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Impact of Open Distance Learning (ODL) on Mathematics Students at UiTM Perlis Branch

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Abstract

The education systems around the world have been greatly affected by Covid-19 outbreak. Teaching and learning methods have been changed from traditional methods that set up face-to-face lectures in a classroom to online distance learning. The higher education institutions are moving to blended learning with elements of face-to-face provision, or hybrid learning where learning supports simultaneous face-to-face and online learning. Although the online distance education is convenient, there are some obstacles that students must overcome. Thus, the main objective of this study is to identify the main perceived impacts of Open Distance Learning (ODL) on UiTM Perlis for mathematics students. A questionnaire was distributed to Mathematics students at UiTM Perlis to explore and find out the problems that they have faced during ODL. Fuzzy Analytic Hierarchy Process was used to rank the factors that contribute and affects students during ODL. The Fuzzy Analytic Hierarchy Process (FAHP) is a method of Analytic Hierarchy Process (AHP) which is developed using fuzzy logic theory. There are nine steps in this method includes determination the goal, construct the hierarchical structure, pairwise comparison matrix, check for consistency, aggregated Fuzzy number of preferences, updated pairwise comparison matrix, weight vector calculation, defuzzification and final ranking. This study found that the greatest impact of ODL on UiTM Perlis Mathematics students is their "time spent learning", followed by their sleeping patterns, student performance, engagement to learn and mental health. The results of this study will guide the policy makers of educational institutions to improve the achievement of online learning process to the next level more successfully.

***Keywords**: Covid-19, FAHP, Online Learning, ODL*

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INTRODUCTION

Teaching and learning delivery methods have been changed from traditional methods that set up face-to-face lectures in a classroom to online distance learning especially in higher education due to the Covid-19 outbreak. Universiti Teknologi Mara (UiTM) has moved all classes to open and distance learning (ODL) mode effectively from April 2020 until the end of the semester for all its campuses nationwide. The study plan for each program needs to be changed according to the online learning mode. Even though many universities are moving to face-to-face studies, but some study plans still use online lessons.

Distance learning is a method of education in which students receive instruction through online classes, video conferencing, video recordings, or any other audio or visual technology medium (Loveless, 2022). It allows students to receive an education

without physically being present in a classroom. A properly designed distance learning program can be a convenient and effective study method. Although distance learning is convenient, there are some obstacles that students must overcome. This is because distance learning is not the same as physical learning. For example, classroom learning requires face-to-face interactions involving the teacher and students, whereas online learning moves this component to a virtual environment. Among the challenges students face are time management, distractions, and others. Developing a time management system may be the most difficult challenge for students because it depends entirely on self-motivation. Students must take their education seriously, learn time management, create a daily schedule, and study despite constant distractions. Furthermore, the problems encountered during online learning include poor internet access, income disparity and a lack of technical expertise (Alenezi et al., 2021). The technical issues are unavoidable in online environments and they can disrupt distance learning sessions (Klawitter, 2022).

During the ODL, there were students who experienced learning difficulties, especially when they were required to have their self-study. This is because they did not have face-to-face learning with their lecturers and friends. Although students can inquire online through WhatsApp, Telegram, and so on, it may be inconvenient for students with internet problems. In addition, students with internet problems were also unable to follow the live learning. This caused them to be left behind because they could not follow the discussion during class time. Moreover, unlike face-to-face learning, immediate feedback was difficult to obtain through online learning. Monkeviciene et al. (2021) stated that when students faced various barriers to learning, these students tended to withdraw, escape, and disengage from the learning process, resulting in complex conditions. The study also discovered that struggling students preferred to keep silent, avoid asking teachers what they did not understand, make themselves invisible and withdraw. Therefore, this study is conducted to determine the impacts of Open Distance Learning (ODL) on students, due to the satisfaction towards online learning and preparation of the best potential educational delivery outcomes. Fuzzy Analytic Hierarchy Process (FAHP) will be used to rank the factors involved.

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LITERATURE REVIEW

Open Distance Learning (ODL)

The online distance learning (ODL) is continuously growing in various field of studies. The work presented by Noori (2021) proposed an investigation of the impact of the COVID-19 pandemic on students' learning in higher education in Afghanistan. It used Statistical Package for Social Sciences (SPSS). The data were analyzed statistically and thematically. The researcher applied Ms Excel and SPSS to evaluate the data for the quantitative section. The Independent Samples T-test and One Way ANOVA tests were used to determine differences in participants' responses depending on demographic characteristics such as gender, class, and age. Furthermore, a regression analysis was performed to investigate the relationship between students' perceptions of teaching and learning, as well as the impact of the COVID-19 programme on students' learning. According to Noori (2021), practically all students suffered from Internet and technological issues, including financial difficulties in obtaining a better Internet package. The findings of the study will assist education managers and higher education leaders in reviewing and implementing teaching and learning policies in the event of an emergency. It will also help lecturers to design a proper plan and improve their teaching.

Alomyan (2021) conducted a study to investigate the impact of challenges during distance learning and the concerns related to distance learning on the psychology and learning of university students. The Pearson Correlation Coefficient was used to validate the internal consistency of the study instrument by determining the correlation coefficients for each item of the instrument with the overall score of the dimension to which it belongs. The Cronbach Alpha Coefficient was then used to confirm the stability of the instrument. The Statistical Package for Social Sciences (SPSS) was used to analyze the data. Furthermore, according to Alomyan (2021), one of the primary concerns in online education is the lack of socialization. This is because, in this mode of learning, students only interact with each other digitally, which may have an impact on the exchange of ideas and knowledge. In addition, a lack of socialization has been attributed to certain students suffering from psychosocial issues such as anxiety and depression. The study's findings can provide policymakers and professionals in education with useful information on the impact of distance learning on psychology and

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the learning of students amid the COVID-19 pandemic. This may help them take precautions and prepare for future outbreaks of novel spreadable diseases.

The study was conducted to reveal students' perspectives and preferences on distance learning due to the dramatic change that happened in the education process (Al-Mawee, et al, 2021). Cross-tabulations and statistical tests were used to examine the distributions of students' responses to distance learning. The Chi-square test of independence was performed to test whether there was a significant relationship between students' responses to the distance learning experience by college level and college type. In this study, the researchers found that students tended to be dissatisfied with online learning since they did not have a good interaction and learning environment. The findings of the study could help higher education institutions to improve distance learning education.

A study by Chaturvedi et al. (2021) investigated the impact of the COVID-19 pandemic on students from various age groups in terms of their lifestyle, education, and health. The Pearson Chi-Square test was used to analyze the relationship between age categories and several variables, including weight, health concerns, stress relievers and others. Furthermore, they discovered that online education caused stress in students, which should be avoided. The findings indicated that the time spent by students in online classes did not comply with the guidelines issued by the Ministry of Human Resources Development (MHRD).

Coughlan et al. (2021) discovered that many students battled mental health due to their isolation and environment following the quick transition from in-person to totally online learning. They discovered that students slipped out of patterns, such as not being forced to attend an 8 a.m. session because it was completely online and that they did not plan well for their sleep. They also stated that they missed seeing their classmates and friends in extracurricular activities. They discovered that students who had already loved online learning, could maintain a regular sleep routine, and not feel alienated. They were less likely to blame their problems on their abilities to use technology. They discovered that high levels of distraction, as well as emotions of loneliness had impact on students' capability to stay engaged in the lesson. Furthermore, they noticed that students were more distracted by family members, the availability of

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entertainment that they would not have access to if they were physically in class, and a lack of structure.

Aristeidou and Cross (2021) conducted a study to understand better changes in students' distance learning on their habits in learning, assessment, and social activities, as well as to identify factors associated with negative impacts. A binary logistic regression analysis was carried out to determine which characteristics and Covid-19 circumstances have a negative impact on the frequency with which OU (Open University) undergraduate students engage in learning, assessment, and social activities. Furthermore, they demonstrated that the pandemic still affected the study habits, lives, and mental health of distance students and exacerbated existing issues. The findings support the notion that the current COVID-19 pandemic significantly negatively impacts students' study habits in distance learning institutions.

Fuzzy Analytic Hierarchy Process

According to a study by Jiaoman (2018), the analytic hierarchy process is a straightforward, mathematically based multi-criteria decision-making tool for dealing with complicated, unstructured, and multi-attribute problems. Human judgments and preferences are frequently sharp values for the old AHP technique. However, in many actual circumstances, human preferences and judgments are imprecise and unpredictable, and decision-makers are unable to give accurate numerical values to comparison assessments. As a result, FAHP was created to assist decision-makers in resolving the ambiguity of alternative situations. Jiaoman (2018) further proposed salvation of the destination choice problem. In that study, the researcher focused on the tourist planning problem, which comprised the travel destination selection problem and the travel itinerary problem. Using the Fuzzy AHP approach, he solved the travel destination selection problem and obtained the priority of trip destination schemes using the FAHP method. The findings of the study suggested that other researchers could investigate additional limitations such as the ideal viewing time frame, time- dependent route condition and others. They could also talk about how varied departure times affect cost and time at origin. Furthermore, the proposed algorithm's performance could be increased further by incorporating other techniques.

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Pham et al. (2021) stated the pure AHP method is less effective when dealing with uncertainty in decision-making. This led to the creation of FAHP approaches, which numerous academics have employed to handle decision- making problems in a variety of fields. The FAHP addresses the service evaluation process's uncertainty and imprecision. Wang et al. (2019) conducted a study to synthesize evaluative criteria for the social network platforms and cloud suppliers using Fuzzy AHP. They evaluated cloud providers' preference attributes, attributed weightings using the Fuzzy AHP method, and offered the cloud suppliers a foundation for building development system standards. Thus, the findings of this study showed that they could be utilized as a referential foundation for users evaluating cloud collaboration systems, as well as for cloud collaboration system developers.

A work presented by Qi (2021) proposed to develop an evaluation mechanism for extensively assessing secondary college performance. The study employed the fuzzy analytic hierarchy process, combining the analytic hierarchy process and the fuzzy comprehensive assessment approach to make a strategic decision. Rokkas and Neokosmidis (2020) investigated the key elements influencing the market acceptance of a cyber-security product in Energy and Electrical systems. The findings demonstrated that it would be a beneficial tool for those like researchers, universities, energy operators, small producers, and other involved stakeholders who are interested in the Smart Grid ecosystem's security. It includes a list of all the key factors that can influence SPEAR adoption. Stakeholders could construct their development strategy by identifying these variables.

METHODOLOGY

This study performed the Fuzzy Analytic Hierarchy Process (FAHP) to rank the impact factors. A primary data was used, and this data was collected through a questionnaire. The respondents for this study were students from the Faculty of Computer and Mathematical Sciences at UiTM Perlis. Before answering the questionnaire, respondents were explained on how to answer the questionnaire given to them. In this study, a total of six respondents were chosen to complete the questionnaire. There is no strict requirement on the minimum sample size for FAHP analysis since Analytic Hierarchy Process integrates experts' opinions and evaluation

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scores into a simple elementary hierarchy system by decomposing complicated problem from higher hierarchy to lower ones (Saaty,1980; Ahyan, 2013). This data aims to determine the major impacts of Open Distance Learning that they have experienced.

According to Izhar (2021), there are nine (9) steps to Fuzzy Analytic Hierarchy Process presents on Figure 1. The steps involve the determination of goal, construct a hierarchical structure model, construct the pairwise comparison matrix, check the consistency ratio, aggregate fuzzy number for criteria, update the pairwise comparison matrix for criteria, weight vector calculation, defuzzification and normalization and final ranking. The steps are explained as follows.

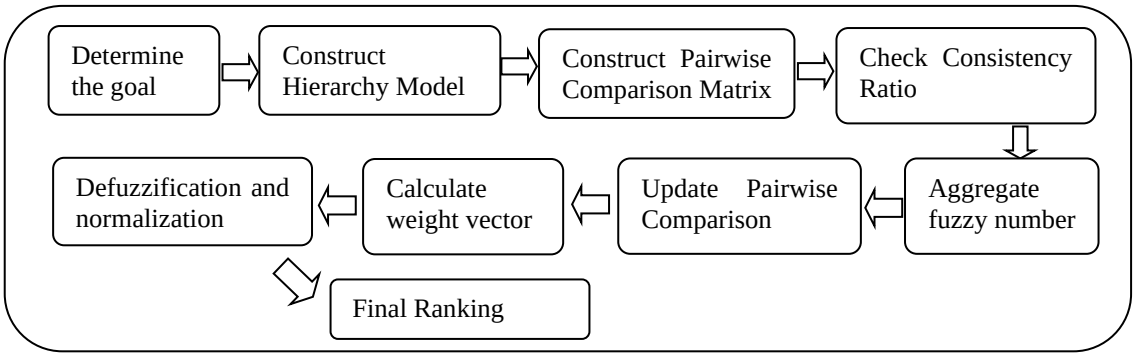

Figure 1: Flowchart of FAHP

Step 1: Determine the goal

The first step in Fuzzy Analytic Hierarchy Process is to determine the goal of the study. This study aims to determine the major impacts of Open Distance Learning (ODL) on UiTM Perlis students. In this step, the criteria for studying the impacts of ODL on students are determined. The criteria are financial problems, internet connection, learning environment, family problems, a lack of socialisation, and assignment deadlines. For all criteria, five sub criteria that give impacts on students ODL have been chosen, which are mental health, student performance, engagement to learn, sleeping pattern and time spent studying.

Step 2: Construct a hierarchical structure model

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There are three (3) levels of hierarchy structure. The first level of the hierarchy is the goal of the study, the intermediate level is the criteria, and the last level is the alternative.

Step 3: Construct the pairwise comparison matrix

A Saaty's scale was used to generate the pairwise comparisons by asking the respondents which one of two dimensions is more important based on the questionnaire design. The levels of the pairwise comparisons range from 1 to 9, where "1" will represent the two (2) criteria which are equally important, while the other extreme "9" represents that one criterion which is extremely more important than the other.

Step 4: Check the Consistency Ratio

The consistency ratio (CR) is calculated using the following formula based on Qi (2021).

$$CR = \frac{CI}{RI} \tag{1}$$

- CI is the consistency index
- RI is index random

Step 5 until Step 9 will follow the calculation by Hafizan & Nah, (2021).

Step 5: Aggregate fuzzy number for criteria

Calculate the average of the preference of each decision maker by dividing the summation of preference number by total of decision maker.

Step 6: Update pairwise comparison matrix for criteria

The pairwise contribution matrix is updated based on average preference as shown in Equation (2).

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$$\tilde{A} = \begin{bmatrix} \widetilde{d_{11}} & \cdots & \widetilde{d_{1n}} \\ \vdots & \ddots & \vdots \\ \widetilde{d_{n1}} & \cdots & \widetilde{d_{nn}} \end{bmatrix} \quad (2)$$

Step 7: Weight vector calculation

In this step, calculate the geometric mean of fuzzy comparison values. Then calculate the vector summation and inverse of vector summation and arrange in ascending order. Lastly, determine the fuzzy weight value by multiplying the geometric mean with ascending order or inverse vector.

Step 8: Defuzzification and normalization

The triangular fuzzy number will defuzzified W_i by using the centre of area method as shown in Equation (3). Then, calculate the normalization and final weight, Z_i as shown in Equation (4).

$$R_i = \frac{l_{wi} + m_{wi} + u_{wi}}{3} \quad (3)$$

$$Z_i = \frac{R_i}{\sum_{i=1}^{n} R_I} \quad (4)$$

Step 9: Final ranking

The scores for each alternative are then calculated by multiplying the weight of each alternative by the relevant criteria. To calculate the defuzzify value, add the values for all criteria by each alternative. Rank each alternative from the highest defuzzify value to the lowest defuzzify value.

$$\tilde{A} = \begin{bmatrix} \widetilde{d_{11}} & \cdots & \widetilde{d_{1n}} \\ \vdots & \ddots & \vdots \\ \widetilde{d_{n1}} & \cdots & \widetilde{d_{nn}} \end{bmatrix}$$

RESULT AND DISCUSSION

After following the nine (9) steps of Fuzzy Analytic Hierarchy Process, the impact factors on ODL have been ranking. Table 1 shows the ranking criteria that

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mention the main factor contributing to the impact of open distance learning (ODL). The main factor is assignment deadline with a normalized weight 0.226322. It is followed by the other factors which are lack of socialization, family problems, internet connection, learning environment and financial problems.

Table 1: *Ranking Criteria*

Criteria	Normalized (Weight)	Ranking
Assignment Deadline	0.212949	1
Lack of Socialization	0.162038	2
Family Problems	0.167823	3
Internet Connection	0.162038	4
Learning Environment	0.140965	5
Financial Problem	0.089902	6

The factor of assignment deadline has a time constraint which makes students feel difficult to complete multiple tasks leading students to stress (Mariyah et al., 2021). The results of the previous study showed that 'academic workload' and 'high frequency of examinations', were the major causes of stress among the students (Kwaah & Essilfie, 2017). The lack of socialization and interaction with lecturers and classmates becomes difficult to understand the lesson and complete the assignments (Kamarul et al., 2021). Family problems such as a lack of support and distracted from family members also have impacted students on their learning (Nikman et al., 2022; Mariyah et al., 2021; Kwaah & Essilfie, 2017).

The qualitative finding revealed that the students involved ODL had problems with Internet and technological facilities in their learning (Mariyah et al., 2021). The Internet from the mobile companies was not stable and they could not experience effective online teaching and learning (Noori, 2021). Qazi (2020) believed that when students did not have access to enough facilities in online learning activities, they achieve low grades and experience negative effects with regards to their achievement. The factor of an unconducive learning environment, such as interference from family members, being distracted by chores, inconsistent temperature and noise also have given the impacts to students (Kamarul et al., 2021; Wang et al., 2021; Mariyah et al., 2021). In addition, students have financial difficulties in purchasing required equipment

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for their learning process during ODL, such as laptops, smartphones and internet packages (Noori, 2021; Kwaah & Essilfie, 2017).

The ranking for sub criteria is shown in Table 2. The results show that time spent studying is the main impact of open distance learning on students with normalized weight 0.275413. The second impact is sleeping pattern, with a normalized score of 0.214888. Then, the third impact and fourth impact of ODL are students' performance and their engagement to learn, with a normalized score of 0.19815 and 0.16956, respectively. Mental Health is the lowest ranked of the five impacts of (ODL) studied, with a normalized 0.141991. It is concluded that the most perceived impact on students is their time spent studying during open distance learning (ODL).

Table 2: *Ranking Sub-Criteria*

Criteria	Normalized (Weight)	Ranking
Time Spend Studying	0.275413	1
Sleeping Pattern	0.214888	2
Student's Performance	0.198149	3
Engagement to Learn	0.169557	4
Mental Health	0.141991	5

The findings of the study revealed that the main impact of ODL on UiTM Perlis Mathematics students was time spent studying. The findings are consistent with the previous study by Aristeidou & Cross (2021), which discovered that half of the students have a negative impact on their time spent revising due to difficulties in managing workload and interacting with other students. The reason why students did not spend time studying is consistent with the findings of this study, namely assignment deadlines and a lack of socialisation. Previous research by Al-mawee et al. (2021) also identified that students interacted with their classmates less during ODL, which is consistent with this study. Furthermore, previous studies by Al-Tammemi et al. (2020) and Pan (2020) discovered that students spent more time on social media sites like Facebook and Instagram, as well as watching TV, movies, videos on YouTube, and playing computer games. Besides, according to the findings, family problems is the third factor contributing to the impact of ODL on students. The findings are consistent with

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previous research by Nikman et al. (2022), which found that a lack of support from family members makes it difficult for students to study while staying at home.

The second impact of ODL on students is their sleeping patterns. The findings are consistent with previous research by Piya et al. (2022), which discovered that many students slept during ODL because they did not have early morning classes. Furthermore, Dutta and Smita (2020), discovered that students slept more during the day and less at night. Student performance is the third impact of ODL on students. The findings of the study are consistent with the previous studies by Allam et al. (2020), which found that performing a task without social interaction with lecturers and group mates can affect academic performance. Furthermore, the study by Kamarul et al. (2021) discovered that group assignments and discussions are difficult for students during ODL because some group members do not respond.

Engagement to learn is found to have lesser impact on students. This is consistent with the previous study by Mariyah et al. (2021), which discovered that students believe ODL helps them cope with their studies better because most lectures are delivered through video recordings. This is because it can improve their understanding of the subject because they can replay the video many times. In addition, the study also found that students are happy to attend online classes from home because they do not have to get out of bed and avoid the morning rush to attend class. They see this situation as a benefit because they can study without worrying about food supplies or security issues, which encourages them to focus. In this study, mental health has the least impact on students, which contradicts to the previous research by Hand (2018). According to the findings of that study, the widespread use of technology for online learning can have negative impacts on student' mental health.

CONCLUSION

In summary, the main objective of this study is to determine the major impacts of Open Distance Learning (ODL) on Mathematics students at UiTM Perlis using the Fuzzy AHP method. Hence, the five (5) impact factors which have been identified are mental health, student performance, engagement to learn, sleeping pattern and time spent studying. In addition, there are six (6) sub criteria that have been studied include

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financial problems, internet connection, a lack of socialization, assignment deadline, family problems and learning environment. The results reveal that the assignment deadline is the main factor contributing to the impact of ODL on students. While lack of socialization is the second factor, and family problems is the third factor that affect the respondents. These factors have contributed to the impacts of ODL on students. In addition, internet connection, learning environment and financial problem are the least factor contributing to ODL impact on UiTM Perlis Mathematics students. Based on the evaluation criteria, time spent studying is the most impact factor of ODL for UiTM Perlis especially on Mathematics students, followed by their sleeping pattern, performance, engagement to learn and mental health.

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Conflict of interest

Not applicable

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