

AGENT-BASED MODELING ON PURCHASE DECISIONS: THE IMPACT OF SOCIAL MEDIA PHENOMENA

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ARTICLE INFO

Keywords:

*Purchasing Decisionsv,
Instagram,
Agency-Based Modeling,
Social Interactions,
Social Media Influencers*

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ABSTRACT

Social media influencers have replaced the phenomenon of traditional influencers playing a role in digital marketing in recent years. On the other hand, academic literature needs to explain this phenomenon fully. The purpose of this study is to understand the role of social media influencers in social interaction and their implications for purchasing decisions for cosmetic products to provide an overview of companies in making business decisions using Instagram. The research employs agent-based modeling simulation (ABM), a combination of a deductive approach using the theory of planned behavior (TPB) and an inductive practice through observation. The number of posts, the number of likes and comments, the number of followers, attractiveness of influencers utilize. These parameters lead to purchasing decisions, which subsequently identify with sales figures. This study categorizes three influencers with different characteristics. The simulation results show that influencer [B] sales are the highest with repeated iterations, then influencer [A] and influencer [C] with several parameters that explain the phenomenon of social media influencers in purchasing decisions. Another discovery was that the parameter quantity of content has the most significant influence on buying decisions, followed by other parameters that also contribute significantly. To provide businesses the chance to consider these factors when selecting the right blend of social media influencers to aid product sales.

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1. INTRODUCTION

Incorporating social media phenomena into contemporary conversations about digital marketing contributes significantly to expanding the scope of the study of marketing concepts. The development of social media applications has transitioned from simply being a communication platform to a platform for collaboration to improve the effectiveness of the application's products and services. One of them is the Instagram application, a social media platform that can send messages quickly to the public. Miles (2013) said that the importance of Instagram's current role in helping market products and services indicates that as many as 50% of well-known brands have used the Instagram application to market their products. On Instagram, approximately five million new pictures uploading every single day. In this day and age of digital marketing, organizations have abandoned traditional marketing methods to sell products and services through social media.

Social media consider more specific marketing capabilities when compared to traditional marketing (Tuten, 2008). Because of the ease with which marketing capabilities on social media platforms can adapt to target market segmentation relatively quickly, the messages that communicate can be more effective and efficient. Social media marketing has other advantages from a cost and time efficiency perspective, as it can reach a broader market than traditional marketing. The dissemination of information has become much more effective due to technological advancements, and the growth of social media has caused applicators to recognize this opportunity and change their business model. This new model no longer provides a platform for users to communicate normally; instead, it provides a platform for the marketing of products

supported by the presence of social media influencers, who have successfully positioned themselves as important figures in today's moderating community.

Jin et al. (2019) showed that people prefer social media influencers because of their social perception over traditional marketing celebrities. It is in line with research (Watts & Dodds, 2014), where through social media activities, an online influencer can influence the attitudes, actions, and behavior of their followers in a mechanism known as influencer marketing (Watts & Dodds, 2014). An organization's problem can also solve with the help of influencers on social media. Identifying and selecting individuals and groups that are referred to as influencers and anticipate to significantly impact the product purchasing decisions of an organization are examples of some of the significant challenges that businesses must contend with marketing. The purchase decision is a customer response to disseminating information from various sources. Customers will purchase a product if they believe it can help them solve the problems they are experiencing and if the product meets their requirements.

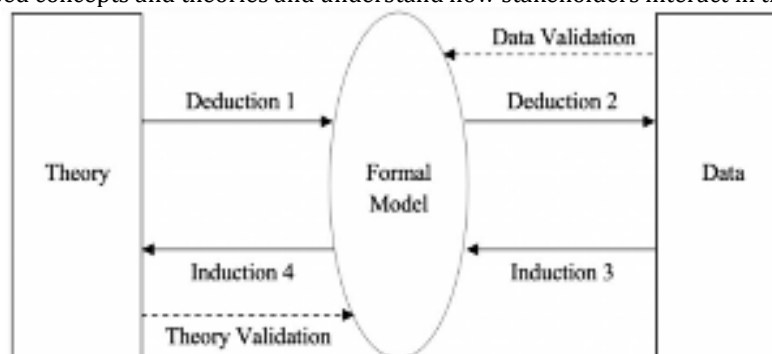
In the field of customer behavior, one of the well-known theories that can explain purchasing decisions is the theory of planned behavior (TPB). This psychological-based theory defines an individual's behavior and influence by three main factors: attitudes, subjective norms, and control—perceived behavior. In marketing and consumer behavior, this theory can apply. Because in online shopping, this theory can provide added value in explaining consumer buying behavior (Pan & Truong, 2018).

It explains the importance of studying consumer behavior in making a purchase decision. Although presented in a different context, this theory has proven that this theory has an extreme attachment to a purchase decision. TPB studies on marketing use more survey methodology to understand the context with a systematic review of the literature so that it has implications for the most widely used statistical instrument in the form of a regression model approach. This research uses a simulation methodology and beauty product case studies to explain the current social media influencer phenomenon. This study aims to understand buying behavior at the micro level through a conceptual model of a social media influencer phenomenon using agent-based modeling. Therefore, this study's findings will assist organizations in decision-making by modeling social interactions and providing an intuitive understanding of changes in the sensation of social media influencers.

This study anticipates contributing to the existing research on product purchase decisions by incorporating the reconstruction phenomena into the computational model. The writing structure of this research begins with an introduction discussing the phenomena that occur, noting the gaps found in the study, research objectives, literature review, and developing hypotheses, followed by determining research methods by outlining how the research will carry out to answer the research objectives. The analysis and the discussion are structured similarly, with the research results discussed alongside additional explanations and written conclusions and recommendations recorded.

2. METHOD

This case study research is a way to understand a particular phenomenon (Yin, 2014). Along with expanding the Internet and social media applications, a new phenomenon known as social media influencers is currently taking shape in digital marketing. According to some sources, social media, marketing, and influencers can be considered a single entity that functions as the most efficient channel for marketing a product. Therefore, this study aims to test the hypothesis. A simulation is an analytical tool to test the developed concepts and theories and understand how stakeholders interact in this phenomenon.



Source: Schwaninger and Grosser (2008)

Figure 2. Research Process Simulation

Agent-based modeling (ABM) is used in this study to understand how social media influences buying a product. This research uses a combination method with deduction and induction approaches (Schwaninger & Grosser, 2008). This argument uses to get all the most relevant information to execute in a computerized model. Data validation uses the deductive approach to make a formal model that fits the existing data. At the same time, the induction approach needs to be validated against the theory so that the standard model can follow the current view. The induction approach in this study used in-depth observation and interviews. In this case, the purpose of the observation tool is to understand how the interaction process and in-depth discussion carry out to obtain the parameters relevant to the simulation process. The combination principle referred to here is trying to match the available data with the developing theory. The Instagram application is a case study used to support the research process as a tool to see interactions between "agents," influencers, and consumers because Instagram is one of the fastest-growing social media marketing platforms today.

Instagram was chosen as a platform because it has unique advantages in social media marketing. Instagram has featured its direct competitors do not have by offering images as its main value proposition. Apart from that, additional features such as hashtags and Instastories support the application's competitiveness with its customers. The simulation carried out in this study uses the spot-oriented agent role simulator (SOARS) application. The Tokyo Institute of Technology has developed this SOARS application to address the limitations of using other social science simulation applications still under development (e.g., NetLogo, MASON, Swarm, and others). Because it does not require coding or technical coding skills, the SOARS application can implement more quickly and easily. However, users of this application need to have a firm grasp of social interaction and the concepts and logic of computer programming to succeed.

Determination of TPB Parameters

In the previous discussion, TPB explained that a purchase decision determines by three main factors: attitude, perceived behavioral control, and subjective norms. Philosophy responds positively to knowledge, information, and experience in product use. A positive attitude will affect a person's decision to purchase a product meaningfully. On the other hand, the behavioral control approach in this research assumes that all people can get their hands on the product. This assumption is determined to identify various factors more measurably in testing the purchasing decision of a product. Subjective norms are a response given to other people who are considered vital. If an individual feels that his social environment has a positive influence, it will affect purchasing the products offered.

Table 1 Parameter Rationale

Parameter	Reason	Influencer_A	Influencer_B	Influencer_C
Attractiveness	The uniqueness of the influencer's appeal	1/3	1/3	1/3
Number of Followers	Number of active followers who follow Influencers	>100.000	80.000 – 100.000	60.000 - <80.000
Number of Likes/Comments (Per day)	Awards received by influencers in response to the content created	0.3	0.2	0.1
Number of Posts	The amount of content created to attract followers or responses	One time	Twice	One time

The specific parameters in this study, as listed in table 1, consist of attractiveness, number of followers, number of likes/comments, and number of posts. The attraction in question is the unique appeal of an influencer that can help attract people to follow their account (Miles, 2013). The number of followers is the number of active followers an influencer has in response to anything (photos, information, and activities) on social media accounts (Jin et al., 2019). Meanwhile, the number of likes or comments is an award or feedback given to influencers for content created on their accounts. Post count is the frequency of creative content created by influencers to provide insight, entertainment, or information about their followers.

Determination of additional parameters also needs in the form of formula expressions that aim to formulate the interaction process, as shown in Table 2. Total product sales are affected by the total price and product quantity. This study sets a price of IDR 40,000 per unit with the number of products sold which is a consumer purchase decision due to the influence of social media influencers. This influencer's effect

will further accumulate with the power of social media influencers on their followers. At the same time, the decision to purchase is a value limit when followers buy an offered product.

Table 2 Parameters and Expression Formulas

Process Parameters	Expression Formulas
Product sale	Quality x Price
Number of Likes/Comments	Total Followers x Likes/Comments
The Influencer Effect	(Number of Likes/Comments x Posts - Frequency)/Total Followers
Buying decision	Influencer Effect \geq Random * 100

3. RESULT AND DISCUSSION

In this study, ABM utilizes, and a more significant emphasis places on, the process of interaction formation. In this particular investigation, the simulation procedure can break down into two stages: the first stage is called the initial stage, and the second stage is called the process stage. The first step here includes predetermined parameters to support the initial research model's development stage. While the process stage focuses on developing interactions between actors using logical language, the stage itself is called the process.

Validity and Reliability

In general, model testing in simulation research uses three approaches: conformity testing, consistency testing, and utility and effectiveness (Martis, 2006). In this investigation, the method for determining the validity and dependability uses two dimensions: the structural model and the behavior model. The result is that the developed model can successfully pass all of these compatibility tests. An external validator selects to help the objectivity and suitability of the model developed in this study (Table 3).

Table 3 Validity and Reliability Test Simulation

Test Type	Model Structure	Behavioral Models
Suitability test	Structure verification	Sensitivity
Consistency test	Advance validity	Behavior
Test utility and effectiveness	Appropriateness	Counter-Intuitive

Several essential points in the SOARS model can define in the discussion in this study, including three different influencers as spots, product stores as places to buy products, and consumers as agents of as many as 500 consumers who have Instagram social media accounts and expose to these three influencers. This research also establishes a simulation period of 180 days, and during that time, the researcher looks at how social media influencers influence the sales of these products.

The social media platform produces two interaction processes that occur. The first is the determination of several parameters that can influence social interaction between social media influencers and consumers on purchasing decisions of the offered beauty products. Some initial parameters are attractiveness, number of followers, number of likes/comments, and number of posts. In contrast, the process of social interaction constitutes the second stage. The primary participants in social interaction are called upon to follow a logical progression that enables them to choose what to purchase and how they will do so. How these social media influencers disseminated this information about the product played a role in influencing this purchase decision.

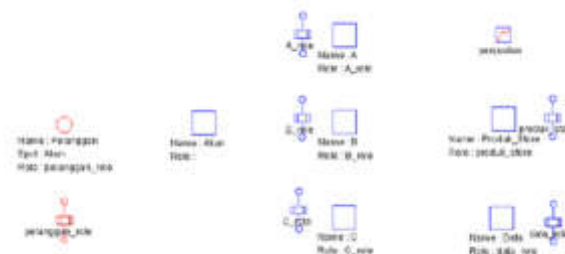


Figure 3 Social Media Influencer Model Simulation

Simulation Results and Hypothesis Testing

This simulation carries out several times. In the first iteration, it produces Influencers [B] as social media influencers with the most decisive influence in increasing product sales. Influencer [A] with possible sales of IDR 9,730,000 and has 100,000 followers, likes (3% of followers), and posts (once per day). Then, Influencer [B] with possible sales of IDR 13,930,000 and has 80,000 followers, likes (2% of followers), and posts (twice per day).

Meanwhile, Influencer [C] with a possible sale of IDR 3,570,000 and has a total of 60,000 followers, likes (1% number of followers), and as many posts (once per day). The second and third iterations yielded the same outcomes.

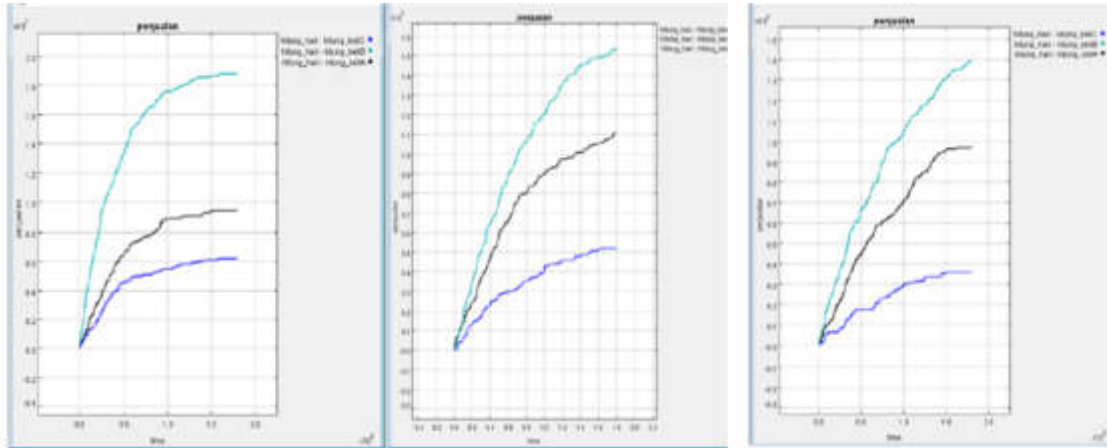


Figure 4 Simulation Iteration

The results of the second and third iterations also reveal Influencer [B] as a social media influencer with the most decisive influence in increasing product sales. Influencer [A] generates possible sales of IDR 11,060,000 in the second iteration and IDR 9,730,000 in the third iteration with the same characteristics in the first iteration. Meanwhile, Influencer [B] can develop each possible sale of IDR 15,400,000 and IDR 13,930,000 in the second and third iterations with the same characteristics as in the first iteration. Through the same iteration, Influencer [C] generates a possible sale of IDR 5,180,000. Based on several iterations, it can conclude that Influencers [B] with specific characteristics through a computerized model always produce the highest product sales, followed by product sales through Influencers [A] and Influencers [C].

This simulation's findings explain the role that social media influencers play in influencing consumers' decisions regarding the products they purchase. The simulation generates significant sales possibilities through social media influencers even though there are differences in sales between the three influencers. Thus, the hypothesis developed in H1 is accepted. Namely, the interaction between agents, social media influencers, and consumers is essential in increasing beauty product sales. It supports the accepted hypothesis H2.

Meanwhile, the different characteristics of the three influencers resulted in various sales. In light of this, the organization needs to determine what kind of person will be selected when making decisions about social media influencers. According to these results, hypothesis H3 should also accept.

Discussion

Based on the findings of this study, it is possible to explain how the phenomenon of social media influencers is through the preparation of the microstructure, the logic of interaction between actors, and the process of interaction between actors during product purchases. It can do by looking at how the actors interact with one another during the purchasing process. At the same time, the critical actors in the influencer social media phenomenon involve influencers and consumers who interact with each other. Social media influencers here play the role of actors who can influence consumers to buy the products offered. This interaction takes place on the Instagram platform, which has expanded its function and is no longer purely for personal use but also considers business concerns. Some of the distinctions in the influencer's personality bring about by the fact that, in actuality, every single person possesses a unique personality.

The simulation results can also answer social media influencer events through TPB when purchasing a beauty product that offers. Social interaction through simulated illustrations states that all the TPB variables significantly emphasize consumer buying behavior because each social media influencer can control individual attitude factors (Giampietro et al., 2018; Merminod et al., 2019). Personal attitude is a belief that someone has that influencing by knowledge, information, and experience. The presence of influencers here can significantly contribute to both of these things because, for an influencer, affecting individuals through disseminating information about products visually, in writing, and in pictures is a habit and a necessity. Individuals who feel suitable with the influencer's attractiveness and way of disseminating information can indirectly reveal implications for improving their attitudes. In parallel, influencers can also influence other variables, such as subjective norms and perceived behavioral control.

Social media influencers can influence individuals to buy their products (De Veirman et al., 2017; Youn & Jin, 2017). This actor is undoubtedly a role model because he is considered to have a certain appeal and can effectively spread information about the products offered, which calls for the relative influence of influencers. An influencer also believes to have particular expertise in disseminating information about the products offered. The characteristics of the products provided and these social media influencers have a close relationship. The more aligned an influencer is with an individual, the more subjective the trust that the individual has toward the product. This influencer's behavior will become a reference for individuals to buy an offered product. So social media influencers are one of the essential individual instruments that can influence a product purchase decision.

Research conducted by (Nuttavut Hisit & Thøgersen, 2017; Pappas, 2017) states that the phenomenon of a social media influencer can influence individual behavioral processes. This product-buying behavior is not a spontaneous process but a complex process. When individuals are exposed to exciting information from social media influencers, they do not immediately react to purchasing the product and will process all the information received before deciding to buy or not buy the offered product. Positive behavioral control will try to get the product despite the many challenges and obstacles that the individual may face. Meanwhile, negative control behavior will stop all purchasing efforts even though someone strongly believes in a product initiated by a social media influencer. In cases like this, a social media influencer's role is to provide a stimulus to the individual to encourage behavioral control in a positive direction (Awaluddin & Hamid, 2019; Piroth et al., 2020).

Various challenges and obstacles in buying products can be removed by encouraging these individuals to buy products endorsed by social media influencers in one way, namely interaction between prospective buyers and social media influencers. It is by the TPB that all variables in the interaction between prospective buyers and social media influencers are significant factors influencing consumer decision-making in purchasing a product. For example, the attractiveness of influencers, the number of likes/comments, the number of followers, and the number of posts on their social media accounts, so there are several things an organization needs to pay attention to assist in increasing product sales through social media influence, including 1). The attractiveness of influencers according to consumer preferences requires essential attention. Social media influencers must be able to represent the products they offer well because the influencer's appeal can increase consumer awareness of a product. 2). Using social media influencers with a certain number of followers who will help consumers buy certain products with the aim that potential consumers feel confident and trust (consumer awareness) in purchasing decisions. 3). The number of likes/comments that can represent the quality of an influencer in terms of the number of followers it has because the better the number of likes/comments, the higher the influencer effect it will have on consumers. An organization also needs to consider using quality social media influencers. 4). In addition to the methods above, the many influencers who post on their social media accounts can also help increase consumer awareness in purchasing decisions. An influencer who continues to be consistent in posting a certain amount is a parameter for organizations to determine the accuracy of selecting an influencer.

4. CONCLUSION

Using a computerized model and TPB as a research framework, the authors of this study explain how influencers on social media can affect consumer purchasing behavior. Their goal was to understand how the influencer phenomenon interacts with consumers—the data or information obtained according to the research framework through interviews and direct field observations. Even though with some assumptions made and data obtained through observation, a social media influencer still has a significant influence on sales of the products they offer with the following results: 1). Influencer [A] with possible sales of IDR 9,730,000 and has 100,000 followers, likes (3% of followers), and posts (once per day). 2). Influencer [B]

with possible sales of IDR 13,930,000 and has 80,000 followers, likes (2% of followers), and posts (twice per day). 3). Influencer [C] with possible sales of IDR 3,570,000 and has 60,000 followers, likes (1% of followers), and posts (once per day).

An organization must consider several aspects when selecting social media influencers to increase product sales. Some elements considered include the personal attractiveness of a social media influencer, the number of followers, the number of likes/comments, and the number of posts. Organizations can strategically use these four parameters to increase consumer awareness and sales of their products

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