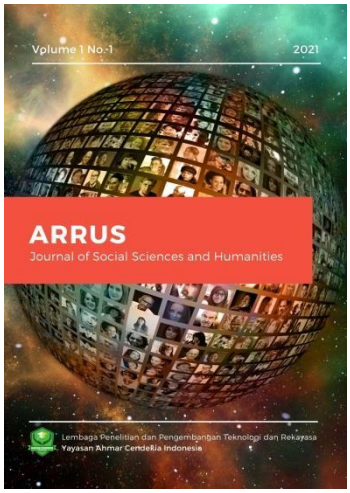
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RESEARCH ARTICLE

The Mediating Effect of Customer Engagement on Brand Awareness: The Strategic Attributes of Digital Packaging for Local Products

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Abstract: This study aims to analyze the effect of digital packaging, consisting of QR Code Quality (X1), Augmented Reality Attractiveness (X2), Interactive Experience (X3), Perceived Information Usefulness (X4), and Technology Ease of Use (X5), on Brand Awareness (Y) of Bernad Tani products through Customer Engagement (Z) as a mediating variable. A quantitative approach with a causal design was applied to 100 respondents obtained through purposive and snowball sampling. Data analysis used Partial Least Square-Structural Equation Modeling (PLS-SEM). The results show that Augmented Reality (X2) is positive and significant effect on Z, and Z significantly affects Y. The main findings indicate that the most dominant factors are Technology Ease of Use (X5) and QR Code Quality (X1) , meaning consumers highly prioritize simple access and technical reliability of QR Codes as the gateway to digital content. The research model demonstrates strong predictive capability, evidenced by an R^2 value of 0.824 for Z and an R^2 value of 0.694 for Y. Customer Engagement is proven to act as a partial mediator in all influence paths. Practically, Bernad Tani's management is advised to prioritize simplifying the technology interface and improving the physical quality of QR Codes on packaging.

Keywords: Augmented Reality, Brand Awareness , Customer Engagement, Digital Packaging, QR Code

1. Introduction

The development of digital technology has transformed the paradigm of product packaging from mere wrapping to an interactive medium capable of enhancing the consumer experience (Devi, 2023). In the era of the Fourth Industrial Revolution, digital packaging based on QR codes and Augmented Reality (AR) has proven effective in increasing brand awareness by 30–40% for consumer goods (Rotsios et al., 2022). The implementation of this technology, though, is still limited to large companies, while agricultural MSMEs such as Bernad Tani in Pengalengan, Bandung, West Java, have not yet made optimal use of it.

Bernad Tani products, as a local brand that promotes the values of sustainable agriculture and natural products, face a major challenge in increasing brand awareness amid the onslaught of large-scale commercial products. The conventional packaging methods used to date remain static, presenting only basic information such as the product name, ingredients, and marketing authorization number. However, in the digital age, consumers want not only high-quality products but also interactive, informative, and engaging experiences (Trivedi et

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al., 2020). Packaging that fails to communicate dynamically with consumers risks causing Bernad Tani's products to get lost in the competition (Htun et al., 2023).

Augmented Reality (AR) in global agricultural product packaging has proven successful in increasing customer engagement by 40% (Söderström et al., 2024). A successful example is the U.S.-based company Blueberry Hill, which uses AR to showcase farmers' stories and organic certifications. However, a similar implementation for Bernad Tani's products does not yet exist, even though 72% of millennial consumers prefer brands that offer interactive experiences (Le, 2024). Bernad Tani, a farmers' group producing organic vegetables in the Pengalengan region (1,200–1,500 meters above sea level), faces challenges in building brand awareness amid intense market competition. Data from the West Java Department of Agriculture (2023) shows that only 15% of agricultural SMEs in this region have effective digital marketing strategies. Meanwhile, a study by (Acuti et al., 2022) demonstrates that QR codes on agricultural product packaging can increase brand recall by up to 35% through educational content about cultivation processes.

QR codes allow consumers to access additional information such as a product's origin, organic certification, instructional videos, and even the farmer's location simply by scanning the code with a smartphone (Ganesan & Kumar, 2024; Hoffmann & Mai, 2022). Meanwhile, augmented reality offers a more immersive experience, for example, by displaying 3D animations of the planting process, visualizations of product benefits, or virtual interactions with the Bernad Tani brand character (Kumar et al., 2024; Söderström et al., 2024). The results of this study are expected to: (1) provide empirical evidence on the effectiveness of QR codes and AR for local agricultural products, (2) develop a model for the implementation of digital packaging for agricultural SMEs, and (3) enhance Bernad Tani's competitiveness in the digital market (Bonioli & Bazzani, 2025; Chen et al., 2022). These findings will contribute to the development of marketing technology literature in the agribusiness sector while also serving as a case study on the implementation of Industry 4.0 for the people's economy (Ngo et al., 2025) .

Despite growing interest in digital packaging, research remains fragmented focusing on single attributes like QR Codes or AR in isolation. Existing studies predominantly examine global brands in developed markets, leaving local products in emerging economies underexplored. Furthermore, while customer engagement is theorized as a mediator between digital stimuli and brand outcomes, limited empirical evidence exists for packaging-specific attributes. Methodologically, comprehensive PLS-SEM testing of multi-attribute models is scarce. This study addresses these gaps by simultaneously examining five strategic attributes (QR Code Quality, Augmented Reality, Interactive Experience, Perceived Information, Technology Ease) and their mediated effects on brand awareness through customer engagement, using Bernad Tani an Indonesian agricultural product as the research context.

2. Research Method and Materials

The research methods include the study design, variable mapping, data collection techniques, the types of data used, the population and sample under study, and the data analysis steps used to produce objective and measurable findings (Le, 2024).

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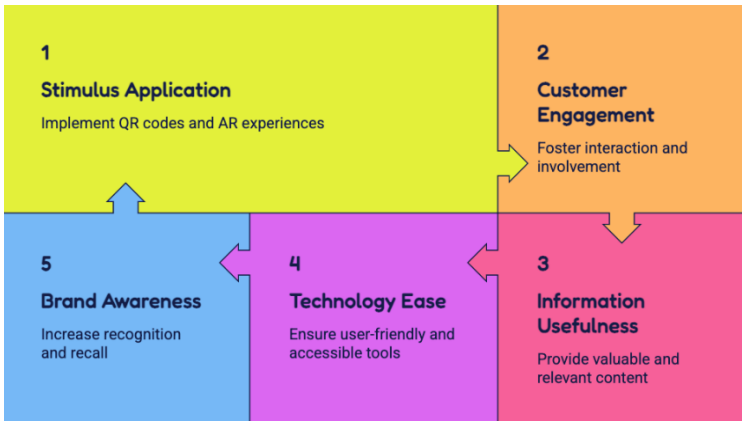


Figure 1: Frame of Work

Based on its objectives, this study is classified as causal research that is, research aimed at testing the cause-and-effect relationship between the independent variable (digital packaging) and the dependent variable (brand awareness) through the mediating variable (customer engagement) (Rawal et al., 2025). Causal research was chosen because it aligns with the primary objective of this study, which is to analyse the effects of QR code quality, augmented reality attractiveness, interactive experience, perceived information usefulness, and technology ease of use on brand awareness through customer engagement (Jiang & Lyu, 2024; Le, 2024).

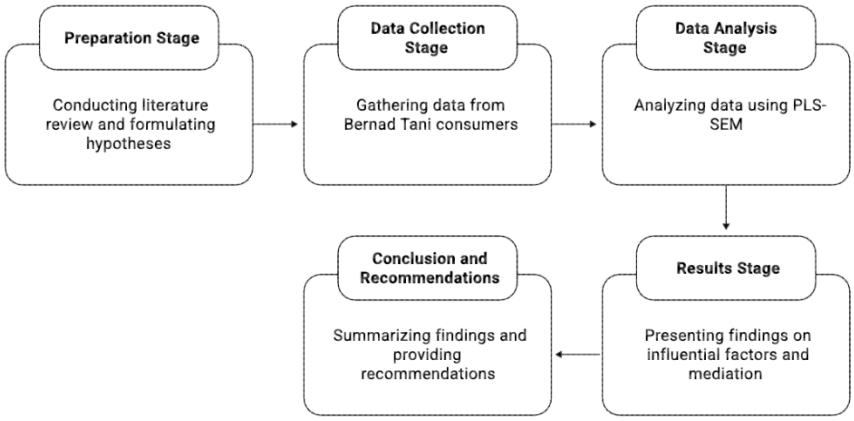


Figure 2: Research Model

In terms of methodology, this study employs a quantitative approach. The quantitative approach was chosen because (1) this study aims to test hypotheses formulated based on theory, (2) the data collected consists of numerical values analyzed using statistical methods, (3) the study's findings are generalizable to the population, and (4) the relationships among variables are measured objectively (Teeluckdharry et al., 2024).

2.1. Population and Research Sample

The population in this study consists of all consumers who have ever seen, heard of, or used Bernad Tani products and have ever interacted with the digital packaging (QR codes and/or augmented reality) on Bernad Tani product packaging. Since the exact size of the population is unknown (infinite population), this study employs an infinite population approach (Alimamy & Al-Imamy, 2022; Vieira et al., 2022). The criteria include:

(1). Have seen or are aware of Bernad Tani products
(2). Have scanned a QR code or used AR on Bernad Tani packaging
(3). 17 years of age or older

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(4). Own a smartphone capable of scanning QR codes and accessing AR.
(5). Willing to provide objective data and information via a questionnaire.

Sample Size: Based on the number of paths, this study includes 6 direct effect paths (H1–H6). With a significance level of $\alpha = 0.05$, a test power of 0.80, and a moderate effect size ($f^2 = 0.15$), the recommended minimum sample size is 100 respondents (Massa & Ladhari, 2025; Neva & Assa, 2025).

2.2. Data Collection Techniques

This research complied with established ethical guidelines for human subject research. All respondents provided voluntary informed consent prior to participation and were assured of anonymity and confidentiality. Participants were informed of their right to withdraw at any stage without consequence. All data were collected, stored, and analyzed securely, used exclusively for academic purposes, with no personally identifiable information disclose. This study uses two types of data (Redwan & Israd, 2025; Subagyo & Israd, 2025):

(1). Primary data is data obtained directly from the primary source, namely Bernad Tani's consumer respondents. Primary data was collected through questionnaires distributed both online and offline. Primary data includes respondents' perceptions of the five independent variables (X1–X5), the mediating variable (Z), and the dependent variable (Y).
(2). Secondary data is data obtained from existing sources, such as books, scientific journals, articles, company reports, Bernad Tani's official website, and other publications. Secondary data is used to strengthen the theoretical framework and the interpretation of the research results..

3. Results and Discussion

3.1. Respondent Characteristics

Respondent characteristics are basic information that describes the profiles of the customers who responded to the questionnaire. These characteristics are important for ensuring the external validity of the research results, as respondents' perceptions of the factors influencing the role of digital packaging are believed to be influenced by age and gender. All data in this section are derived from the questionnaire responses.

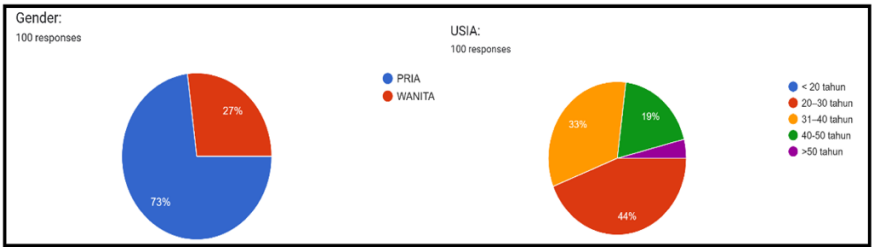


Figure 3: Graph of Respondent Characteristics

Based on Figure 3, the characteristics of the 100 study respondents are shown by gender and age. By gender, male respondents accounted for 73% and female respondents for 27%. In terms of age, the majority of respondents were in the 20–30 age group (44%) and the 31–40 age group (33%), indicating a predominance of people of working age.

3.2. Analysis of Structural Equation Modeling (SEM-PLS)

The SEM-PLS analysis was conducted in several stages: testing the measurement model (outer model), testing the structural model (inner model), and testing the significance of the relationships among variables.

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3.2.1. Outer Model Evaluation (Measurement Model)

Outer model analysis was conducted to evaluate the validity and reliability of the indicators used to measure each latent construct. The purpose of the outer model analysis is to ensure that the research instruments are capable of measuring the variables under study accurately and consistently. The outer model analysis in this study included convergent validity testing, construct reliability testing, and multicollinearity testing.

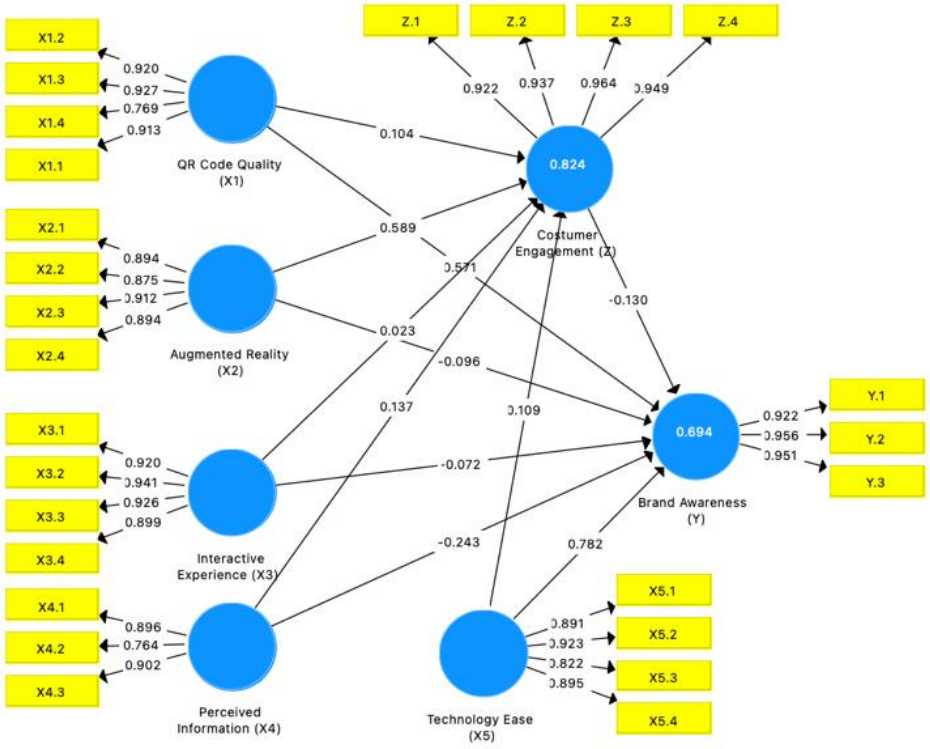


Figure 4: Model Construct

Table 1. Outer Loading

	X1	X2	X3	X4	X5	Y	Z	VALID >0,7
X1.1	0.913							Valid
X1.2	0.920							Valid
X1.3	0.927							Valid
X1.4	0.769							Valid
X2.1		0.894						Valid
X2.2		0.875						Valid
X2.3		0.912						Valid
X2.4		0.894						Valid
X3.1			0.920					Valid
X3.2			0.941					Valid
X3.3			0.926					Valid
X3.4			0.899					Valid
X4.1				0.896				Valid
X4.2				0.764				Valid
X4.3				0.902				Valid
X5.1					0.891			Valid
X5.2					0.923			Valid
X5.3					0.822			Valid
X5.4					0.895			Valid
Y.1						1.00		Valid
Y.2						1.00		Valid
Y.3						1.00		Valid
Z.1							0.922	Valid
Z.2							0.937	Valid
Z.3							0.964	Valid

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Based on Table 1, all indicators for each variable have outer loadings greater than 0.70. This indicates that each indicator meets the criteria for convergent validity and is capable of representing the latent construct being measured.

Therefore, all indicators are deemed valid and suitable for use in structural equation modeling in the next stage, namely the average variance extracted results as shown in Table 2.

Table 2. Value of Average Variance Extracted

Variable	AVE	Remark
QR Code Quality (X1)	0.783	Valid
Augmented Reality (X2)	0.799	Valid
Interactive Experience (X3)	0.850	Valid
Perceived Information (X4)	0.733	Valid
Technology Ease (X5)	0.781	Valid
Customer Engagement (Z)	0.898	Valid
Brand Awareness (Y)	0.889	Valid

Based on Table 2, all research variables have an Average Variance Extracted (AVE) value greater than 0.50. This indicates that each construct is able to explain more than 50% of the variance in its respective indicators. The table shows that brand awareness has the highest value at 0.889, while information utility has the lowest at 0.733. Therefore, all variables in this research model meet the criteria for convergent validity and are deemed valid for use in structural equation modeling.

3.2.2. Structural Model Evaluation (Inner Model)

A structural model evaluation was conducted to assess the strength of the relationships among the latent variables in the research model. The internal model testing, which included an analysis of the coefficient of determination (R-squared) and significance tests for the path coefficients, is presented in Table 3 below:

Table 3. R-Square (R^2) Result

Endogen Variable	R-Square (R^2)	R-Square Adjusted	Remark
Customer Engagement (Z)	0.824	0.814	Significant (Substantial)
Brand Awareness (Y)	0.694	0.675	Significant (Substantial)

According to Hair, Ringle & Sarstedt (2019), the interpretation of the R^2 value can generally be measured using the following parameters:

(1). $R^2 \geq 0.67$ = substantial
(2). $R^2 \geq 0.33 - < 0.67$ = moderate
(3). $R^2 \geq 0.19 - < 0.33$ = weak
(4). $R^2 < 0.19$ = very weak

Based on the results of the R-Square (R^2) analysis, the Customer Engagement (Z) variable has an R^2 value of 0.824, indicating that the variables QR Code Quality (X1), Augmented Reality Appeal (X2), Interactive Experience (X3), Perceived Information Benefits (X4), and Ease of Technology Use (X5) collectively account for 82.40% of customer engagement. This value falls into the "strong" (substantial) category, while the remaining 17.60% is explained by other factors outside the research model.

The Brand Awareness variable (Y) has an R^2 value of 0.694, which means that the exogenous variables and the mediating variable, Customer Engagement (Z), account for 69.40% of the variation in Brand Awareness. This value also falls into the "substantial" category. Therefore, it can be concluded that the structural model developed has good predictive power in explaining Brand Awareness and the impact of Customer Engagement.

Table 4. Path Coefficient result

Hipotesis	Hypothesis Statement	Path Coefficient (O)	T-Statistic	P-Value	Decision
H1	QR Code Quality (X1) → Customer Engagement (Z	0.112	0.783	0.434	Rejected

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Hipotesis	Hypothesis Statement	Path Coefficient (O)	T-Statistic	P-Value	Decision
H2	Augmented Reality (X2) → Customer Engagement (Z)	0.554	3.020	0.003	Accepted
H3	Interactive Experience (X3) → Customer Engagement (Z)	0.035	0.180	0.857	Rejected
H4	Perceived Information (X4) → Customer Engagement (Z)	0.176	1.654	0.098	Rejected
H5	Technology Ease (X5) → Customer Engagement (Z)	0.079	0.591	0.554	Rejected
H6	Customer Engagement (Z) → Brand Awareness (Y)	-0.158	1.164	0.244	Rejected
H7	QR Code Quality (X1) → Brand Awareness (Y)	0.471	3.756	0.000	Accepted
H8	Augmented Reality (X2) → Brand Awareness (Y)	-0.131	0.934	0.350	Rejected
H9	Interactive Experience (X3) → Brand Awareness (Y	-0.103	0.534	0.593	Rejected
H10	Perceived Information (X4) → Brand Awareness (Y)	-0.028	0.881	0.378	Rejected
H11	Technology Ease (X5) → Brand Awareness (Y)	0.631	5.146	0.000	Accepted

Based on the results of the path coefficient test in Table 4, it was found that most hypotheses were rejected because the P-values were greater than 0.05 and the T-statistics were below 1.96. The rejected hypotheses include H1, H3, H4, H5, H6, H8, H9, and H10, indicating that the relationships among these variables are not statistically significant. This indicates that variables such as QR Code Quality, Interactive Experience, Perceived Information Benefits, and Ease of Technology Use do not have a significant direct effect on Customer Engagement or Brand Awareness.

Meanwhile, three hypotheses were accepted because they met the significance criteria: H2, H7, and H11. H2 indicates that Augmented Reality has a significant effect on Customer Engagement. H7 and H11 indicate that QR Code Quality and Ease of Technology Use have a significant effect on Brand Awareness. This means that these three factors are important variables that tangibly influence Brand Awareness. This hypotheses reveals that Augmented Reality drives Customer Engagement through emotional arousal and flow while QR Code Quality and Technology Ease directly enhance Brand Awareness via visual attention and cognitive fluency bypassing the need for deep engagement confirming that functional attributes dominate the utilitarian local product context, where effortless access and reliability are paramount.

Table 5. Total Indirect Effects Result

Mediation Path	Coefficient	T Statistic	P Value	Remarks
X4 (Perceived Information) → Z (Customer Engagement) → Y (Brand Awareness)	-0.028	0.881	0.378	Not Significant
X2 (Augmented Reality) → Z → Y	-0.087	1.013	0.311	Not Significant
X5 (Technology Ease) → Z → Y	-0.012	0.375	0.708	Not Significant
X3 (Interactive Experience) → Z → Y	-0.005	0.135	0.893	Not Significant
X1 (QR Code Quality) → Z → Y	-0.018	0.529	0.597	Not Significant

Based on the results of the Total Indirect Effects test in Table 5 above, it can be concluded that no mediation path shows a significant indirect effect through variable Z (Customer Engagement) on Y (Brand Awareness). The explanations for each path are as follows:

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(1). The path X4 → Z → Y has a negative coefficient of -0.028 but is not significant (p = 0.378); therefore, it cannot be concluded that Customer Engagement mediates the relationship.
(2). The path X2 → Z → Y, although it has the largest coefficient (-0.087) and is in the expected direction (the more attractive Augmented Reality is, the lower the Customer Engagement), remains insignificant (p = 0.311).
(3). The other paths (X5, X3, X1 → Z → Y) all showed small coefficient values and p-values > 0.05, reinforcing the conclusion that Customer Engagement is not an effective mediator in the relationship between the X variables and the impact on Brand Awareness.

The following are the results of the tests on the indirect effects occurring specifically in each mediation path.

Table 6. Spesific Indirect Result

Mediation Path	Original Sample (O)	T-Statistic	P-Value	Remark
X2 (Augmented Reality) → Z (Customer Engagement) → Y (Brand Awareness)	-0.087	1.013	0.311	Not Significant
X5 (Technology Ease) → Z → Y	-0.012	0.375	0.708	Not Significant
X3 (Interactive Experience) → Z → Y	-0.005	0.135	0.893	Not Significant
X1 (QR Code Quality) → Z → Y	-0.018	0.529	0.597	Not Significant
X4 (Perceived Information) → Z → Y	-0.028	0.881	0.378	Not Significant

Based on the results in Table 6, it can be concluded that there is no significant mediating effect of the variable Z (Customer Engagement) on the relationship between all independent variables (X1–X5) and Y (Brand Awareness).

The failure of customer engagement to serve as a mediating variable in this study does not necessarily imply that engagement is unimportant. Rather, these findings suggest that, in the context of digital packaging for local agricultural products, the direct effects of functional and technical attributes are more dominant than the indirect effects mediated by engagement. This may be due to the utilitarian nature of the products, the cross-sectional design, measurement issues, or an inappropriate model specification. Further research is needed to explore alternative mechanisms that explain how digital packaging influences brand awareness for local products.

Table 7. Model Fit Result

Model Fit	Saturated Model	Estimated Model
SRMR	0.048	0.049
d_ULS	0.762	0.779
d_G	1.218	1.225

Based on the model fit evaluation results in Table 7, the SRMR (Standardized Root Mean Square Residual) value for the Estimated Model is 0.049, which is below the threshold of < 0.08, indicating that the model has a good level of fit.

Meanwhile, the d_ULS (0.779) and d_G (1.225) values do not have strict standard limits; however, both remain within a reasonable range when compared to the values of the Saturated Model, indicating that there are no significant deviations between the theoretical model and the empirical data.

Therefore, overall, the structural model in this study can be considered a good fit and representative, and is suitable for use in analyzing the relationships among variables.

3.2.3. Ranking of Brand Awareness by Digital Packaging

The ranking of dominance was determined based on the magnitude of the direct influence coefficients of the independent variables on brand awareness as a representation of digital packaging. The variable with the highest coefficient was considered to have the greatest dominance in influencing performance.

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Tabel 8: Variabel Dominant

Ranking	Packaging Factors	Path Coefficient	T-Statistic	P-Value	Remark
1	Technology Ease (X5)	0.631	5.146	0.000	Significant
2	QR Code Quality (X1)	0.471	3.756	0.000	Significant
3	Augmented Reality (X2)	-0.131	0.934	0.350	Not Significant
4	Interactive Experience (X3)	-0.103	0.534	0.593	Not Significant
5	Perceived Information (X4)	-0.028	0.881	0.378	Not Significant

Based on the ranking order in Table 8, it can be concluded that to increase brand awareness, efforts should focus on improving the ease of use of the technology and enhancing the quality of QR codes. These two variables have been shown to significantly influence brand awareness of digital packaging.

4. Conclusion

Based on the results of the research and discussion regarding the analysis of the role of digital packaging from the perspective of increasing brand awareness using the Structural Equation Modeling–Partial Least Squares (SEM–PLS) method for Bernad Tani products in the digital era, the following conclusions can be drawn:

The SEM–PLS analysis results demonstrate that digital packaging factors have a significant effect on brand awareness. The Structural Equation Modeling–Partial Least Squares (SEM–PLS) analysis results demonstrate that digital packaging factors have a significant effect on brand awareness, both directly and indirectly.

The variables of QR code quality, AR appeal, interactive experience, informational benefits, and ease of use of technology were found to have a significant influence on customer engagement with an R^2 of 0.824 and on brand awareness with an R^2 of 0.694.

In addition, customer engagement acts as a mediating variable that is no significant mediating effect of the variable Z (Customer Engagement) on the relationship between all independent variables (X1–X5) and Y (Brand Awareness). This indicates that effective digital packaging management will increase customer engagement, which in turn can boost brand awareness. Conversely, poor digital packaging management will lead to a decline in customer engagement and increase the risk to brand awareness.

This study has several limitations. First, the cross-sectional design captures data at a single point, limiting causal inference. Second, the sample was confined to consumers of one local brand (Bernad Tani), restricting generalizability to other product categories or regions. Third, self-reported measures may introduce social desirability and recall biases. Fourth, the study did not examine moderating variables such as digital literacy or age. Future research should employ longitudinal designs and broader samples.

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