



Optimization of Gamification Type Selection in Pop-Up Campaigns to Enhance Customer Engagement on E-Commerce Platform XYZ Using the Analytical Hierarchy Process Method

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Abstract

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The application of gamification in campaigns has been proven to have a significant impact on customer engagement in e-commerce. This research aims to optimize the selection of gamification types in pop-up campaigns to increase consumer engagement on the XYZ e-commerce platform. The selection of the right type of gamification is very important, but is often affected by subjectivity in judgment. The research method uses the analytic hierarchy process method which integrates historical data as a reference in filling alternatives based on criteria to reduce the subjectivity of the AHP method in determining the most effective type of gamification based on the criteria of Click-Through Rate (CTR), Conversion Rate (CR), and Impression. The results show that the Memory Card gamification type is the most effective type that has the potential to increase consumer engagement. This approach is expected to be a reference for e-commerce platforms in designing more effective gamification strategies.

Keywords: *Gamification, Analytic Hierarchy Process (AHP), Customer Engagement, E-commerce, Pop-up Campaign.*

Abstrak

Penerapan gamifikasi dalam campaign sudah terbukti memiliki dampak signifikan terhadap *customer engagement* dalam e-commerce. Penelitian ini bertujuan untuk mengoptimalkan pemilihan jenis gamifikasi dalam *pop-up campaign* untuk meningkatkan *consumer engagement* pada platform e-commerce XYZ. Pemilihan jenis gamifikasi yang tepat sangat penting, namun sering kali dipengaruhi oleh subjektivitas dalam penilaian. Metode penelitian menggunakan metode *analytic hierarchy process* yang mengintegrasikan data historis sebagai acuan dalam pengisian alternatif berdasarkan kriteria untuk mengurangi subjektivitas metode AHP dalam menentukan jenis gamifikasi yang paling efektif berdasarkan kriteria *Click-Through Rate (CTR)*, *Conversion Rate (CR)*, dan *Impression*. Hasil penelitian menunjukkan jenis gamifikasi Memory Card merupakan jenis yang paling efektif berpotensi untuk meningkatkan *consumer engagement*. Pendekatan ini diharapkan dapat menjadi acuan bagi platform e-commerce dalam merancang strategi gamifikasi yang lebih efektif.

Kata-kata kunci: *Gamifikasi, Analytic Hierarchy Process, Customer Engagement, E-commerce, Pop-up Campaign.*



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1. Introduction

In recent years, the e-commerce sector has experienced rapid expansion, accompanied by increasing competition among platforms [1] [2]. One of the key success factors in this industry is consumer engagement. High engagement has been proven to drive increased sales and customer loyalty [3]-[6]. To achieve this goal, the implementation of gamification in campaigns has been proven to have a significant impact on customer engagement in e-commerce [7]-[17].

Pop-up campaigns are used to deliver specific information, such as promotional offers, discount vouchers, or engaging challenges, to encourage participation and customer engagement with the e-commerce platform [18] [19]. Although many e-commerce platforms have implemented gamification in their marketing strategies, selecting the most effective type of gamification for pop-up campaigns remains a significant challenge. Not all types of gamification yield the same impact, and the diverse preferences and behaviors of customers are not yet fully understood [20].

Several previous studies have examined the impact of gamification on enhancing consumer engagement on e-commerce platforms and have shown that gamification has a positive effect on consumer engagement in e-commerce [7] [10]. However, these studies do not address how different types of gamification specifically affect consumer engagement. One method that can be used to determine the most effective type of gamification to enhance consumer engagement is the Analytic Hierarchy Process (AHP). AHP is a multi-criteria decision-making method developed by Thomas L. Saaty in the 1970s. It is used to aid decision-making in solving problems that involve multiple interrelated criteria or alternatives [21].

However, the Analytic Hierarchy Process (AHP) is often criticized for its subjectivity in comparative assessments. One previous study concluded that the Fuzzy Analytic Hierarchy Process (F-AHP) can address AHP's weaknesses in dealing with subjective judgments [22]. However, its complexity, such as defuzzification and fuzzy vector calculations, requires in-depth understanding, making it less practical for use.

Therefore, this study aims to optimize the type of gamification used in pop-up campaigns to enhance consumer engagement on the e-commerce platform XYZ. Through a scientific approach using the Analytic Hierarchy Process (AHP) method, this research not only identifies and selects the most effective type of gamification but also reduces subjectivity in

assigning weights to alternatives by utilizing historical data as a reference for weight assignment, without involving complex methods like F-AHP. This approach is expected to provide practical guidance for the e-commerce company XYZ in designing effective gamification strategies to boost consumer engagement on the XYZ platform.

2. Method

2.1. Analytic Hierarchy Process (AHP) Method

This study employs the Analytic Hierarchy Process (AHP) method as the main framework to optimize the type of gamification in pop-up campaigns to enhance consumer engagement on the e-commerce platform XYZ. Data is collected through observation, interviews, and AHP-based questionnaires, with historical data used as a reference for filling in alternatives based on criteria to reduce subjectivity in decision-making. The process is carried out as illustrated in **Figure 1**, which shows the flow or steps involved in using the AHP method [23].

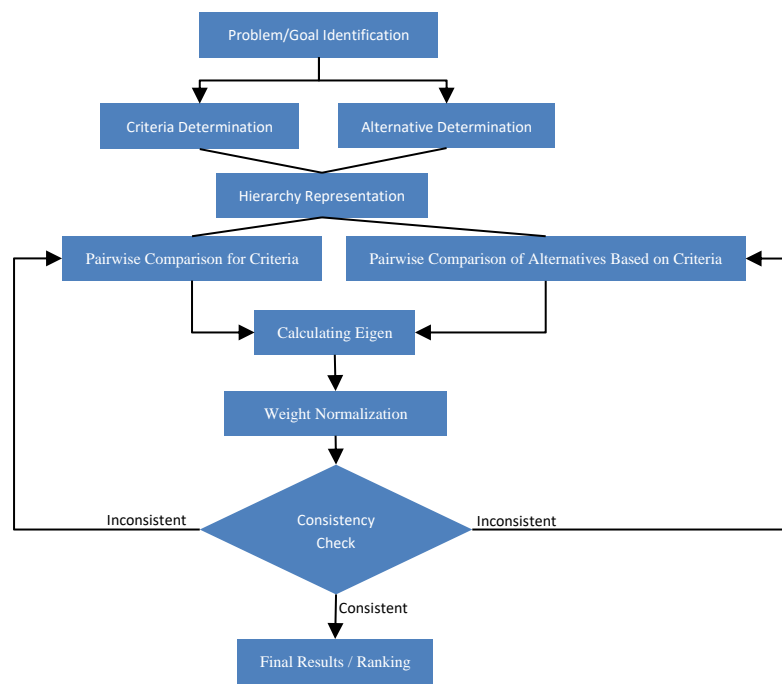


Figure 1. AHP Steps

2.2. Data Collection

1. Observation

Observation was conducted by directly observing the activities and marketing strategies currently implemented by e-commerce company XYZ. The purpose of this observation is to identify the challenges, opportunities, and needs faced in enhancing

consumer engagement through pop-up campaigns. This observation is fundamental for understanding the context of the existing issues.

2. Interview

Interviews were conducted with the digital campaign team at XYZ company to explore in-depth the criteria and alternatives relevant to determining the most effective type of gamification. The interviewed digital campaign team consisted of three professionals with experience in managing digital campaigns on the e-commerce platform XYZ.

3. Questionnaire

The team of experts in digital campaigns at e-commerce XYZ was asked to fill out a pairwise comparison matrix using the Analytic Hierarchy Process (AHP) method. They assessed the relative importance of each criterion and alternative based on their experience and historical data.

4. Historical Data Document

November. To ensure that the resulting assessments are objective, historical data used as a reference for filling in alternatives based on criteria [23], such as CTR, Conversion Rate, and impressions, were obtained from gamification pop-up campaigns conducted in November.

2.3. AHP Process and Application Implementation

In this research, the Analytic Hierarchy Process (AHP) is implemented through the development of a web-based application using the Streamlit framework. The application is designed to simplify the process for users to perform AHP calculations systematically. Below is an explanation of the implementation of the Analytic Hierarchy Process (AHP) within the application's features:

1. Data input

At this stage, the user is required to input names, alternatives, and criteria.

- a. Identify three types of gamification that have been implemented and used in pop-up campaigns on the e-commerce platform XYZ, namely:

- 1) Puzzle
- 2) Memory Card
- 3) Spinning Machine

b. Determination of Evaluation Criteria

The three main criteria to be used for evaluating the identified types of gamification are:

- 1) *Click-Through Rate (CTR)*: The percentage of users who click on the pop-up after viewing it. The Equation for calculating this is shown in Equation (1).

$$CTR = \left(\frac{\text{number of click}}{\text{number of impressions}} \right) \times 100 \quad (1)$$

For example : If a pop-up is displayed 1,000 times and 50 users click on it, the CTR is as shown in Equation (2).

$$\left(\frac{50}{1000} \right) \times 100 = 5\% \quad (2)$$

- 2) *Conversion Rate (CR)*: the percentage of users who complete the desired action after interacting with the pop-up, as shown in Equation (3), with the result shown in Equation (4).

$$Conversion Rate = \left(\frac{\text{number of conversions}}{\text{number of users who interacted}} \right) \times 100 \quad (3)$$

For example : If 50 users click on the pop-up and 10 of them make a transaction, the conversion rate is:

$$\left(\frac{10}{50} \right) \times 100 = 20\% \quad (4)$$

- 3) *Impression*: The ratio of the number of pop-ups displayed.

2. Pairwise comparison for criteria.

At this stage, the AHP application processes pairwise comparisons among the criteria, namely click-through rate (CTR), conversion rate (CR), and impression. Each respondent is asked to evaluate the importance of each criterion compared to the others in enhancing consumer engagement, using a scale of 1 to 9 as shown in [Table 1](#).

Table 1. Pairwise Comparison Scale in AHP

Value	Description
1	Equally important
3	Slightly more important
5	More important
7	Much more important
9	Absolutely more important
2, 4, 6, 8	Intermediate values between two adjacent judgments

For example, users are asked to assess the importance of CTR compared to the conversion rate. If CTR is considered twice as important as the conversion rate, respondents will input a value of 2. Conversely, if the conversion rate is deemed less important than CTR, the value for the conversion rate compared to CTR will be set to 0.5 (the inverse of 2). This evaluation results in a comparison matrix that forms the basis for calculating the weights of each criterion, as shown in **Table 2**.

Table 2. Comparison of Criteria

Kriteria	CTR	conversion rate	Impression
CTR	1	2	0.5
Conversion Rate	0.5	1	0.33
Impression	2	3	1 ¹

3. Pairwise Comparison of Alternatives Based on Each Criterion

After the weights of the criteria are determined, the application guides the experts to compare the gamification alternatives (Puzzle, Memory Card, and Spinning Machine) based on each existing criterion. For example, they are asked to evaluate which type of gamification is better at improving CTR, conversion rate, and impressions. For example, the results of the pairwise comparisons for the criteria are shown in **Table 3**.

Table 3. Pairwise Comparison of Alternatives Based on CTR Criterion

Alternatives	Puzzle	Memory Card	Spinning Machine
<i>Puzzle</i>	1	3	2
<i>Memory Card</i>	0.3	1	0.5
<i>Spinning Machine</i>	0.5	2	1

Example of Values:

- 4) Puzzle compared to Memory Card is given a value of 3 because the CTR of Puzzle is considered slightly better than that of Memory Card.
- 5) Memory Card compared to Spinning Machine is given a value of 0.5 because the CTR of Memory Card is less favorable compared to Spinning Machine.

4. Eigen Vector Normalization and Consistency Check

At this stage, the AHP application calculates the final weights for each criterion and checks the consistency of the comparisons provided by the digital campaign team. This process involves the following steps:

a. Calculating the eigenvector

Equation (5) is used to determine the weights of criteria or alternatives:

$$A \cdot w = \lambda_{max} \cdot w \quad (5)$$

Where:

λ_{max} : The maximum eigenvalue calculated from the comparison matrix.

w : weight vector resulting from this calculation.

b. Weight Normalization

After obtaining the weights, the next step is normalization. The weights are normalized as shown in Equation (6).

$$W_i^1 = \frac{w_i}{\sum_{j=1}^n w_j} \quad (6)$$

Di mana:

w_i' : Normalized weight for the i -th criterion or alternative

w_i : Normalized weight for the i -th criterion or alternative

n : Total number of criteria or alternatives

w_j : Original weight for all criteria or alternatives j

c. Calculating Consistency

To ensure that the comparisons made are consistent, the application calculates the consistency index (CI) as shown in Equation (7) and the consistency ratio (CR) as shown in Equation (8)

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (7)$$

Where n = the number of element.

λ_{max} : The maximum eigenvalue calculated from the comparison matrix.

$$CR = \frac{CI}{RI} \quad (8)$$

Where RI is the random index corresponding to the number of criteria or alternatives, with its value shown in [Table 4](#). If the CR value is less than 0.1, the comparison is considered consistent and acceptable.

Table 4. Determination of RI Value

Matrix Size	1,2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI Value	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

5. Presentation of Final Results

At the final stage, the AHP application presents the calculation results in the form of tables and graphs, facilitating the assessment to select the optimal type of gamification to enhance consumer engagement on the XYZ e-commerce platform. These results are expected to serve as a practical, data-driven guide for designing a more effective gamification strategy.

3. Results and Discussion

3.1 Research Results

In the Analytic Hierarchy Process (AHP) method, the construction of a hierarchical structure is used to break down complex decision problems into several levels or tiers, enabling decision-making by decomposing the problem into simpler components and organizing those components into a hierarchy [24], as shown in Figure 2.

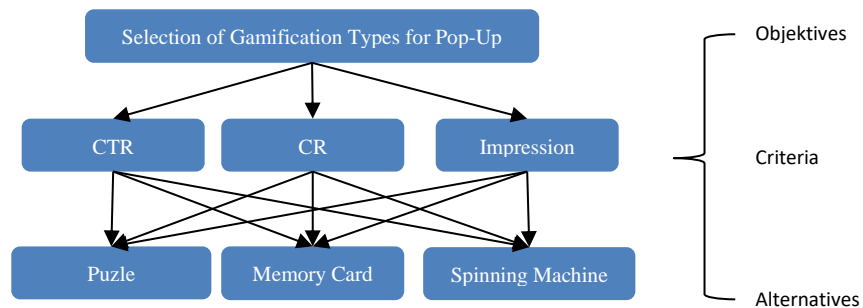


Figure 2. Hierarchical Structure

Based on the hierarchical criteria above, the first step is to create a pairwise comparison matrix of criteria, conducted by respondents 1, 2, and 3. Figure 3 is results of criteria weight comparison by respondent 1.

Criteria			
	CTR	Conversion Rate	Impression
CTR	1.0000	3.0000	4.0000
Conversion Rate	0.3333	1.0000	3.0000
Impression	0.2500	0.3333	1.0000

Figure 3. Results of Criteria Weight Comparison by Respondent 1

The comparison of criteria weights generated from respondent 1 shown in Figure 3 shows CTR has the highest weight, considered 4 times more important than CR and 3 times more important than impression, indicating that success in driving users to click is prioritised over conversion or simply displaying content. Meanwhile, CR is considered 2 times more important than impression, signalling that conversions are valued more than the number of impressions that occur. results of criteria weight comparison by respondent 2 can be seen in [Figure 4](#).

Criteria			
	CTR	Conversion Rate	Impression
CTR	1.0000	4.0000	3.0000
Conversion Rate	0.2500	1.0000	2.0000
Impression	0.3333	0.5000	1.0000

Figure 4. Results of Criteria Weight Comparison by Respondent 2

The comparison of criteria weights generated from respondent 2 shown in Figure 4 shows that CTR has the highest weight compared to other criteria, considered 4 times more important than conversion rate (CR) and 3 times more important than Impression. This suggests that success in attracting clicks from the audience is a top priority. conversion rate has a higher weight compared to impressions, with a ratio of 2 times higher, indicating that specific actions from users are valued more than the number of impressions alone. results of criteria weight comparison by respondent 3 can be seen in [Figure 5](#).

Criteria			
	CTR	Conversion Rate	Impression
CTR	1.0000	4.0000	3.0000
Conversion Rate	0.2500	1.0000	2.0000
Impression	0.3333	0.5000	1.0000

Figure 5. Results of Criteria Weight Comparison by Respondent 3

The comparison of criteria weights generated from respondent 3 shown in Figure 5 shows that CTR has the highest weight compared to other criteria, considered 4 times more important than Conversion Rate (CR) and 3 times more important than Impression. This suggests that success in attracting clicks from the audience is a top priority. Conversion Rate has a higher weight compared to Impression, with a ratio of 2 times higher, indicating that specific actions from users are valued more than the number of impressions alone.

The next step is the pairwise comparison of alternatives based on each criterion conducted by the three respondents, with the results shown in **Figures 6, 7, and 8**. From the results of the assessment of the three alternative respondents based on the Memory Card criteria, it consistently excels in all three criteria (CTR, Conversion Rate, and Impressions),

Alternatives for Criterion CTR			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	4.0000
Puzzle	0.3333	1.0000	3.0000
Spinning Machine	0.2500	0.3333	1.0000

Alternatives for Criterion Conversion Rate			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	5.0000
Puzzle	0.3333	1.0000	4.0000
Spinning Machine	0.2000	0.2500	1.0000

Alternatives for Criterion Impressions			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	4.0000
Puzzle	0.3333	1.0000	3.0000
Spinning Machine	0.2500	0.3333	1.0000

Figure 6. Pairwise Comparison of Alternatives by Respondent 1 Based on Criteria

Alternatives for Criterion CTR			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	4.0000
Puzzle	0.3333	1.0000	3.0000
Spinning Machine	0.2500	0.3333	1.0000

Alternatives for Criterion Conversion Rate			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	5.0000
Puzzle	0.3333	1.0000	4.0000
Spinning Machine	0.2000	0.2500	1.0000

Alternatives for Criterion Impressions			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	4.0000
Puzzle	0.3333	1.0000	3.0000
Spinning Machine	0.2500	0.3333	1.0000

Figure 7. Pairwise Comparison of Alternatives by Respondent 2 Based on Criteria

Alternatives for Criterion CTR			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	4.0000
Puzzle	0.3333	1.0000	3.0000
Spinning Machine	0.2500	0.3333	1.0000

Alternatives for Criterion Conversion Rate			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	5.0000
Puzzle	0.3333	1.0000	4.0000
Spinning Machine	0.2000	0.2500	1.0000

Alternatives for Criterion Impressions			
	Memory Card	Puzzle	Spinning Machine
Memory Card	1.0000	3.0000	4.0000
Puzzle	0.3333	1.0000	3.0000
Spinning Machine	0.2500	0.3333	1.0000

Figure 8. Pairwise Comparison of Alternatives by Respondent 2 Based on Criteria

Based on the eigenvector normalisation and consistency check as shown in Figures 9, 10, and 11, it shows that Memory Cards consistently recorded the highest scores on CTR (0.6144), Conversion Rate (0.6267), and Impressions (0.6144). Puzzle came next with lower scores (CTR: 0.2684, Conversion Rate: 0.2797, Impressions: 0.2684), while Spinning Machine ranked last (CTR and Impressions: 0.1172, Conversion Rate: 0.0936). The consistency ratio (<0.1) confirms valid results.

Normalized Eigenvector for Criteria:		Weight
CTR		0.6144
Conversion Rate		0.2684
Impressions		0.1172
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion CTR:		
Memory Card		0.6144
Puzzle		0.2684
Spinning Machine		0.1172
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion Conversion Rate:		
Memory Card		0.6267
Puzzle		0.2797
Spinning Machine		0.0936
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion Impressions:		
Memory Card		0.6144
Puzzle		0.2684
Spinning Machine		0.1172
CR = 0.0274		

Figure 9. Normalized Eigenvector Based on Respondents' Results

Normalized Eigenvector for Criteria:		Weight
CTR		0.6144
Conversion Rate		0.2684
Impressions		0.1172
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion CTR:		
Memory Card		0.6144
Puzzle		0.2684
Spinning Machine		0.1172
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion Conversion Rate:		
Memory Card		0.6267
Puzzle		0.2797
Spinning Machine		0.0936
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion Impressions:		
Memory Card		0.6144
Puzzle		0.2684
Spinning Machine		0.1172
CR = 0.0274		

Figure 10. Normalized Eigenvector Based on Respondent 2's Results

Normalized Eigenvector for Criteria:		Weight
CTR		0.6144
Conversion Rate		0.2684
Impressions		0.1172
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion CTR:		
Memory Card		0.6144
Puzzle		0.2684
Spinning Machine		0.1172
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion Conversion Rate:		
Memory Card		0.6267
Puzzle		0.2797
Spinning Machine		0.0936
CR = 0.0274		
Normalized Eigenvector for Alternatives for Criterion Impressions:		
Memory Card		0.6144
Puzzle		0.2684
Spinning Machine		0.1172
CR = 0.0274		

Figure 11. Normalized Eigenvector Based on Respondent 3's Results

In the final stage of the AHP (Analytic Hierarchy Process) application, the calculation results shown in Figures 12 show the average scores for the three alternatives based on respondents' responses. Memory Card has the highest score (0.6241) and is ranked first, followed by Puzzle (0.2510) in second place, and Spinning Machine (0.1249) in third place. The bar graph illustrates the comparison of the average score of each alternative. to evaluate the most effective gamification type in increasing consumer engagement on the XYZ e-commerce platform. The calculation results show that Memory Card is the most effective type of gamification to be used for pop-up campaigns in XYZ e-commerce.

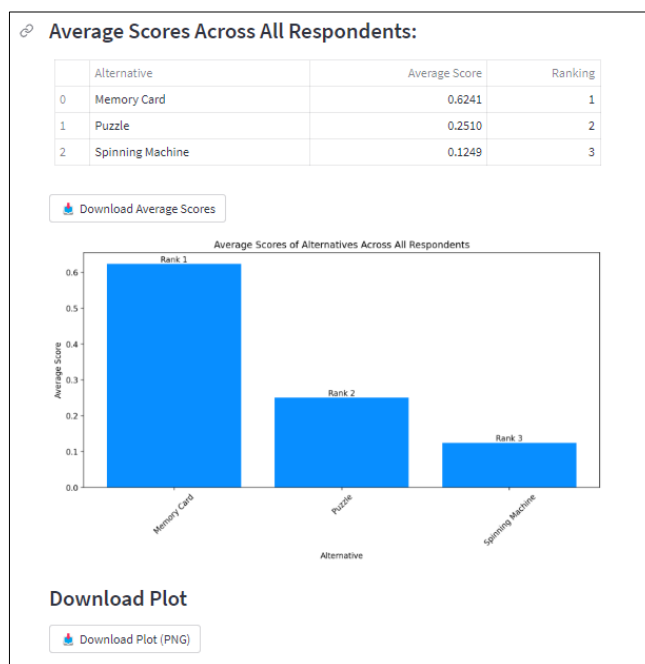


Figure 12. Average Results of Calculations from All Respondents

3.2 Discussion

This study aims to optimize the type of gamification in pop-up campaigns to enhance consumer engagement on the XYZ e-commerce platform using the AHP method. The results show that Memory Card-based gamification is the most effective type for increasing consumer engagement.

This research successfully addresses the common criticism of AHP regarding subjective evaluations by utilizing historical data to reduce subjectivity in the assessment process, while also avoiding the complexity of using fuzzy AHP (F-AHP). These findings complement previous studies that demonstrated gamification's ability to enhance consumer engagement but did not specifically explore how different types of gamification

impact consumer engagement. Further testing is needed to ensure the effectiveness of gamification in increasing consumer engagement.

This study contributes by presenting a data-driven approach to selecting potentially effective gamification types. The practical implications of this research provide guidance for XYZ e-commerce companies in designing more effective and data-based gamification strategies, which can also be applied by other e-commerce platforms.

4. Conclusion

This study shows that the Memory Card gamification is the most effective type of gamification for improving consumer engagement on the XYZ e-commerce platform, based on calculations using the Analytic Hierarchy Process (AHP) method. Memory Card has the highest score (0.6241) and ranks first, followed by Puzzle (0.2510) in second place, and Spinning Machine (0.1249) in third place.

However, this study has not tested the specific impact of each type of gamification on consumer engagement, so further validation is required. Future research is recommended to conduct A/B testing or field studies to confirm these findings and explore other types of gamification for various user segments. Further development in the application of AHP could also improve the accuracy of gamification type selection.

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