UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPLICATION OF TOPSIS AND VIKOR TO COMPARE AHP RESULTS IN BLENDED LEARNING BASED ON STUDENT LEARNING STYLE

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MASTER OF MANUFACTURING ENGINEERING (QUALITY SYSTEM ENGINEERING)

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A master project submitted
in partial fulfillment of the requirements for the degree of
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DECLARATION

I declare that this master project entitled "Application of TOPSIS and VIKOR to Compare AHP Results in Blended Learning Based on Student Learning Style " is the result of my own research except as cited in the references. The master project has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature   :..

Name   : Zulhilmi Bin Mohamed Nawi

Date   :..

APPROVAL

I hereby declare that I have read this master project and in my opinion this master project is sufficient in terms of scope and quality as a partial fulfillment of Master of Manufacturing Engineering in Quality System Engineering

Signature   :...

Supervisor Name   : Associate Prof. Ir. Ts. Dr. Shajahan Maidin

Date   :...

DEDICATION

This Project is dedicated to

My beloved son

My dearest mother and family

My respectful supervisor, panels and other lecturers

My supportive friends and colleagues

Thank you for all the support that have given to me in order to complete this project

I do really appreciate it and I love you all

ABSTRACT

Blended learning, an instructional strategy integrating traditional and online learning, has gained prominence in education. A critical aspect of its success lies in the accurate identification of students' learning styles for effective customization. Previous studies conducted by (Maidin et al. 2023) were using the Analytical Hierarchy Process (AHP) to determine suitable blended learning model, however, the sensitivity and accuracy of AHP was only at 74%. Thus, this report utilized the application of the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) methods to compare with AHP results in terms of sensitivity and accuracy towards the blended learning model to student learning styles. The research employs TOPSIS and VIKOR as alternative multi-criteria decision-making tools to evaluate the sensitivity and accuracy of outcomes in the context of blended learning and learning style preferences. The study utilizes a dataset comprising learning style indicators and performance metrics from a diverse student population. The proposed methodology aims to provide a comprehensive understanding of the comparative effectiveness of these decision-making tools in assessing the sensitivity and accuracy of the results. Based on the study, TOPSIS & VIKOR agreed with AHP results that the face-to-face driver model is the most preferred option among students, with AHP assigning it a preference score of 31.33%, while TOPSIS gives it the highest score of 1.000 and VIKOR a score of 0.00. Ultimately, this report offers a nuanced perspective on enhancing the effectiveness of blended learning models through the integration of decision-making tools and considerations of individual learning styles.

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DISSERTATION/MASTER PROJECT/PROJECT PAPER TITLE IN BAHASA MELAYU

ABSTRAK

Pembelajaran gabungan, strategi pengajaran yang mengintegrasikan pembelajaran tradisional dan dalam talian, telah mendapat perhatian dalam pendidikan. Aspek kritikal kejayaannya terletak pada pengenalpastian yang tepat terhadap gaya pembelajaran pelajar untuk penyesuaian yang efektif. Kajian terdahulu yang dilakukan oleh (Maidin et al. 2023) menggunakan Proses Hierarki Analitikal (AHP) untuk menentukan model pembelajaran gabungan yang sesuai, namun sensitiviti dan ketepatan AHP hanya pada 74%. Oleh itu, laporan ini menggunakan aplikasi Teknik untuk Urutan Keutamaan dengan Keserupaan kepada Penyelesaian Ideal (TOPSIS) dan Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) untuk membandingkan dengan hasil AHP dari segi sensitiviti dan ketepatan terhadap model pembelajaran gabungan kepada gaya pembelajaran pelajar.. Kajian ini menggunakan set data yang merangkumi penunjuk gaya pembelajaran dan metrik prestasi dari populasi pelajar yang pelbagai. Berdasarkan kajian, TOPSIS & VIKOR bersetuju dengan hasil AHP bahawa model pelajaran bersemuka adalah pilihan yang paling disenangi di kalangan pelajar, dengan AHP memberikan skor keutamaan sebanyak 31.33%, manakala TOPSIS memberikan skor tertinggi 1.000 dan VIKOR memberikan skor 0.00.Akhirnya, laporan ini menawarkan perspektif yang lebih mendalam tentang peningkatan keberkesanan model pembelajaran gabungan melalui integrasi alat pengambilan keputusan dan pertimbangan gaya pembelajaran individu.

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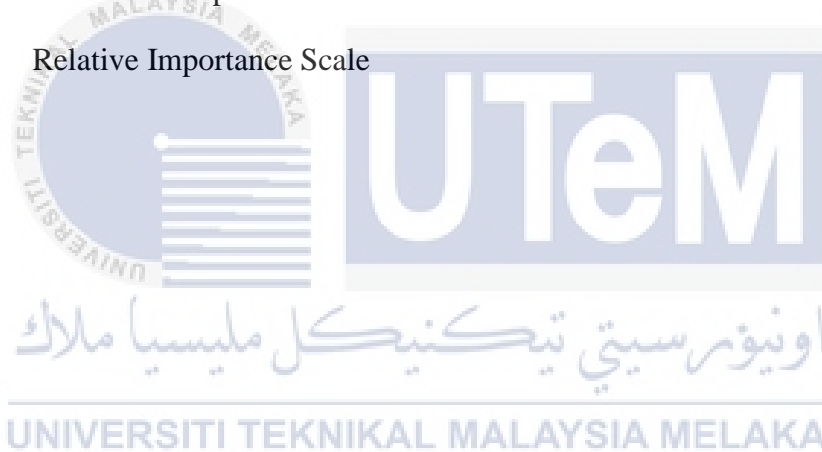
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LIST OF ABBREVIATIONS

UTeM	-	Universiti Teknikal Malaysia Melaka
FTKIP	-	Fakulti Teknologi Kejuruteraan dan Industri Pembuatan
TOPSIS	-	Technique for Order of Preference by Similarity
VIKOR	-	VlseKriterijumska Optimizacija I Kompromisno Resenje
AHP	-	Analytic Hierarchy Process
VARK	-	Visual, Auditory, Reading/writing, and Kinesthetic.
MCDM	-	Multi-Criteria Decision Making
MADM	-	Multi-Attribute Decision Making
MODM	-	Multi-Objective Decision Making
ICT	-	Information and Communication Technologies

LIST OF SYMBOLS

		TOPSIS
$Ai:$	-	Alternative
Cj	-	Certain attributes
W	-	Attribute weight
X	-	Decision rating
Y	-	Normalised performance rating
V	-	Weighted-normalised decision matrix
Vi	-	Overall preference score
		VIKOR
Rij	-	Normalized value
Xij	-	Value of sample i data criteria j
$X*j$	-	Best value in one criterion
$X'j$	-	Worst value in one criterion
Wj	-	Weighting criteria
S	-	Sum of the result of the multiplication of the criteria weights
R	-	largest value of the multiplication of the weight of the criteria with the normalized data of each sample
Q	-	Vikor Index
S'	-	smallest S value (the best value)
$S*$	-	the largest S value
R'	-	the smallest R value
$R*$	-	the largest R value
V	-	weight of the strategy of ''the majority of criteria'

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1   Background

Learning is an essential aspect in everyone life which can be translated easily as a process of gaining knowledge, abilities, and information. Learning has gone through many phases through out the decades (Akbar 2020). Higher education also had seen tremendous transformation in the recent years. Covid-19 had open-up new chapter in higher education learning methodology. The demand for online learning has increased due to the COVID-19 pandemic, which has changed how people utilize digital technologies (Stupina and Paniotova 2023) . The COVID-19 pandemic drives universities to substitute significant portions of the conventional lecture format with online alternatives in order to uphold social distancing protocols and minimise in-person interactions within the classroom (Suwannaphisit et al. 2021).

Blended learning provides numerous benefits, enabling universities to utilize technology for enhanced and adaptable instruction. The concept or idea behind the application of blended learning is combining the advantages of traditional learning with information and communication technology supported learning to enable both online and offline study. In a mixed learning setting, students gain flexibility in their education by learning to rely less on their teachers and more on themselves (Mavuso and Jere 2022). Even with many advantages blended learning do facing some challenges, lecturers lack of skills on online teaching is one of the main that can issues influencing blended learning (Rudhumbu 2022).

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Studies from (Maidin et al. 2023) had suggested the application of VARK also known as visual, audio, reading or writing and kinesthetic can successfully determine the ideal learning styles of the students in order to raise academic standards and encourage studies. VARK was introduced by Fleming in 1987 which the main objective is to better understand each student's unique learning preferences (K. Cherry 2023). Visual learners learn best by seeing. For audio learner, they preferred the information supplied to them by hearing it. As for readers and writing learners, information that shown in a form of text and words are the best for them. Lastly for kinesthetic learners, they prefer an information through hands-on application.

With many styles of blended learning available, the application of Multi-Criteria Decision Making or MCDM is a practical approach to find the most suitable learning style for UTeM undergarudate student. MCDM is an approach that analyze using multiple-decesion criteria to define best out of all the ones that are available (Nain et al. 2023). MCDM issues can be categorized into two main groups: multi-attribute decision making (MADM) and multi-objective decision-making (MODM) (Chakraborty et al. 2019). MCDM had various approached or tools and the most common tools is AHP or Analytic Hierarchy Process but due to its lack of information consistency, thus Technique for Order of Preference by Similarity (TOPSIS) and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) emerge is an ideal solution (H. Wang & R. Deng 2018).

TOPSIS is a method, which weighs the best and worst ideas when assessing the options. TOPSIS facilitates decision-making by selecting the optimal option among numerous criteria (Uddin et al. 2021). TOPSIS works by allocating ranks based on the weights and effects of the specified factors by using the Euclidean distance to calculate an

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alternative's relative proximity to the optimal solution, TOPSIS applies the principle that the alternatives chosen must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution (Rahim et al. 2018). As for VIKOR, is an approach of ranking technique that takes into account the circumstances around responses while applying MCDM (Sotoudeh-Anvari 2022) as the smallest index value is the best selection.

Previous studies by (Maidin et al. 2023) have significantly contributed to our understanding of effective blended model based on student learning style. However, the studies had highlited that the AHP results was only at 74% making it low in term of consistency and lack of sensitivity. Given the evolving nature of blended learning model, further investigation is necessary to address these gaps and provide a more comprehensive understanding of blended learing model through comparing the AHP results with other types of multi-objective decision-making (MODM). By using the same VARK results, this study employs TOPSIS and VIKOR methodology to analyze the data, offering a different perspective that goes beyond the scope of previous research performing the study. In light of the above-mentioned gaps, this study aims to to compare the AHP results with TOPSIS and VIKOR to provide a more comprehensive understanding of effective blended learning model selection.

1.2   Problem Statement

Blended learning provides flexibility in various aspects of education, including fostering a diverse and engaging learning experience for students (Graham 2013), assessment methods, collaborative group work, assignment submission, marking, grading, feedback, and communication between teachers and learners (B. Jumani et al. 2018). Thus,

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it is crucial to clearly establish the desired learning results and take into account the attributes of your learners, encompassing factors such as their existing knowledge, preferred learning styles, and technological proficiency.

The Analytic Hierarchy Process (AHP) is a widely employed methodology for decision-making in this context. However, the sensitivity and accuracy of AHP results in determining the most suitable blended learning model based on student learning styles remain areas of inquiry and potential concern. Studies from (Maidin et al. 2023) suggests that the outcome of AHP decision-making processes maybe lack of sensitive in input data, potentially influencing the effectiveness of AHP in ranking and selecting optimal blended learning models. Additionally, concerns persist regarding the accuracy of AHP outcomes in truly reflecting the preferences and requirements of diverse learning styles within a student population.

To address these issues, this report seeks to explore and compare the sensitivity and accuracy of AHP results in the context of blended learning model selection. This study target to go beyond the use of AHP by introducing a comparative analysis with the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) methods. By undertaking this comparative examination, the research aims to provide a comprehensive understanding of the strengths and limitations of these methodologies in the specific domain of blended learning model selection based on student learning styles.

The significance of this research lies in its potential to offer educators and educational policymakers' insights into the nuanced dynamics of decision-making methodologies in the context of UTeM FTKIP students. The outcomes of this study could contribute valuable

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knowledge that informs more informed and effective decisions in implementing blended learning environments tailored to the diverse learning preferences of students.

1.3   Research Question

The aim of this research is to systematically evaluate and compare the results obtained from the Analytical Hierarchy Process (AHP) in terms of sensitivity and accuracy when applied to a blended learning model customized according to student learning styles. Specifically, the research seeks to assess the effectiveness of AHP and compare it with the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) methods. Specifically, the objectives are as follows:

i) What are the comparative differences in sensitivity and accuracy between AHP results and those obtained through the TOPSIS and VIKOR in the context of a blended learning student learning styles?

ii) How effective are TOPSIS and VIKOR as alternative MCDM tools in assessing the sensitivity and accuracy of AHP results

iii) How can the findings from comparing AHP, TOPSIS, and VIKOR results contribute to the refinement and improvement of blended learning models tailored to diverse student learning styles

1.4   Research Objective

The main aim of this research is to compare TOPSIS and VIKOR againts AHP for the blended learning style. Specifically, the objectives are as follows:

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i) To develop TOPSIS and VIKOR model based on the blended learning model data.

ii) To analyse the blended learning model data with TOPSIS and VIKOR in terms of sensitivity and accuracy.

iii) To compare the blended learning model data with TOPSIS and VIKOR in terms of sensitivity and accuracy.

1.5   Scope of Research

The scope of this study uses the TOPSIS and VIKOR methods to examine the sensitivity and accuracy against AHP from the blended learning models are selected for engineering technology and manufacturing industry course (FTKIP) students at UTeM, taking into account the students' learning styles. The study will be utilized of TOPSIS and VIKOR will be using the AHP data from (Maidin et al. 2023) in order to generate the TOPSIS and VIKOR model and formulation.

1.6   Report Outline

Based on the objectives previously presented and on the approach proposed before, this report is made up of five (5) chapters, which contents are summarized as follows:

- Chapter 1. Introduction. This chapter presents the background of the study, research problems, objectives, scopes, contributions and significance of the research.

- Chapter 2. Literature review. This chapter starts with brief overview of Blended Learning Models, VARK, MCDM, AHP, TOPSIS, VIKOR.

- Chapter 3. Methodology. This chapter presents the methodology and the step taken for data Analysis, comparative Analysis of AHP, TOPSIS, and VIKOR which eventually relates to its sensitivity and accuracy assessment.

- Chapter 4. Result and Discussion. In this chapter it focus on presentation of TOPSIS, and VIKOR results, comparative analysis of decision making methods and sensitivity and accuracy assessment

- Chapter 5. Conclusion and Recommendations for Future Research. This chapter summarizes the main conclusions specifically TOPSIS and VIKOR, in the context of a blended learning model tailored to student learning styles. The investigation sought to compare the sensitivity and accuracy of AHP results when compared with TOPSIS and VIKOR.
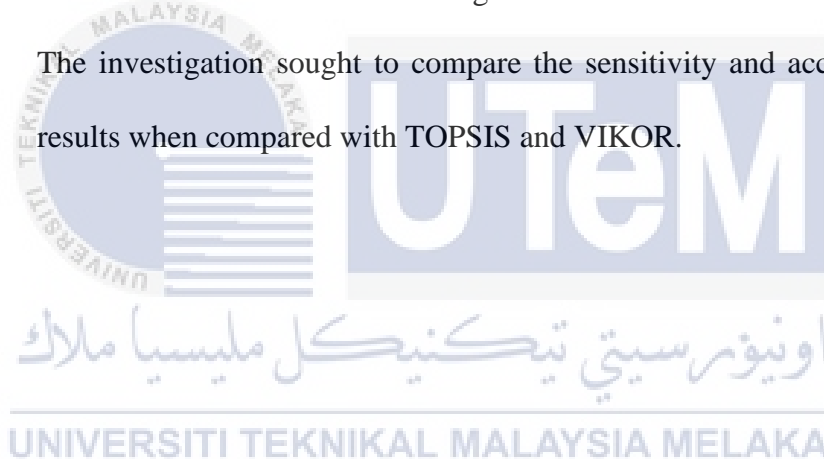
CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

In recent years, the convergence of technology and education has given rise to innovative instructional methodologies aimed at catering to diverse student needs and preferences. Blended learning, an approach that seamlessly integrates traditional classroom methods with online learning components, has emerged as a transformative paradigm in education. Tailoring blended learning models to individual student learning styles is recognized as a crucial factor in enhancing the effectiveness of such educational frameworks. Within this context, the application of decision-making methods becomes imperative for evaluating and optimizing the customization process. This literature review delves into the key concepts and theories surrounding blended learning, Analytical Hierarchy Process (AHP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR). The exploration of these elements is crucial for understanding the foundations of this research. The literature review then introduces the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) methods, alternative decision-making tools that have gained prominence in various fields. A comprehensive analysis of these methods sets the stage for understanding their potential applications in the context of blended learning and student learning styles.