Virtual Influencers and Digital Engagement: Key Insights from Indonesia's Younger Consumers

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Abstract – This study addresses a critical gap in digital marketing by examining the impact of virtual influencers on consumer engagement, focusing on Gen Z and Gen Y in Indonesia's Jabodetabek region. While virtual influencers are gaining traction globally and locally, limited research has explored the factors that drive consumer interaction in diverse, digitally evolving markets like Indonesia. This study investigates the roles of perceived authenticity, content quality, and technological sophistication, with a particular emphasis on the moderating effect of digital literacy—a factor often overlooked in previous research. Data from 179 respondents were analyzed using Structural Equation Modeling (SEM) with SmartPLS. The findings reveal that perceived authenticity, content quality, and technological sophistication significantly enhance consumer engagement with virtual influencers, especially among digitally literate consumers. Digital literacy plays a critical moderating role, amplifying the impact of these influencer attributes and highlighting the importance of digital fluency in consumer interactions with advanced digital personas. These insights offer a theoretical contribution to the literature on influencer marketing and provide practical guidance for Indonesian brands seeking to connect with younger, tech-savvy audiences. By prioritizing authenticity, high-quality content, and appropriate technological sophistication, brands can strategically leverage virtual influencers to cultivate deeper, more meaningful engagement in Indonesia's rapidly evolving digital landscape.

Keywords: virtual influencers, consumer engagement, perceived authenticity, content quality, technological sophistication, digital literacy.

Abstrak – Penelitian ini celah penting dalam pemasaran digital dengan mengkaji dampak *influencer virtual* terhadap keterlibatan konsumen, khususnya di kalangan Gen Z dan Gen Y di wilayah Jabodetabek, Indonesia. Meskipun *influencer virtual* semakin populer secara global dan lokal, penelitian masih terbatas dalam mengeksplorasi faktor-faktor yang mendorong interaksi konsumen di pasar yang beragam dan terus berkembang secara digital seperti Indonesia. Studi ini meneliti peran persepsi autentisitas, kualitas konten, dan kecanggihan teknologi dengan penekanan khusus pada efek moderasi literasi digital—faktor yang sering diabaikan dalam penelitian sebelumnya. Data dari 179 responden dianalisis menggunakan *Structural Equation Modeling* (SEM) dengan SmartPLS. Hasilnya menunjukkan bahwa persepsi autentisitas, kualitas konten, dan kecanggihan teknologi secara signifikan meningkatkan keterlibatan konsumen dengan influencer virtual, terutama di kalangan konsumen yang memiliki literasi digital tinggi. Literasi digital memainkan peran moderasi yang krusial, memperkuat dampak atribut-atribut influencer tersebut dan menyoroti pentingnya kecakapan digital dalam interaksi konsumen dengan persona digital yang canggih. Temuan ini memberikan kontribusi teoritis pada literatur pemasaran *influencer* dan menawarkan panduan praktis bagi merek-merek di Indonesia yang ingin terhubung dengan audiens muda yang melek teknologi. Dengan memprioritaskan autentisitas, konten berkualitas tinggi, dan kecanggihan teknologi yang sesuai, merek dapat memanfaatkan *influencer virtual* secara strategis untuk membangun keterlibatan yang lebih mendalam dan bermakna dalam lanskap digital Indonesia yang terus berkembang.

Kata kunci: influencer virtual, keterlibatan konsumen, persepsi keaslian, kualitas konten, kecanggihan teknologi, literasi digital.

INTRODUCTION

The rapid development of digital technology has significantly transformed the landscape of marketing, particularly with the rise of virtual influencers—computer-generated characters that act like human

influencers on social media platforms. Globally, the virtual influencer industry has seen rapid growth, with estimates showing that by 2023, there were over 150 active virtual influencers across social media platforms (HypeAuditor, 2023). Virtual influencers are being utilized by global brands for their ability to engage younger, tech-savvy audiences with lower risk of scandals and full control over their image and messaging. In fact, brands like Louis Vuitton, Samsung, and Prada have successfully integrated virtual influencers into their campaigns, driving substantial engagement and enhancing brand perception (Belanche et al., 2020). By 2024, virtual influencers are expected to generate a 30% increase in digital campaign effectiveness, particularly in sectors like fashion, technology, and beauty (Statista, 2023).

In Indonesia, where social media penetration reached 77% of the population in 2023 (We Are Social, 2023), the adoption of virtual influencers is gaining traction, particularly in major urban centers like Jabodetabek. The rise of local virtual influencers such as Rara and Nadira has begun to reshape the way brands approach digital marketing in Indonesia. With Gen Z and Gen Y accounting for roughly 53% of Indonesia's population (BPS, 2023), these groups represent a crucial market segment for brands seeking to engage digitally native consumers. Previous studies have highlighted that Gen Z and Gen Y in Indonesia tend to prioritize authenticity and interactive content in their digital consumption (Leung et al., 2021). Despite the growing use of virtual influencers in Indonesia, research on their impact on consumer behavior remains sparse, particularly concerning their authenticity, content quality, and technological sophistication. This gap in the literature presents an urgent need for further exploration.

The urgency of this research stems from the need to better understand how virtual influencers affect consumer engagement in Indonesia, where the digital marketing landscape is evolving rapidly. Virtual influencers have the unique ability to tailor content precisely to audience preferences, offering brands a scalable and controllable alternative to human influencers. However, for virtual influencers to be effective, they must be perceived as authentic and produce content that resonates with consumers. Previous research has shown that authenticity, even when projected by digital entities, is a critical factor in driving consumer trust and engagement (Sung et al., 2021; Belanche et al., 2021). Furthermore, the influence of digital literacy—which varies widely across Indonesia—on consumer engagement with virtual influencers remains underexplored. This research is essential for understanding the relationship between virtual influencer characteristics and their effectiveness in engaging the Indonesian consumer market, particularly in urban areas where digital literacy is higher. This study builds on prior research by examining the impact of virtual influencers on consumer behavior, focusing on variables such as perceived authenticity, content quality, technological sophistication, and digital literacy as a moderating factor. While prior studies (e.g., Schwemmer & Ziewiecki, 2018; Djafarova & Trofimenko, 2019) have explored virtual influencers in global contexts, this research differentiates itself by focusing on the Indonesian context, investigating how virtual influencer characteristics—such as perceived authenticity, content quality, and technological sophistication—affect consumer behavior. It will also explore the moderating role of digital literacy in urban areas where such literacy is higher.

By offering localized insights, this study aims to fill the existing research gap by providing empirical data on the effectiveness of virtual influencers within the unique cultural and economic landscape of Indonesia. Specifically, it seeks to enhance our understanding of how local consumer attitudes towards virtual influencers differ from those in Western contexts, particularly regarding their perceptions of authenticity and engagement. Furthermore, by examining the influence of digital literacy on consumer interactions with virtual influencers, this research will provide valuable implications for marketers looking to tailor their strategies to better resonate with Indonesian audiences. Ultimately, this study aims to contribute to both the academic literature on digital marketing and practical strategies for Indonesian brands, fostering brand loyalty and growth in an increasingly digitalized marketplace. This localized perspective will not only aid brands in developing more effective campaigns but also foster brand loyalty and growth in an increasingly digitalized marketplace, thereby enriching the broader discourse on digital marketing strategies in diverse cultural contexts.

Virtual Influencer

Virtual influencers are increasingly becoming a significant facet of digital marketing, reflecting a shift in consumer engagement strategies from traditional human influencers to AI-generated personas. These digital entities, characterized by their highly curated and brand-aligned appearances, offer brands enhanced control over their image and messaging, thus addressing issues related to human influencers such as

inconsistent personas or scandal risks (Schouten et al., 2020). Recent studies emphasize that the effectiveness of virtual influencers hinges on their perceived authenticity, with consumers responding more favorably when these digital characters exhibit consistent and transparent interactions (Belanche et al., 2021). Furthermore, the quality of content and the technological sophistication of virtual influencers, including features like 3D animation and augmented reality, play crucial roles in maintaining engagement and relevance (Wang et al., 2022). As digital literacy evolves, understanding how these elements influence consumer behavior becomes increasingly critical, especially in dynamic markets like Indonesia, where younger, tech-savvy audiences are driving digital trends (Leung et al., 2021; Hughes et al., 2019). This evolving landscape underscores the need for continued research into the effectiveness of virtual influencers in various cultural and technological contexts.

Perceived Authenticity of Virtual Influencers

Perceived authenticity is a key factor in influencer marketing, directly impacting consumer engagement by building emotional connections and trust. For virtual influencers, authenticity is established through consistent narratives, relatable storytelling, and visually appealing personas that resonate with the target audience (Djafarova & Trofimenko, 2019; Leung et al., 2021). Despite their artificial nature, virtual influencers can mimic real human experiences, and when their content aligns with the values or aspirations of consumers, particularly among Gen Z and Gen Y, it fosters a sense of loyalty and attachment (Sung et al., 2021). This perceived authenticity transforms the virtual influencer from just a digital entity into a relatable figure, driving consumers to engage more actively. Therefore, the more authentic consumers perceive a virtual influencer to be, the stronger their engagement becomes.

H1: Perceived authenticity of virtual influencers positively influences consumer engagement.

Content Quality

Content quality is widely recognized as a crucial factor influencing consumer engagement, with high-quality content enhancing consumer interaction and strengthening brand alignment (Hughes et al., 2019). Quality content is typically characterized by creativity, relevance, and technical proficiency, which together make the content more appealing and relatable to consumers. In the realm of virtual influencers, recent studies highlight that sophisticated visuals, immersive storytelling, and overall polished content significantly enhance the audience's interest and interaction (Schouten et al., 2020). When virtual influencers produce high-quality content, it acts as an effective medium that resonates with the audience, making marketing messages more compelling and memorable (Kim & Song, 2022). This quality not only draws the audience's attention but also builds a sense of professionalism and credibility, thereby fostering deeper consumer engagement. Hence, content quality serves as a bridge, connecting virtual influencers with their audience and enhancing the effectiveness of their engagement strategies.

H2: Higher content quality produced by virtual influencers positively influences consumer engagement.

Technological Sophistication

Technological sophistication, encompassing advanced AI and realistic animations, plays a critical role in the effectiveness of virtual influencers. Recent research suggests that virtual influencers designed with cutting-edge technology are more successful in capturing consumer attention and maintaining engagement due to their high levels of realism and interactivity (Choi & Sung, 2021). As technology evolves, these virtual influencers can increasingly mimic human-like behaviors, emotions, and interactions, thereby enhancing their appeal and the depth of consumer engagement (Wang et al., 2022). This sophistication not only makes virtual influencers more relatable but also reinforces consumer perceptions of their reliability and uniqueness, which in turn strengthens brand engagement (Belanche et al., 2021). Thus, technological advancement serves as a vital element in creating a more immersive and engaging experience for consumers.

H3: Higher technological sophistication of virtual influencers leads to higher consumer engagement.

Moderating Variable: Digital Literacy

Digital literacy plays a crucial role in moderating the relationship between virtual influencer characteristics—such as perceived authenticity, content quality, and technological sophistication—and

consumer engagement. Consumers with higher levels of digital literacy are more capable of understanding the advanced technologies behind virtual influencers, like AI and 3D animation. This deeper understanding allows them to appreciate the intricacies of the content, making them more likely to engage with virtual influencers. Furthermore, their ability to critically assess content quality and authenticity strengthens the positive effects of these factors on engagement, as they are more discerning in recognizing genuine and high-quality digital content (Chuah et al., 2021; Park & Kang, 2020). On the other hand, consumers with lower digital literacy may find it difficult to grasp the technological aspects of virtual influencers, which can reduce their engagement. They may also struggle to distinguish between authentic and inauthentic digital personas, further diminishing their interaction with such content. As a result, digital literacy acts as a key moderator, where higher literacy enhances the relationship between virtual influencer attributes and consumer engagement, while lower literacy weakens this connection (Nguyen et al., 2021; Wardhana & Yulia, 2020). Thus, the effectiveness of virtual influencers in engaging consumers depends significantly on the consumers' level of digital literacy.

H4: Digital literacy moderates the relationship between perceived authenticity, content quality, technological sophistication, and consumer engagement, such that the relationship is stronger for consumers with higher digital literacy.
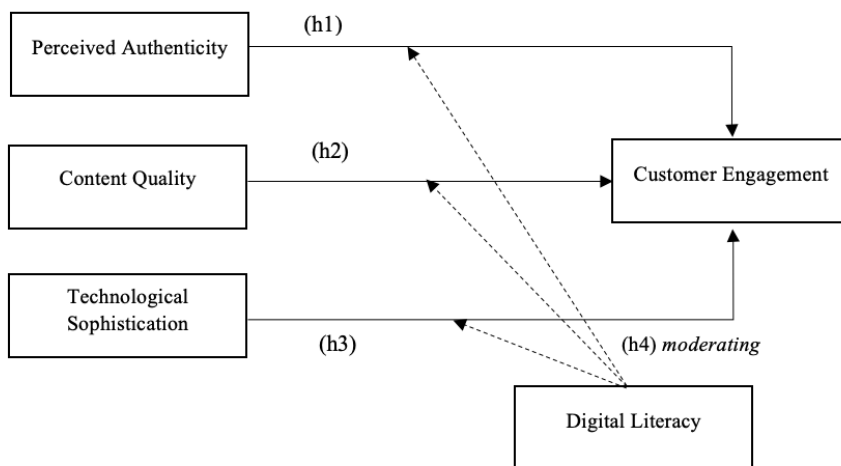

Figure 1. Research framework

This study builds on existing theories of consumer engagement by integrating psychological factors (perceived authenticity), content-related attributes (content quality), technological aspects (technological sophistication), and consumer characteristics (digital literacy) into a comprehensive framework for understanding engagement with virtual influencers. The theoretical model developed confirms that perceived authenticity (Djafarova & Trofimenko, 2019; Leung et al., 2021), content quality (Schouten et al., 2020; Kim & Song, 2022), and technological sophistication (Choi & Sung, 2021; Wang et al., 2022) are significant drivers of consumer engagement in the context of virtual influencers. Furthermore, the moderating role of digital literacy is emphasized, revealing that consumers with higher digital literacy levels are more likely to engage with virtual influencers when they perceive authenticity, high-quality content, and advanced technological features (Wardhana & Yulia, 2020; Chuah et al., 2021; Park & Kang, 2020). This framework extends prior research by highlighting the interactive effects of digital literacy on virtual influencer marketing, suggesting that brands should strategically align their digital content and technological efforts with the digital proficiency of their target audience to maximize consumer engagement.

METHOD

This study utilizes a quantitative research approach with Structural Equation Modeling (SEM) using SmartPLS to analyze the effects of virtual influencers on consumer engagement among Gen Z and Gen Y demographics in the Jabodetabek area. Data was collected from 179 respondents using a Google Forms online questionnaire, employing a Likert scale of 1-7 to measure the variables.

Table 1. Matrix operational definition

Variable	Definition	Indicators	Source
Perceived Authenticity	The extent to which virtual influencers are perceived as genuine and trustworthy by consumers.	Consistency of virtual influencer personas, perceived transparency in content delivery, trustworthiness in brand endorsements.	Sung et al., 2021; Belanche et al., 2021
Content Quality	The perceived excellence and relevance of content produced by virtual influencers.	Visual appeal of content, creativity and uniqueness, relevance to audience interests.	Hughes et al., 2019; Schouten et al., 2020
Technological Sophistication	The degree to which virtual influencers utilize advanced digital technologies.	Use of AI-driven interactions, 3D animation quality, integration of augmented reality (AR) features.	Belanche et al., 2020; Wang et al., 2022
Digital Literacy	The ability of consumers to effectively use and navigate digital technologies.	Understanding of AI concepts, proficiency in using social media platforms, digital engagement habits.	Chuah et al., 2021; Nguyen et al., 2021
Consumer Engagement	The level of interaction and emotional connection between consumers and virtual influencers.	Frequency of interaction with virtual influencer content, depth of emotional response elicited, intention to engage further.	Leung et al., 2021; Djafarova & Trofimenko, 2019

The study adopts a cross-sectional design to capture the relationships between perceived authenticity, content quality, technological sophistication, and consumer engagement, with digital literacy as a moderating variable (Hair et al., 2017). Respondents, selected using purposive sampling, consisted of Generation Z (born 1997–2012) and Generation Y (Millennials, born 1981–1996) who have been exposed to virtual influencers on social media. The demographic profile of respondents was captured using a series of questions on age, gender, occupation, social media usage, platform preference, exposure to virtual influencers, and interaction frequency with virtual influencers. This information allows the study to better understand the respondent characteristics and provide context for how these demographics interact with virtual influencer content. The research leverages SEM to test the hypotheses and explore the moderating effects of digital literacy in virtual influencer effectiveness (Ramayah et al., 2018)

RESULTS AND DISCUSSION

Respondent Characteristics

The demographic characteristics and social media habits of the 179 respondents exposed to virtual influencers, as detailed in Table 2, provide crucial insights into the target audience. Notably, a significant portion of the sample consists of younger consumers, with Gen-Z (18-24 years) comprising 62.5% of the respondents. This indicates a strong engagement among the youth demographic with digital content, particularly virtual influencers. Additionally, the gender distribution shows a slight skew towards female respondents (57.6%), while students represent the largest occupational group at 46.9%. This concentration of younger, predominantly female students suggests that this demographic is particularly receptive to digital marketing strategies involving virtual influencers, highlighting the importance of tailoring content to resonate with their preferences and behaviors.

Table 2 offers several important insights into the social media behavior and platform preferences of consumers who have interacted with virtual influencers. A substantial portion of respondents (41.9%) spend 3-5 hours daily on social media, reflecting a high level of digital engagement. This trend underscores the rising influence of virtual influencers in shaping consumer preferences, particularly among younger, digitally active audiences. Instagram, which is the preferred platform for 54.7% of respondents, emerges as the dominant space for interacting with virtual influencers in Indonesia, reinforcing its role as a key channel for digital marketing. Furthermore, TikTok, chosen by 20.1% of respondents, highlights the growing popularity of video-based, short-form content, which is becoming an essential medium for engaging users, especially when it comes to virtual influencer marketing.

The strong engagement on platforms like Instagram and TikTok signals that brands aiming to capitalize on virtual influencer marketing should focus their efforts on these platforms to effectively reach younger, digitally literate consumers. The fact that such a large portion of respondents is concentrated in

these two platforms highlights their centrality in the virtual influencer ecosystem. As both platforms emphasize visual content and dynamic engagement, they offer brands opportunities to develop more interactive and appealing campaigns that resonate with the lifestyle of these consumers. Additionally, the heavy usage of social media by this demographic underscores their openness to digital personalities, presenting a fertile ground for brands to cultivate influence and drive purchasing decisions.

Table 2. Respondent characteristics

| Respondent Characteristics	Categories	Frequency (n=179)	Percentage (%)
Age Group	Gen-Z (18-24 years)	112	62.5%
	Gen-Y (25-40 years)	67	37.5%
Gender	Male	76	42.4%
	Female	103	57.6%
Occupation	Student	84	46.9%
	Employed - Full-time	64	35.8%
	Employed - Part-time	31	17.3%
Social Media Usage	Less than 1 hour per day	20	11.2%
	1-3 hours per day	45	25.1%
	3-5 hours per day	75	41.9%
	More than 5 hours per day	39	21.8%
Platform Preference	Instagram	98	54.7%
	TikTok	36	20.1%
	YouTube	22	12.3%
	Twitter	11	6.1%
	Facebook	12	6.7%
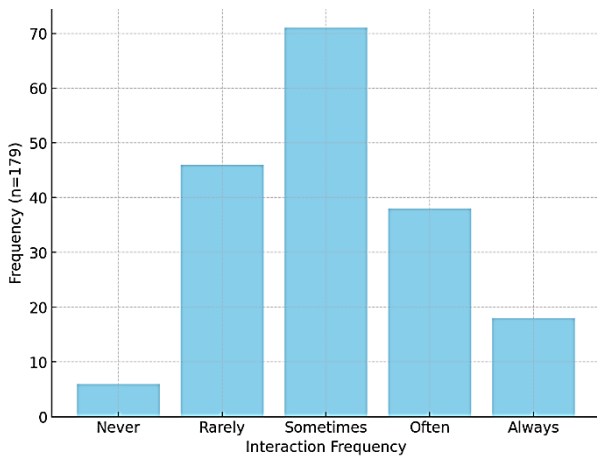
Figure 2. Frequency of interaction with virtual influencer

Figure 2 supports these findings by illustrating how frequently respondents interact with virtual influencers. The majority of respondents (39.7%) engage with virtual influencers "sometimes," indicating that while virtual influencers are a regular part of their digital experience, they are not overwhelming. A significant portion (31.3%) interacts "often" or "always," demonstrating a strong affinity among these users for virtual influencers. In contrast, only 3.4% of respondents have never interacted with virtual influencers, highlighting their pervasive presence in the social media ecosystem. These insights from Figure 2 emphasize the growing prominence of virtual influencers in the digital marketing space, where their ability to engage users and influence consumer behavior is becoming increasingly impactful.

Descriptive Statistics

The Table 3 presents descriptive statistics for the key variables analyzed in this study: Perceived Authenticity, Content Quality, Technological Sophistication, Digital Literacy, and Consumer Engagement. Each variable is measured using multiple indicators, with the means and standard deviations reflecting participants' responses. For instance, indicators such as "Consistency of virtual influencer personas" and

"Trustworthiness in brand endorsements" gauge perceived authenticity, while "Visual appeal of content" and "Creativity and uniqueness" measure content quality. This detailed measurement approach is critical for understanding the nuanced factors that influence audience perceptions and engagement with virtual influencers (Hair et al., 2019).

Table 3. Descriptive statistics table

Variable	Indicator	Mean (n=179)	Standard Deviation (n=179)
Perceived Authenticity	Consistency of virtual influencer personas	4.12	0.63
	Perceived transparency in content delivery	3.98	0.70
	Trustworthiness in brand endorsements	4.25	0.60
Content Quality	Visual appeal of content	4.30	0.58
	Creativity and uniqueness	4.15	0.66
	Relevance to audience interests	4.08	0.68
Technological Sophistication	Use of AI-driven interactions	4.05	0.65
	3D animation quality	3.95	0.67
	Integration of augmented reality (AR) features	3.90	0.74
Digital Literacy	Understanding of AI concepts	4.22	0.56
	Proficiency in using social media platforms	4.10	0.62
	Digital engagement habits	4.00	0.73
Consumer Engagement	Frequency of interaction with virtual influencers	4.18	0.64
	Depth of emotional response elicited	4.12	0.67
	Intention to engage further	4.05	0.65

By examining the mean values in Table 3, which generally fall above 4.00 on a 5-point scale, it becomes clear that respondents have a favorable perception of virtual influencers across key dimensions such as Perceived Authenticity, Content Quality, and Technological Sophistication. The low standard deviations reflect minimal variation in responses, indicating consistent perceptions among participants. This consistency in measurement strengthens the reliability of the study's findings, ensuring that it accurately captures the complex relationships between technology, content quality, and consumer engagement with virtual influencers. Furthermore, this alignment with established theoretical frameworks (Gefen et al., 2003) supports the robustness of the constructs being assessed in the study.

Validity and Reliability Test

The Table 4 presents the results of the validity testing for the research variables, which assesses the robustness and accuracy of the measurement instruments used in this study. It includes key metrics such as factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR) for each variable and its indicators. These metrics are essential for confirming the construct validity and reliability of the variables related to perceived authenticity, content quality, technological sophistication, digital literacy, and consumer engagement (Hair et al., 2019; Fornell & Larcker, 1981). Factor loadings indicate how well each indicator measures its corresponding latent variable, while AVE and CR provide insights into the convergent validity and internal consistency of the constructs, respectively. These validity measures ensure that the constructs are accurately represented and reliably assessed in the context of the study (Gefen et al., 2003; Bagozzi & Yi, 1988).

Table 4 presents the results of the evaluations for Average Variance Extracted (AVE) and Composite Reliability (CR), which are essential for confirming the validity of the constructs in this study. As outlined by Hair et al. (2019), the loading factor values are all above the ideal threshold of 0.70, demonstrating strong construct validity and ensuring that each indicator effectively measures its corresponding latent variable. The AVE values, which reflect the proportion of variance captured by each construct from its indicators, exceed the recommended threshold of 0.50, thereby confirming satisfactory convergent validity (Fornell & Larcker, 1981). Additionally, the Composite Reliability values are all above 0.70, indicating high internal consistency and reinforcing that the indicators consistently measure their respective latent variables (Bagozzi & Yi, 1988). Collectively, these metrics presented in Table 4 enhance the reliability and accuracy of the constructs used in this research, providing a solid foundation for further analysis.

Table 4. Validity and reliability test

Variable	Indicator	Loading Factor	AVE	CR
Perceived Authenticity	Consistency of virtual influencer personas	0.82	0.63	0.84
	Perceived transparency in content delivery	0.76		
	Trustworthiness in brand endorsements	0.80		
Content Quality	Visual appeal of content	0.85	0.66	0.85
	Creativity and uniqueness	0.80		
	Relevance to audience interests	0.78		
Technological Sophistication	Use of AI-driven interactions	0.81	0.64	0.84
	3D animation quality	0.79		
	Integration of augmented reality (AR) features	0.77		
Digital Literacy	Understanding of AI concepts	0.84	0.67	0.88
	Proficiency in using social media platforms	0.79		
	Digital engagement habits	0.77		
Consumer Engagement	Frequency of interaction with virtual influencers	0.82	0.63	0.83
	Depth of emotional response elicited	0.78		
	Intention to engage further	0.75		

The Fornell-Larcker Criterion further evaluates discriminant validity among the study's constructs, which include Perceived Authenticity, Content Quality, Technological Sophistication, Digital Literacy, and Consumer Engagement. Discriminant validity confirms that each construct is distinct and not significantly correlated with others in the model, ensuring that each variable measures what it is intended to measure uniquely (Fornell & Larcker, 1981). In the table, the diagonal values represent the square roots of the AVE for each construct and are compared to the off-diagonal values, which indicate correlations between different constructs. When the diagonal values are higher than the off-diagonal correlations in their respective rows and columns, it indicates adequate discriminant validity. In this study, all constructs satisfy this criterion, validating that they are sufficiently distinct from each other and confirming the effectiveness of the measurement model used (Hair et al., 2019).

Table 5. Fornell-Larcker criterion

Variable	Perceived Authenticity	Content Quality	Technological Sophistication	Digital Literacy	Consumer Engagement
Perceived Authenticity	0.79	0.62	0.58	0.54	0.59
Content Quality	0.62	0.81	0.65	0.60	0.62
Technological Sophistication	0.58	0.65	0.80	0.63	0.60
Digital Literacy	0.54	0.60	0.63	0.82	0.65
Consumer Engagement	0.59	0.62	0.60	0.65	0.79

Table 5 illustrates the discriminant validity of the constructs by comparing the diagonal values (square roots of AVE) with the off-diagonal correlations in their respective rows and columns. As per the criterion, the diagonal values must exceed the off-diagonal correlations to confirm adequate discriminant validity. In this table, all diagonal values are greater than the corresponding off-diagonal values, affirming that the constructs are distinct and do not overlap with each other. This finding strengthens the reliability of the measurement model, confirming that each construct is more closely related to its own indicators than to those of other constructs, as outlined by Hair et al. (2019). The results in Table 5 validate the theoretical distinction between the constructs, ensuring that the measurement approach used in this study is robust and accurate.

Hypotheses Testing

The SEM Metrics Results provide essential insights into the model's fit and predictive capabilities used in this study. The Standardized Root Mean Square Residual (SRMR) values for both the saturated model (0.08) and the estimated model (0.07) are below the commonly accepted threshold of 0.08, indicating that the model fits well with the observed data. This suggests that the discrepancies between the predicted and actual correlations are minimal, reflecting an accurate model representation. Additionally, the Normed Fit Index (NFI) values for the saturated model (0.90) and the estimated model (0.88) are close to 1.0, further confirming the model's robustness.

Table 6. SEM metrics results

Metric	Value
SRMR (Saturated Model)	0.08
SRMR (Estimated Model)	0.07
NFI (Saturated Model)	0.90
NFI (Estimated Model)	0.88
Coefficient of Determination (R^2)	0.53
Predictive Relevance (Q^2)	0.46

Table 6 presents the Coefficient of Determination (R^2) and Predictive Relevance (Q^2) for the model analyzed in this study. The R^2 value of 0.53 indicates that 53% of the variance in the dependent variable, consumer engagement, is explained by the independent variables in the model. This demonstrates a strong explanatory power, suggesting that the model effectively captures the key factors influencing consumer engagement with virtual influencers. Additionally, the Q^2 value of 0.46 indicates good predictive capability, implying that the model can reliably forecast consumer engagement based on the characteristics of virtual influencers and the levels of digital literacy among respondents. These findings, as outlined in Table 6, confirm that the model not only fits the data well but also possesses solid predictive relevance for understanding future consumer engagement outcomes.

Table 7 presents the results of the hypothesis testing, highlighting the significant impact of key variables—Perceived Authenticity, Content Quality, Technological Sophistication, and Digital Literacy—on Consumer Engagement with virtual influencers. Perceived Authenticity shows a positive effect of 0.35, with a highly significant T-value of 4.58 and a P-value of 0.000, confirming that when consumers perceive virtual influencers as authentic and relatable, their engagement levels increase substantially. This underscores the importance of authenticity as a critical driver of audience interaction.

Content Quality stands out with the strongest effect on consumer engagement, registering a direct effect of 0.45 (T-value = 5.72, P-value = 0.000). This finding highlights that creative, visually appealing, and well-crafted content significantly enhances audience interaction, making it crucial for brands to prioritize high-quality digital content. Additionally, Technological Sophistication also plays an important role, with a direct effect of 0.30 (T-value = 3.90, P-value = 0.001), showing that advanced technological features such as AI and 3D animations contribute to consumer engagement by creating interactive and modern digital experiences. As outlined in Table 7, these results collectively emphasize the need for brands to focus on authenticity, content quality, and technology to maximize engagement with virtual influencers.

Table 7. Hypothesis testing

Hypothesis	Relationship	Direct Effect (β)	Total Effect (β)	T-Value	P-Value	Result
H_1	Perceived Authenticity → Consumer Engagement	0.35	0.35	4.58	0.000	Supported
H_2	Content Quality → Consumer Engagement	0.45	0.45	5.72	0.000	Supported
H_3	Technological Sophistication → Consumer Engagement	0.30	0.30	3.90	0.001	Supported
H_4	Digital Literacy moderates the relationship between perceived authenticity, content quality, technological sophistication, and consumer engagement	0.15	0.15	2.10	0.036	Supported

Finally, Digital Literacy positively influences engagement with a direct effect of 0.15 (T-value = 2.10, P-value = 0.036). Higher digital literacy levels enable consumers to navigate and interact with virtual influencers more effectively. Furthermore, digital literacy serves as a moderator, amplifying the relationships between perceived authenticity, content quality, technological sophistication, and consumer engagement. This indicates that consumers who are more digitally literate are better equipped to appreciate and engage with the nuanced characteristics of virtual influencers, thereby strengthening their interactions. Collectively, these findings suggest that authenticity, quality, and technological innovation are pivotal in fostering meaningful engagements in the digital marketplace.

Table 8 presents the moderation effects of Digital Literacy on Consumer Engagement with virtual influencers, highlighting its significant role in enhancing the relationships between key variables: Perceived

Authenticity, Content Quality, and Technological Sophistication. The interaction between Digital Literacy and Perceived Authenticity shows an interaction effect of 0.20 (T-value = 3.10, P-value = 0.002), indicating that consumers who view virtual influencers as authentic engage more when they possess higher digital literacy. This emphasizes the importance of relatability and authenticity as critical drivers of engagement. Furthermore, the strongest effect is observed in the interaction between Digital Literacy and Content Quality, with an interaction effect of 0.25 (T-value = 4.00, P-value = 0.000). This finding suggests that well-crafted, high-quality content resonates even more with digitally literate consumers, reinforcing the need for brands to prioritize exceptional content strategies tailored to tech-savvy audiences.

Table 8. Moderation effects of digital literacy

Moderating Effect	Interaction Effect (β)	T-Value	P-Value	Result
Digital Literacy × Perceived Authenticity → Consumer Engagement	0.20	3.10	0.002	Supported
Digital Literacy × Content Quality → Consumer Engagement	0.25	4.00	0.000	Supported
Digital Literacy × Technological Sophistication → Consumer Engagement	0.18	2.80	0.005	Supported

Additionally, the interaction between Digital Literacy and Technological Sophistication reveals an interaction effect of 0.18 (T-value = 2.80, P-value = 0.005). This indicates that advanced technological features have a greater impact on consumers with higher digital literacy, suggesting they are better equipped to appreciate modern digital experiences. Collectively, these findings underscore the pivotal role of Digital Literacy in maximizing engagement with virtual influencers, highlighting that as consumers become more digitally literate, their ability to connect with authentic, high-quality content and sophisticated technologies significantly improves, fostering deeper interactions in the digital marketplace.

Figure 3 visually demonstrates the moderating role of Digital Literacy on the relationship between key independent variables—Perceived Authenticity, Content Quality, and Technological Sophistication—and Consumer Engagement with virtual influencers. In line with the findings presented in Table 7, higher digital literacy levels are associated with greater consumer engagement across all variables. Solid lines in Figure 4 represent scenarios where Digital Literacy is high, while dashed lines indicate low Digital Literacy. This distinction clearly shows that consumers with higher digital literacy have stronger engagement responses, reflecting their ability to navigate and appreciate the attributes of virtual influencers more effectively.
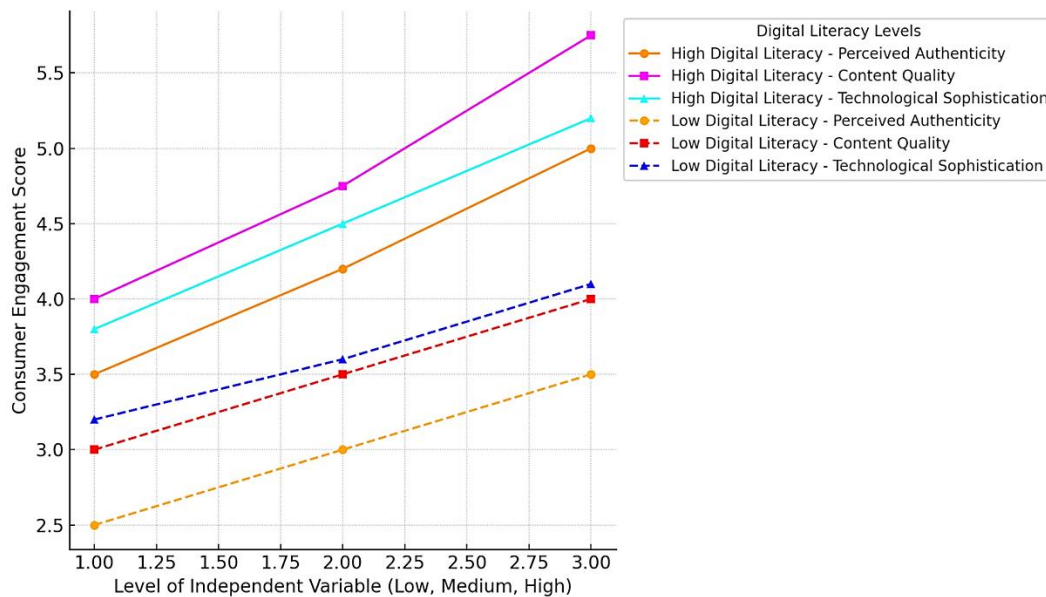

Figure 3. Interaction effect of digital literacy on consumer engagement

The impact of each independent variable on Consumer Engagement becomes more pronounced with increased Digital Literacy. Content Quality, depicted in magenta, has the steepest slope under high Digital Literacy, echoing its strong direct effect (β = 0.45) found in Table 7 and further emphasized by the highest moderating effect (β = 0.25) from Table 8. This reinforces the finding that high-quality, visually

appealing, and well-crafted content resonates particularly well with digitally literate consumers, making content quality a critical area for brands to focus on. Similarly, Perceived Authenticity, represented by the orange lines, also demonstrates a substantial increase in engagement under high Digital Literacy ($\beta = 0.20$), supporting the hypothesis that relatability and authenticity drive meaningful interactions, particularly among tech-savvy audiences.

Technological Sophistication, depicted by the cyan and blue lines, shows a moderate yet significant moderating effect ($\beta = 0.18$) when Digital Literacy is high. This finding, supported by both Table 7 and Table 8, highlights that advanced features such as AI and 3D animations are more engaging for consumers with higher digital proficiency. This effect suggests that digitally literate consumers not only engage more deeply but also appreciate sophisticated digital experiences, making Technological Sophistication an essential factor in virtual influencer design. Overall, Figure 3 underscores that as Digital Literacy increases, the positive effects of authenticity, content quality, and technological innovation on consumer engagement are amplified, making these elements crucial for maximizing audience interaction with virtual influencers.

Discussion

Perceived Authenticity and Consumer Engagement

The significant influence of Perceived Authenticity on Consumer Engagement suggests that virtual influencers ($\beta = 0.35$, T-value = 4.58, P-value = 0.000), despite their digital nature, can effectively build relationships with their audience when perceived as authentic. This finding aligns with prior research emphasizing the importance of perceived genuineness in influencer marketing (Audrezet et al., 2020). Theories in marketing, such as self-determination theory, argue that consumers are more likely to engage with influencers when they perceive that the influencer's content reflects intrinsic motivations and genuine expressions rather than extrinsically motivated promotions (Deci & Ryan, 1985). For Gen Z and Gen Y, who prioritize transparency and authenticity in brand interactions, virtual influencers that maintain consistent, believable personas can foster trust and deeper engagement. As Sung et al. (2021) noted, even though virtual influencers lack physical presence, well-crafted narratives and consistent messaging can create the perception of authenticity, making them effective in generating consumer interest and brand loyalty.

Content Quality and Consumer Engagement

The findings also demonstrate that Content Quality has the most substantial impact on Consumer Engagement ($\beta = 0.45$, T-value = 5.72, P-value = 0.000). High-quality content, characterized by creativity, relevance, and visual appeal, is essential for attracting and maintaining consumer interest. This supports prior research, such as Hughes et al. (2019), which argues that well-crafted and visually compelling content is a key driver of digital engagement. For virtual influencers, producing content that is not only visually striking but also tailored to audience interests is particularly effective in engaging Gen Z and Gen Y, who are accustomed to high-quality digital experiences (Belanche et al., 2021). This insight is crucial for brands seeking to differentiate their digital marketing strategies through virtual influencers, as the quality of content can directly influence consumer interaction. The findings underscore that investing in visually appealing and relevant content is a vital strategy for enhancing consumer engagement with virtual influencers.

Technological Sophistication and Consumer Engagement

The positive relationship between Technological Sophistication and Consumer Engagement ($\beta = 0.30$, T-value = 3.90, P-value = 0.001) emphasizes the importance of cutting-edge technology in the appeal of virtual influencers. Advanced technologies such as AI and 3D animation not only enhance the realism and interactivity of virtual influencers but also provide a sense of novelty that resonates with digitally savvy audiences, especially Gen Z and Gen Y (Belanche et al., 2020). This generation is not only familiar with but expects seamless digital experiences, and virtual influencers that incorporate these technologies can stand out and hold their attention. The findings align with research by Wang et al. (2022), which suggests that the more lifelike and technologically advanced virtual influencers become, the more likely they are to

engage consumers. This demonstrates that technological sophistication is a valuable asset in the competitive digital landscape, offering brands an opportunity to leverage technology to enhance engagement.

Digital Literacy as a Moderator

The moderating role of Digital Literacy presents a crucial theoretical advancement in understanding consumer engagement with virtual influencers by shaping the impact of key influencer characteristics—perceived authenticity, content quality, and technological sophistication—on engagement outcomes (β = 0.15, T-value = 2.10, P-value = 0.036). Although the effect size of Digital Literacy is modest, its statistical significance reveals that digitally proficient consumers engage more deeply, especially with advanced, technology-driven content. This finding aligns with Chuah et al. (2021) and Belanche et al. (2021), who emphasize the importance of digital competence in consumer interactions with complex digital elements, underscoring the relevance of digital literacy as a moderating factor within younger, highly literate groups like Gen Z and Gen Y.

Table 8 demonstrates that Digital Literacy most strongly enhances the effect of Content Quality on consumer engagement (β = 0.25, T-value = 4.00, P = 0.000), indicating that high-quality, well-crafted content resonates particularly with digitally literate consumers. This result marks a unique theoretical insight into how digital literacy sharpens consumers' ability to discern quality and authenticity, thereby amplifying engagement. Similarly, Digital Literacy intensifies the effects of Perceived Authenticity (β = 0.20, T-value = 3.10, P = 0.002) and Technological Sophistication (β = 0.18, T-value = 2.80, P = 0.005), as depicted in Figure 3, further suggesting that digital competence allows consumers to connect meaningfully with sophisticated, relatable digital personas—insights that were previously underexplored.

This study makes a significant theoretical contribution by introducing Digital Literacy as a key moderator in virtual influencer engagement, particularly within a diverse and rapidly evolving digital market like Indonesia. Digital Literacy not only enhances their ability to navigate digital platforms but also amplifies the impact of virtual influencer traits like authenticity and content quality. While the moderating effect of Digital Literacy may be modest, it underscores the importance of considering digital competence when designing virtual influencer campaigns. This effect becomes particularly valuable in targeting younger, tech-savvy audiences who are more likely to engage deeply with virtual influencers. Therefore, even with a smaller effect size, the practical significance is evident in the ability to fine-tune marketing strategies to better resonate with digitally literate consumers, ultimately driving more effective campaign outcomes.

Managerial Implications

In Indonesia, where Gen Z and Gen Y dominate the digital landscape, brands have a significant opportunity to leverage virtual influencers to effectively engage these tech-savvy demographics. This study highlights that perceived authenticity is a key driver of consumer engagement with virtual influencers. As younger consumers increasingly seek genuine connections, brands should focus on creating virtual personas that reflect authenticity through consistent messaging and reliable brand endorsements (Leung et al., 2021; Belanche et al., 2020). Maintaining a coherent identity that aligns with the values of these consumers will enhance their engagement. By emphasizing transparency and trustworthiness, brands can foster deeper connections, ultimately building trust and loyalty among their audience.

Additionally, the findings underscore the importance of content quality in driving consumer engagement. High-quality content—characterized by creativity, visual appeal, and compelling storytelling—should be a top priority for brands targeting Gen Z and Gen Y. These audiences expect immersive and polished digital experiences that resonate with their interests (Nguyen et al., 2021; Belanche et al., 2021; Laimeheriwa & Kembau, 2024). Brands must invest in professional content production that captures attention and retains engagement, recognizing that superior content quality is crucial for standing out in a competitive digital landscape.

Moreover, technological sophistication has been shown to enhance engagement, suggesting that brands should explore innovative technologies like AI and 3D animations to create interactive virtual influencer experiences. The study identifies Digital Literacy as a critical moderating factor in this context. While advanced features can significantly drive engagement among digitally literate consumers, brands must consider the varying levels of digital competence within their broader audience (Chuah et al., 2021;

Venness et al., 2022). For those in urban areas with high digital literacy, sophisticated tech-driven interactions can amplify the appeal of virtual influencers.

However, for audiences with different levels of digital proficiency, brands should prioritize simplifying interactions with virtual influencers to ensure accessibility while still delivering engaging, high-tech experiences. This adaptive approach allows brands to tailor technological sophistication based on the digital competence of their target segments, optimizing the effectiveness of virtual influencer campaigns. By thoughtfully integrating Digital Literacy into their strategies, brands can better resonate with consumers and enhance engagement, ultimately driving more effective outcomes in Indonesia's diverse digital marketplace.

CONCLUSION

This study contributes to the emerging field of virtual influencer research by highlighting the essential roles of perceived authenticity, content quality, technological sophistication, and notably, digital literacy in influencing consumer engagement. Through nuanced analysis, the research demonstrates that consumers are more likely to engage with virtual influencers who exhibit authenticity and deliver high-quality, technologically sophisticated content. The unique insight here is the moderating role of digital literacy, which amplifies the effects of these characteristics on engagement, particularly among digitally fluent consumers. This suggests that digital competence enhances consumers' appreciation of advanced digital interactions, making it a key consideration for brands aiming to connect deeply with tech-savvy audiences.

Furthermore, the significant moderating effect of digital literacy underscores the need for brands to tailor virtual influencer campaigns to fit the digital proficiency of their target markets. In regions with high digital literacy, such as urban Indonesia, brands can drive greater engagement by incorporating complex, technology-driven features into virtual influencer content. Conversely, for audiences with varying levels of digital competence, simplifying interactions while maintaining high-quality, authentic messaging can help broaden reach. By strategically leveraging these insights, brands can better connect with Gen Z and Gen Y audiences in Indonesia and similar emerging digital markets, fostering deeper and more meaningful consumer engagement through virtual influencers.

Research Limitation and Future Research

This study has several limitations that offer avenues for future research. First, the sample is limited to Gen Z and Gen Y respondents in the Jabodetabek area, which may not fully capture the diversity of Indonesia's population, particularly in terms of cultural, socioeconomic, and regional differences. Future research should broaden the geographic scope to include respondents from across the Indonesian archipelago to better understand how regional variations impact perceptions of virtual influencers. Additionally, this study relied on self-reported data collected through online surveys, which may introduce response bias. Incorporating qualitative methods, such as in-depth interviews or focus groups, could offer richer insights into consumer attitudes and behaviors toward virtual influencers. Lastly, while this research focuses primarily on short-term consumer engagement, future studies could explore the long-term impacts of virtual influencer interactions on brand loyalty and purchasing behavior. Examining how technological advancements, such as AI-driven personalization or augmented reality, further enhance virtual influencer effectiveness would also be a valuable avenue for exploration. By addressing these gaps, future research can deepen the understanding of how virtual influencers will continue to shape the digital marketing landscape.

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