environments. Although blended learning environments are becoming more popular, there is still a lack of thorough knowledge about the factors influencing the most efficient mix of online and face-to-face instruction in these environments, particularly in the Malaysian context (Bordoloi et al., 2021; Müller & Mildenberger, 2021). The majority of currently conducted research mostly focuses on Western contexts, and there is little empirical data that addresses the special requirements and difficulties faced by Malaysian students and institutions (Bordoloi et al., 2021; Heilporn et al., 2021).

Additionally, in the Malaysian setting, little is known about how varying ratios of online and face-to-face training affect student engagement and learning results (Kang & Kim, 2021). In spite of the fact that studies from other regions have found that blended learning improves learning outcomes (Kang & Kim, 2021; Xu et al., 2021), it is crucial to look at the specific outcomes and engagement patterns of Malaysian students in order to design efficient blended learning models that meet their needs (Heilporn et al., 2021; Müller & Mildenberger, 2021).

By identifying the key variables determining the most efficient blend of online and face-to-face training in blended learning environments in Malaysia, this research attempts to close the research gap. This study aims to comprehend the distinct potential and problems connected with blended learning implementation in the Malaysian higher education setting by taking into account elements such as student preferences, technology infrastructure, pedagogical methodologies, and institutional support. This study also aims to examine the impact of various ratios of face-to-face instruction to online education on student engagement and learning outcomes, offering important insights into the ideal ratio of face-to-face to online instruction for Malaysian students.

The improvement of blended learning practises in Malaysia will be facilitated by addressing these research aims and gaps. This study will assist educators, instructional designers, and policymakers in developing engaging and effective learning experiences for Malaysian higher education students by offering evidence-based suggestions on building and implementing effective blended learning models. Additionally, by laying the groundwork for future studies on blended learning in the Malaysian setting, this research will add to the body of information on how to best utilise mixed learning for higher education students.

* 1. **Research Questions**

(i) What are the main factors influencing the optimal blend of online and face-to-face instruction in blended learning environments in Malaysia higher educations?

(ii) How do different ratios of online and face-to-face instruction affect student engagement and learning outcomes in blended learning for Malaysia higher educations?

(iii) What are the evidence-based recommendations can be provided on designing and implementing effective blended learning models?

* 1. **Research Objectives**

(i) Identify the main factors influencing the optimal blend of online and face-to-face instruction in blended learning environments.

(ii) To investigate the effects of different ratios of online and face-to-face instruction on student engagement and learning outcomes in blended learning.

(iii) To provide evidence-based recommendations on designing and implementing effective blended learning models.

* 1. **Research Significance**

The research study on blended learning optimisation for Malaysian higher education students is very important for a number of reasons. First of all, the results of this study will add to the body of information developing on blended learning strategies, particularly in the Malaysian setting. Despite the increased interest in blended learning around the world, there is a dearth of research that focuses on the particular requirements and difficulties faced by Malaysian students and institutions. This study will shed important light on the creation and application of successful blended learning models that are contextually and culturally appropriate by concentrating on Malaysia.

Second, this study will fill a knowledge gap concerning the elements determining the ideal blend of online and in-person training in Malaysian blended learning contexts. Students' preferences, technological infrastructure, pedagogical tactics, and institutional support are just a few of the aspects that educators and instructional designers can pinpoint to better understand the essential components of a blended learning implementation. This information can be used to guide decisions made on faculty professional development, resource allocation, and curriculum development.

Thirdly, by examining how alternative ratios of in-person and online education affect student engagement and learning results, it will be possible to develop blended learning models for Malaysian students that are based on factual information. This study will help raise student engagement and boost academic results in higher education by examining the ideal split between online and in-person components. The findings will provide educators with information on the best methods for developing memorable and significant learning experiences that are in line with the tastes and needs of Malaysian students.

This research study also has applications for policymakers and educational institutions. The study's evidence-based suggestions will help institutions create and use blended learning models that effectively combine the advantages of online and in-person training. These ideas can be used by policymakers to create frameworks and norms that support the integration of blended learning into Malaysia's higher education system, encouraging innovation in education and raising the standard of learning experiences.

The research study on maximising blended learning for higher education students in Malaysia holds significance in that it fills knowledge gaps specific to the Malaysian context, informs instructional design practises, and offers helpful advice for educational institutions and policymakers. This study will develop blended learning methodologies by concentrating on Malaysia and ultimately improve student engagement and learning results in higher education.

**CHAPTER 2: LITERATURE REVIEW**

* 1. **Introduction**

Higher education in a lot of countries has paid a lot of attention to blended learning, which blends online and in-person instruction, as a potential strategy to boost student engagement and enhance learning results. This literature review seeks to give a thorough overview of the current studies on Malaysian higher education students' use of blended learning. This review will investigate the effects of various ratios of online and face-to-face instruction on student engagement and learning outcomes by reviewing pertinent studies, identify the key factors influencing the most effective blend of online and face-to-face instruction, and present evidence-based recommendations for developing and implementing successful blended learning models.

* 1. **Factors Influencing the Optimal Blend of Online and Face-to-Face Instruction:**

The best combination of online and face-to-face training in blended learning environments is influenced by a number of characteristics that have been discovered in the research. The degree of student engagement and satisfaction with blended learning is significantly influenced by their preferences (Bordoloi et al., 2021; Heilporn et al., 2021). Students preferred a well-balanced mix of in-person and online activities that offered flexibility while preserving social contacts, according to research by Heilporn et al. (2021). A successful adoption of blended learning also requires adequate technological infrastructure, including access to dependable internet and suitable learning management systems (Bordoloi et al., 2021). Institutions must make sure that students have access to the tools and technical support they need to participate in blended learning's online components successfully.

The effectiveness of blended learning is greatly influenced by pedagogical practises. The utilisation of interactive online resources can increase student engagement and encourage active learning. Examples include multimedia presentations and simulations (Müller & Mildenberger, 2021). In addition, in blended learning environments, instructors' assistance and clear communication are essential for supporting students' understanding and promoting their learning process (Bordoloi et al., 2021). For blended learning to be implemented successfully, the institution must offer support for course redesign, faculty professional development opportunities, and proper training in blended learning pedagogy (Heilporn et al., 2021; Müller & Mildenberger, 2021).

**2.3 Effects of Different Ratios of Online and Face-to-Face Instruction:**

Numerous research have examined how differing proportions of online and face-to-face training affect student engagement and learning outcomes. In an evaluation of team-based learning and flipped classrooms in a public healthcare education course, Kang and Kim (2021) discovered that this blended learning strategy had a good impact on learning outcomes, including the development of critical thinking abilities and knowledge retention. When Xu et al. (2021) investigated the usage of blended learning in predicting student success, they discovered that higher academic accomplishment was related to an ideal balance between online and face-to-face components.

Additionally, it has been demonstrated that the flexibility offered by blended learning raises student motivation and engagement (Bordoloi et al., 2021; Müller & Mildenberger, 2021). Students can take control of their educational experience thanks to the availability of online resources at any time and the possibility of self-paced learning. To preserve social connections and encourage collaborative learning, it is crucial to create a balance between online and face-to-face components (Kang & Kim, 2021; Heilporn et al., 2021).

**2.4 Evidence-Based Recommendations for Effective Blended Learning Models:**

Based on the existing research, several evidence-based recommendations can be made for designing and implementing effective blended learning models in Malaysia. Firstly, institutions should invest in technological infrastructure and provide necessary support to ensure equitable access to online resources and technical assistance for students (Bordoloi et al., 2021). Moreover, faculty members should receive professional development opportunities to enhance their pedagogical skills in designing and facilitating blended learning experiences (Müller & Mildenberger, 2021). Collaboration among faculty members and instructional designers can promote the sharing of best practices and innovative approaches to blended learning.

Additionally, careful consideration should be given to the balance between online and face-to-face components. While online components provide flexibility and self-paced learning opportunities, face-to-face interactions foster social connections and promote active engagement (Kang & Kim, 2021; Heilporn et al., 2021). Institutions should provide clear guidelines and recommendations to instructors on how to effectively integrate these components in a complementary manner.

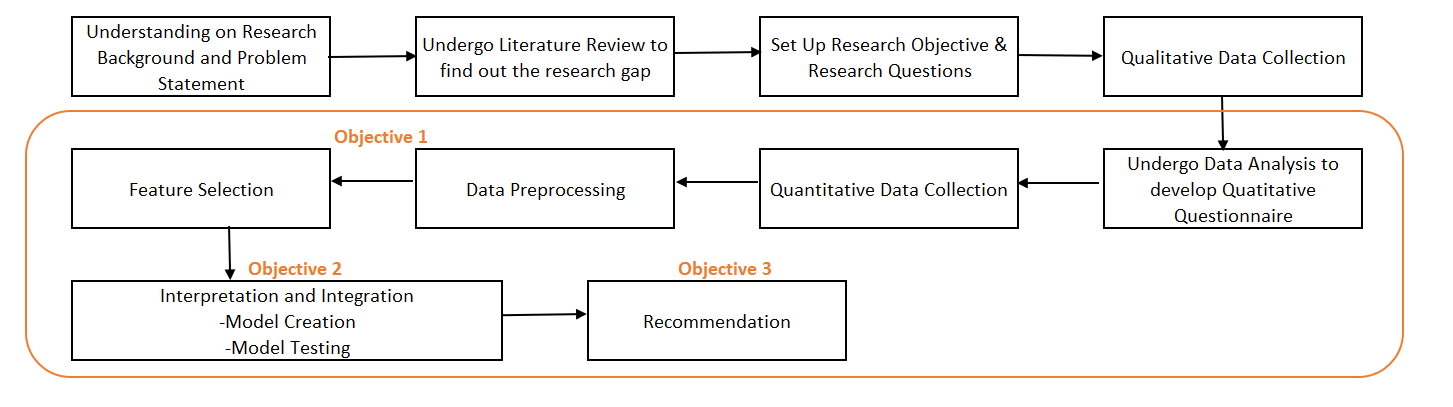
**2.5 Conclusion**

The factors influencing the ideal combination of online and in-person training in blended learning environments in Malaysia have been examined in this literature study. It has brought attention to how crucial it is to build effective blended learning models that take into account student preferences, technology infrastructure, instructional tactics, and institutional support. The review has also covered the impact of various online-to-face instruction ratios on student engagement and learning outcomes, highlighting the necessity of a well-rounded strategy. For creating and implementing successful blended learning models in the Malaysian higher education context, evidence-based recommendations have been offered. Institutions and educators can build and improve their blended learning practises to increase student engagement, improve learning outcomes, and deliver a high-quality learning experience for higher education students in Malaysia by taking into account these elements and recommendations.

**CHAPTER 3: RESEARCH METHODOLOGY**

* 1. **Research Design**

A sequential exploratory design will be used, starting with the gathering and analysis of qualitative data and moving on to the collection and analysis of quantitative data. This method enables a thorough investigation of the variables affecting the mix and serves as a basis for later quantitative study to look at the effects of various ratios of online and in-person training.



**Figure 1: Research Design with sequential exploratory design**

* 1. **Qualitative Phase:**

1. Data Collection:

With educators, instructional designers, students, and administrators with experience in blended learning, semi-structured interviews and focus groups will be held. The student profiles, instructional objectives, and learning strategies are just a few examples of the variables impacting the ideal blend that will be revealed by these qualitative data collection techniques. Below are some field that we can gather and collect for qualitative data, which are:-

A. Experiences: Share experiences with blended learning and describe specific instances or courses where blended learning was encountered.

B. Perceptions: Explore how participants perceive optimizing the integration of combining online and face-to-face instruction, highlighting advantages and challenges.

C. Factors for Effectiveness: Identify factors that contribute to an effective blend and understand their impact on learning outcomes and engagement.

D. Strategies: Collect examples of specific strategies that have enhanced the learning experience in blended learning environments.

E. Preferences: Determine participants' preferred modes of instruction and their reasons for choosing one over the other or a combination of both.

F. Flexibility: Investigate how the flexibility offered by blended learning affects the learning process and accommodates other commitments.

G. Engagement and Outcomes: Examine participants' observations of differences in engagement levels and learning outcomes compared to fully online or traditional classroom-based courses.

H. Digital Resources: Assess the role of digital resources, such as online platforms and multimedia materials, in enhancing understanding and retention of course content.

I. Collaboration: Explore the impact of collaborative activities and group work on the learning experience, considering both online and face-to-face settings.

J. Recommendations: Gather participants' recommendations to improve the design and implementation of blended learning models.

1. Data Analysis:

The iterative process of coding, categorising, and detecting new themes will be included in the qualitative data analysis. The qualitative data will be analysed using machine learning and data science approaches including sentiment analysis and natural language processing. By assisting in the discovery of patterns, sentiments, and linkages within the qualitative data, these tools will help shed more light on the variables determining the ideal combination of online and in-person education.

* 1. **Quantitative Phase:**

1. Data Collection:

A survey questionnaire will be administered to a larger sample of students at the University of Malaya, encompassing them from different faculties and courses. The survey will gather data on student engagement levels, learning outcomes, and the perceived effectiveness of different ratios of combining online and face-to-face instruction. The survey will include questions related to demographics, learning preferences, engagement levels, learning outcomes, online resources, interaction and collaboration, flexibility and convenience, support and guidance, technological readiness, and overall satisfaction.

1. Data Analysis:

The links between instructional ratios, student involvement, and learning outcomes will be investigated using descriptive statistics, correlation analysis, and regression analysis. We'll use machine learning methods to look for patterns and relationships in the quantitative data, like classification or clustering models. These algorithms will offer more information and help uncover variables that have a big impact on student engagement and learning results.

* 1. **INTEGRATION & INTERPRETATION:**

To fully comprehend the best way to combine online and face-to-face training, the qualitative and quantitative findings as well as the results from machine learning and data science techniques will be merged and understood. The qualitative insights will provide a deeper understanding of the elements impacting the blend and their impact on student engagement and learning results, helping to contextualise and deepen the quantitative data. Utilising machine learning and data science approaches together will help reveal hidden links and patterns in the data, improve the way the results are understood, and produce evidence-based insights.

* 1. **Recommendations**

Based on the integrated findings and analysis, evidence-based recommendations will be developed for designing and implementing effective blended learning models. These recommendations will leverage the knowledge gained from qualitative analysis, quantitative analysis, and machine learning techniques to provide practical guidance to educators and policymakers on optimizing the blend of combining online and face-to-face instruction to enhance student engagement and promote positive learning outcomes. The recommendations will highlight specific strategies, approaches, and instructional ratios that have shown promise in improving engagement and learning outcomes in blended learning environments.

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