

The Impact of Artificial Intelligence (AI) Technology on the Effectiveness of Digital Marketing by Student Entrepreneurs at Politeknik Balik Pulau

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ABSTRACT

In today's rapidly changing digital world, new technologies like Artificial Intelligence (AI), the Internet of Things (IoT), and automation are transforming how we approach marketing. These tools are not just fancy gadgets; they are becoming essential partners that help businesses navigate the unpredictable, fast-paced landscape of modern marketing. Therefore, this study was conducted to assess the impact of AI technology use on the effectiveness of digital marketing among student entrepreneurs at Balik Pulau Polytechnic (PBU). This study focused on two main objectives: (i) to assess the level of use, challenges and support for AI and the effectiveness of AI in digital marketing, and (ii) to identify the significant influence between AI use and the challenge and support factors on the effectiveness of AI in digital marketing. A quantitative approach was used with data collection through questionnaires to 181 students who took the DFT30103 Cyberpreneurship course. Descriptive statistical analysis and Pearson correlation were conducted using SPSS software. The findings showed that AI use, challenges and support, and the effectiveness of AI in digital marketing were high. There was a very strong and significant relationship between AI use and its effectiveness ($r = 0.818$, $p < 0.001$), as well as a moderately strong relationship between challenges and support and AI effectiveness ($r = 0.671$, $p < 0.001$). In conclusion, AI technology plays an important role in the success of digital marketing by student entrepreneurs. The study recommends that more comprehensive training, technical support, and exposure programs be provided to enable students to fully leverage AI's potential in their digital business strategies, aligning with SDG 4 Quality Education and SDG 9 Industry, Innovation and Infrastructure.

Keywords: Artificial Intelligence (AI) technology, Digital marketing, Student entrepreneurs, Technology, Effectiveness.

1. INTRODUCTION

The rapid development of digital technology in the Industry 4.0 era has brought significant transformation in various aspects of life, particularly in business and marketing [1-3]. Industry 4.0 refers to the fourth generation of the industrial revolution, emphasizing the use of smart technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), automation, big data, and blockchain that are digitally interconnected [4]. This transformation has shifted the landscape from traditional marketing to digital marketing, which is more efficient, targeted, and interactive. Recent studies have demonstrated the applicability of the Technology Acceptance Model (TAM) in explaining AI adoption in educational settings, particularly through the roles of perceived usefulness, perceived ease of use, and behavioral intention [5].

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In digital marketing, Industry 4.0 technologies enhance the effectiveness of marketing strategies through process automation, real-time data analysis, and content personalization based on customer behavior [6]. Through AI, entrepreneurs can identify customer purchasing patterns, predict market trends, and optimize marketing campaigns more effectively [7]. Technologies like IoT allow the collection of real-time data from products or users, providing a clearer understanding of customer needs and preferences [8].

In Malaysia, this transformation has significantly impacted polytechnic student entrepreneurs, who increasingly rely on digital platforms to promote their products and services [9]. According to an MDEC report (2023), 65% of young entrepreneurs have begun incorporating at least one Industry 4.0 technology into their marketing strategies. Polytechnic students engaged in digital entrepreneurship have the potential to leverage these technologies to strengthen their businesses [10]. However, the level of technology adoption among polytechnic students remains lower compared to corporate entrepreneurs. A study [9] found that only 30% of student entrepreneurs in technical institutions such as polytechnics actively use AI or Big Data, compared to 75% among experienced companies. Constraints such as limited technical knowledge and resources for implementing advanced technologies still exist [11].

Therefore, this study focuses on the impact of Artificial Intelligence (AI) technology on the effectiveness of digital marketing among student entrepreneurs at Politeknik Balik Pulau (PBU). The first objective of this study is to assess the level of AI usage, the challenges and support for using AI, and the effectiveness of AI in digital marketing. The second objective is to identify the extent of AI's influence on digital marketing, as well as the challenges and support for its use, and their impact on the effectiveness of AI-driven digital marketing.

The hypotheses of this study are as follows:

H1a: There is a significant relationship of AI usage in digital marketing on the effectiveness of AI-driven digital marketing.

H1b: There is a significant relationship of the challenges and support in using AI on the effectiveness of AI-driven digital marketing.

2. MATERIAL AND METHODS

The researcher employed a quantitative approach using questionnaires to collect data from PBU student entrepreneurs engaged in digital business. This study was conducted at Politeknik Balik Pulau, targeting all Semester 3 students of Session I: 2024/2025 enrolled in the DFT30103 Cyberpreneurship course as the study population. The total population consisted of 345 students enrolled in the course. Based on the sample size determination table proposed by Krejcie and Morgan (1970) [12], a sample size of 181 respondents was deemed appropriate for a population of 345. Therefore, 181 respondents were selected as the study sample using a simple random sampling technique from the population of 345 students enrolled in the DFT30103 Cyberpreneurship course.

The questionnaire, developed using a 5-point Likert scale, measured the usage of Artificial Intelligence (AI) technology, digital marketing effectiveness, and the challenges encountered. Data analysis was conducted using SPSS for descriptive statistics (mean, percentage) and inferential statistics (Pearson correlation test) to examine relationships among the study variables.

2.1 Model and Data

Table 1 presents the interpretation of mean scores based on specific ranges categorized into five

main levels. Establishing these levels allows the researcher to provide a more systematic and consistent interpretation of the mean scores obtained in the study. It is also important to offer a clear understanding of respondents' perceptions or levels of agreement with the study items. This scale was adapted from the guidelines of Nunnally and Bernstein (1994) [13], a standard reference in psychometric and social research.

Table 1: Interpretation of Mean Scores.

Mean Score Range	Level
1.00 – 1.99	Very Low
2.00 – 2.99	Low
3.00 – 3.99	Moderate / Moderately High
4.00 – 4.49	High
4.50 – 5.00	Very High

Source: Nunnally and Bernstein (1994)

Table 2 presents the interpretation of Pearson correlation coefficient values according to McBurney (2001) [14]. This interpretation helps the researcher understand the extent to which two variables are statistically related to each other.

Table 2: Interpretation of Pearson Correlation Coefficient

Correlation Coefficient (r)	Interpretation
0.81 and above	Strong correlation
0.61 to 0.80	Moderately strong correlation
0.41 to 0.60	Moderate correlation
0.21 to 0.40	Weak-moderate correlation
below 0.20	Weak correlation

Sumber: McBurney (2001)

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) to ensure the study's findings were accurate, systematic, and reliable. The use of SPSS enables the researcher to perform statistical analyses, such as descriptive statistics and correlation analyses, more efficiently and in greater detail, thereby producing precise results grounded in empirical evidence.

3. RESULTS AND DISCUSSION

Before descriptive and inferential analysis was conducted, instrument reliability tests were conducted using Cronbach's Alpha (α) coefficient to assess the internal consistency of the items. Alpha values closer to 1.00 indicate higher reliability. According to Tavakol and Dennick (2011) [15] and George and Mallery (2003) [16], α values ≥ 0.70 generally indicate acceptable reliability, while values of 0.80–0.90 indicate good internal consistency. Values above 0.90 should be examined as they may indicate overlap between items.

Table 3 shows the reliability analysis for the three study variables based on 181 respondents. The construct of AI Use in Digital Marketing obtained a Cronbach's Alpha value of $\alpha = .891$, while Challenges and support for AI use recorded $\alpha = .786$. Next, the construct of AI Effectiveness in Digital Marketing obtained a value of $\alpha = .898$. Overall, the Cronbach's Alpha values were in the range of .786 to .898, which is above the minimum value of .70. This finding indicates that all three constructs have good and acceptable internal consistency, thus confirming that the study instrument is suitable for use in subsequent descriptive and inferential analyses.

Table 3: Questionnaire Reliability Analysis.

Study Variables	No. of Samples	No. of Item	Cronbach's Alpha
Use of artificial intelligence (AI) in digital marketing	181	4	.891
Challenges and supports of using artificial intelligence (AI)	181	7	.786
Effectiveness of Artificial Intelligence (AI) in Digital Marketing	181	4	.898

3.1 Descriptive Analysis and Pearson Correlation

The analysis includes descriptive statistics and inferential methods, specifically correlation analysis, to identify relationships among the variables studied. The results of this analysis provide a comprehensive overview of the data obtained from the respondents.

Table 4: Demographics of Study Respondents.

Item	Number	Percentage (%)
Gender		
Male	65	35.9
Female	116	64.1
Age		
18 - 20	48	26.5
21 - 22	60	33.1
23 and above	73	40.3

Table 4 presents the demographic profile of the study respondents, consisting of Semester 3 students of Session I: 2024/2025 at Politeknik Balik Pulau enrolled in the DFT30103 Cyberpreneurship course. A total of 181 students participated as respondents.

In terms of gender, the majority of respondents were female, with 116 students (64.1%), while 65 students (35.9%) were male. Regarding age, the largest group consisted of students aged 23 years and above, totaling 73 students (40.3%), followed by those aged 21 to 22 years with 60 students (33.1%), and 48 students (26.5%) aged between 18 and 20 years. This distribution indicates that the respondents came from a range of age groups, providing a comprehensive overview of the demographics of the students involved in this study.

Table 5: Analysis of Mean Score Levels.

Study Variables	No. of Respondents	No. of Item	Mean (M)	Standard Deviation (SD)	Interpretation
Use of Artificial Intelligence (AI) in Digital Marketing	181	4	4.2044	0.60063	High
Challenges and Support in AI Usage	181	7	4.0458	0.40678	High
Effectiveness of AI in Digital Marketing	181	4	4.0608	0.57894	High

Table 5 presents the analysis of mean scores and standard deviations for the three main variables in the study related to Artificial Intelligence (AI) in digital marketing. For the variable AI usage in digital marketing, the recorded mean was $M = 4.2044$ with a standard deviation of $SD = 0.60063$. This indicates a high level of AI usage among respondents, with a fairly consistent data distribution.

Next, the variable "challenges and support in using AI" obtained a mean of $M = 4.0458$ and a standard deviation of $SD = 0.40678$, indicating a high level with lower data variation compared to the other variables. Meanwhile, the variable effectiveness of AI in digital marketing showed a mean of $M = 4.0608$ and a standard deviation of $SD = 0.57894$, which is also considered high.

According to the interpretation proposed by Nunnally and Bernstein (1994) [13], a mean value in the range of 4.00 to 4.49 is defined as a high level. Therefore, all variables in this study are interpreted as being at a high level. Additionally, the low to moderate standard deviations (ranging from 0.40 to 0.60) indicate that the data are homogeneous, meaning respondents' perceptions are fairly uniform and do not show large variations. This strengthens the reliability of the findings and their suitability for further analysis, such as parametric testing.

Table 6: Results of Correlation Analysis.

Independent Variable	Dependent Variable		
	Effectiveness of AI in Digital Marketing		
	No. of Respondents	Correlation Coefficient (r)	Significance (p)
Use of Artificial Intelligence (AI) in Digital Marketing	181	.818**	.000
Challenges and Support in AI Usage	181	.671**	.000

Table 6 presents the results of the Pearson correlation analysis between two independent variables and one dependent variable, namely the effectiveness of Artificial Intelligence (AI) in digital marketing. For the relationship between AI usage in digital marketing and AI effectiveness, the correlation coefficient was $r = 0.818$ with a significance value of $p = 0.000$. According to McBurney (2001) [14], this indicates a strong correlation, and the highly significant level ($p < 0.01$) confirms that the relationship is statistically significant. This suggests that the higher the usage of AI in digital marketing, the higher its perceived effectiveness among respondents. Meanwhile, the relationship between challenges and support in AI usage and AI effectiveness showed a correlation coefficient of $r = 0.671$, also with a significance value of $p = 0.000$. This indicates a moderately strong, statistically significant correlation at the 0.01 level, demonstrating a meaningful relationship. Therefore, it can be concluded that both independent variables have a positive and significant relationship with the effectiveness of AI in digital marketing. The findings for AI usage in digital marketing on AI effectiveness ($r = 0.818$, $p = 0.000$, $p < 0.001$) support the study hypothesis H1a. Similarly, the results for challenges and support in AI usage on AI effectiveness ($r = 0.671$, $p = 0.000$, $p < 0.001$) support hypothesis H1b.

3.2 Research Findings

The findings of this study indicate that the levels of AI usage, challenges, support and the effectiveness of Artificial Intelligence (AI) in digital marketing are all high. The majority of students demonstrate a positive level of acceptance and application of AI in digital marketing, in line with current technological advancements. The findings further indicate that AI adoption among student entrepreneurs extends beyond general technology use and supports various practical aspects of digital business activities. Students may utilize generative AI tools to develop marketing content, generate business ideas, prepare product descriptions, create social media captions and support customer communication through automated messaging. In addition, AI can assist students in analyzing customer data, identifying market trends and making business-related decisions. These applications demonstrate the potential of AI to enhance the efficiency and effectiveness of students' entrepreneurial and digital marketing activities.

Based on the Pearson correlation analysis, the study found a positive and significant relationship

between the two independent variables, namely AI usage and challenges and support for AI and the dependent variable, AI effectiveness in digital marketing. Specifically, AI usage demonstrated a very strong positive correlation with AI effectiveness ($r = 0.818$, $p < 0.001$), while challenges and support showed a strong positive correlation ($r = 0.671$, $p < 0.001$). These findings suggest that higher levels of AI usage and greater levels of support are associated with higher perceived effectiveness of AI in students' digital marketing activities. However, the findings should be interpreted as associations rather than causal effects, as Pearson correlation measures the strength and direction of relationships between variables.

The findings are consistent with previous studies, such as Ng et al. (2023) [17] and Zhang et al. (2022) [8], which reported that AI can enhance the efficiency of digital marketing strategies. The findings are also supported by Lim et al. (2020) [7], who found that students using AI were better able to identify target customers and assess campaign performance more accurately. These findings highlight the potential of AI to help students perform digital marketing activities more efficiently and make more informed business decisions. Nevertheless, the effective use of AI may still be constrained by students' knowledge, skills, and available time. As noted by Hassan et al. (2024) [18], limitations in knowledge and time remain major challenges in fully leveraging AI. Students may also experience difficulties in formulating effective prompts, selecting appropriate AI tools, interpreting AI-generated information, managing data privacy and evaluating the accuracy and reliability of AI-generated outputs.

Therefore, educational support is important in helping students overcome these technical and practical barriers. As suggested by Saidin et al. (2021) [19], educational institutions and related agencies should provide students with appropriate training, guidance and technological facilities. In the context of polytechnic education, structured guidance, practical workshops and hands-on activities can be incorporated to strengthen students' AI literacy and digital competencies. Such support would enable students not only to understand the functions of AI tools but also to apply them appropriately and responsibly in real-world digital business activities.

Based on these findings, polytechnic curriculum development should incorporate AI-related activities into entrepreneurship and digital business courses. Practical learning activities could include using generative AI for marketing content creation, digital marketing campaign development, customer engagement, data analysis, and AI-assisted business decision-making [20-22]. Lecturers should also provide clear guidelines on responsible AI use, particularly regarding data privacy, ethical considerations, verification of AI-generated content and appropriate citation practices. These initiatives can help students develop the practical knowledge and skills required to use AI effectively and responsibly as future digital entrepreneurs.

From a managerial and policy perspective, polytechnic management should consider providing continuous professional development opportunities for lecturers to strengthen their knowledge and pedagogical skills in AI applications. Institutions should also ensure access to appropriate AI tools, digital platforms and supporting technological facilities. In addition, the development of institutional guidelines on the responsible use of AI in teaching, learning, and entrepreneurship activities would provide clearer direction for both lecturers and students. These initiatives could strengthen institutional support, reduce technical barriers, and enable students to maximize AI's potential in digital entrepreneurship.

Overall, this study demonstrates that polytechnic students use AI extensively and perceive AI as effective in supporting digital marketing activities. The significant and positive relationships between AI usage, challenges and support, and AI effectiveness further highlight the importance of both technology adoption and institutional support. Consequently, a more comprehensive approach to technology education, involving curriculum integration, continuous training, practical exposure, and appropriate institutional support, is necessary to ensure that students

can fully harness AI's potential as future digital entrepreneurs.

4. CONCLUSION

Overall, this study demonstrates that Artificial Intelligence (AI) technology has a significant impact on the effectiveness of digital marketing among student entrepreneurs at Politeknik Balik Pulau (PBU). The findings indicate that the levels of AI usage, support, and awareness of its challenges are high. This suggests that students are increasingly prepared to accept and apply modern technology in line with the demands of Industry 4.0. Through AI usage, students can analyze customer data, identify purchasing patterns, and predict market trends more efficiently, thereby assisting in planning more targeted and effective marketing campaigns.

Pearson correlation analysis also confirmed a positive and significant relationship between AI usage, as well as its challenges and support, and the effectiveness of its implementation in digital marketing. This shows that students who actively use AI in marketing strategies are likely to achieve higher effectiveness. These findings align with previous studies, which also confirm that AI can enhance the efficiency and accuracy of digital marketing strategies. However, constraints such as limited technical skills, knowledge, and financial resources remain major challenges in the full implementation of AI. Therefore, continuous support from higher education institutions, government agencies, and the industry is essential in the form of training, competency development courses, and technological infrastructure.

In summary, AI has great potential to empower student entrepreneurship. A more comprehensive and structured approach is crucial to ensure that this technology can be fully leveraged to advance sustainable digital entrepreneurship, contributing to the growth of the country's digital economy.

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