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An integrated model for the usage and acceptance of stickers in WhatsApp through SEM-ANN approach

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A B S T R A C T

This analysis integrates the "technology acceptance model (TAM)" with the "use of gratifications theory (U&G)" to develop an embedded model that predicts the use and satisfaction of emotional icons called stickers through WhatsApp. The explanation for combining these two theories is that U&G offers accurate information and a thorough knowledge of use, while TAM theory has been firmly established in several technical implementations. A newly developed hybrid analysis procedure has been applied within this research. Using an artificial neural network (ANN), and the structural equation model (SEM) have been combined. The research also uses the importance-performance map analysis (IPMA) to present each factor's performance as well as importance. The ANN and IPMA research have both indicated that for sticker use intention, a highly essential predictor is Socialization. An online questionnaire survey was developed to assess the recommended model. The intention to use stickers was significantly affected by "Socialization, Self Presentation, Enjoyment, Novelty, Unique Function, Perceived Ease of Use, and Perceived Usefulness". The research's main achievement is the convergence of two separate theories into a single conceptualization to accurately calculate the TAM components when it comes to the usage of stickers in WhatsApp. Theoretically, the recommended model provides enough insight for aspects which affect the intention to use stickers with relevance to the socialization's factors considering interpersonal aspects. Practically, the higher education decision-makers along with professionals would extract variables that are important as compared to others and policies would be developed accordingly. The deep ANN model competence has been analyzed within the research to decide upon the non-linear associations between variables of the theoretical model, methodologically.

1. Introduction

The psychological and social variables behind the use of engaging social media applications have altered how people enjoy, share, and engage with internet content; more academic exposure is needed (R. S. Al-Maroof, Alshurideh, et al., 2021; Shao & Kwon, 2018). Emojis have been widely used to express emotions and improve user experience. Emojis' "ubiquitous" use allows us to research and compare people's expectations and behaviors throughout countries and cultures (Lu et al., 2016). Conversely, the use of stickers, which are new to WhatsApp, has placed a certain level of innovation and imagination. These

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two characteristics have never been observed in emoji use. Emojis, are small (Zhou et al., 2017), depend on Unicode, are accessible via standard keyboards, and cannot be modified. Stickers, on the other end, are larger, static, and animated. They can be added or removed at any time, and they're being sent independently from text messages. Furthermore, they are more detailed and frequently animated (Zhou et al., 2017). Correspondingly, (J. Y. Lee et al., 2016) claims that users' reason for using stickers is powerful and that users send stickers not only to express emotions but also for tactical or interaction (Zhou et al., 2017).

The majority of academic papers on computer-mediated argumentation are the latest and current. A collection of studies looks at how emojis are used in various situations based on a set of data. Interestingly, no research has been done to see how well stickers are accepted through WhatsApp. This is due to a combination of two factors. The first is that stickers have only recently become popular as a WhatsApp communication method. The second fact is that only in the years 2018-2019 have Arab users, where the research was performed, begun to use and develop their exclusive stickers. As a result, no prior research in this area has been discovered. To our awareness, (Zhou et al., 2017) is the only paper that examines stickers in WeChat in depth.

It's worth noting that several efforts have been made to explain and demonstrate the use of emoji through various applications. They looked at the most current research. (Suresh, 2018), who conducted a quantitative analysis to assess the role of emoji in communication, is the most recent research in chronological order. (Tandyonomanu, 2018) performed a related study that year that centers on the use of emoji as a non-verbal symbol in communication. Another research was performed by (Muhammad, 2017), who performed an emoji case study to determine people's intentions to use emojis. The data comes from a variety of WhatsApp emoji users' interactions. (Chairunnisa & Benedictus, 2017) concentrate on the use of emojis in black-berry phones to learn their use in interpersonal communication that year. [9] conducted similar research in which emojis were shown to have a specific purpose, which is to ultimate punctuation marks, using quantitative analysis.

The researchers discovered research papers in Saudi Arabia and Oman to address the numerous research trials in the Arab world. (Al Rashdi, 2015, 2018) conducted a study on emoji in an Arabic context, providing a comprehensive overview of emoji use among Omani people. Likewise, (Al Zidjaly, 2010) looks into the use of emoji in Oman, claiming that Omanis use emoji as a form of jokes. (Albawardi, 2018) explores Saudi’s females' use of emojis, concluding that emojis are meant to maintain interpersonal relationships. Furthermore, Arabic social communication is a key component in describing the language included in computer-mediated communication, and its relationship to speech or writing in solely Arabic computer-mediated discussion is governed by rules. As a result, this research aims to uncover additional roles and characteristics in Arabic computer-mediated communication.

The objective of the research is to create a new model that combines TAM and the Uses and Gratification approach (U&G) to predict why people use stickers on WhatsApp. There are two key reasons for the necessity of combining these two theories into a single conceptualized model. The first is to apply the TAM technique to concentrate on the technology's attributes. The second rationale is to adopt the U&G approach to an emphasis on the technology's interactions. To the best of the best knowledge of the analyst, the combination of TAM and U&G theories has not been examined concerning the use of stickers via WhatsApp text messages among college or university students.

Earlier research has mostly focused upon single-stage linear data assessments (Sohaib et al., 2019), by applying the Structural Equation Modeling (SEM) technique, considering the procedure. Between variables, the linear associations within the theoretical model can be assessed with the help of the single stage of SEM analysis. However, this is not enough for prediction for the decision making procedure that is quite complex (Sim et al., 2014). The Artificial Neural Network (ANN) procedure has also been applied by quite a few researchers as part of the second-stage so that the limitation can be resolved (Al-Emran et al., 2021; Khan & Ali, 2018; Leong et al., 2013). Yet, a single hidden layer is present within this procedure which is why it is considered a shallow kind of ANN (Huang & Stokes, 2016). Hence, as compared to the shallow ANN architecture, the deep ANN is proposed to enhance the non-linear model accuracy through the addition of a single hidden layer (Wang et al., 2017). Keeping these aspects in mind, for deep learning, the hybrid SEM-ANN procedure based on the deep ANN architecture has been applied in this research. Earlier research is very much based on the TAM model considering it the primary conceptual model, however, the current research objective is to analyze the ML acceptance within the hybrid conceptual model.

2. Theoretical Framework and Research Model

2.1 TAM Theory

For information systems, the behavioral intention is assessed within TAM. As part of the TAM theory (Al-Maroof R.S., 2021), the core aspects are two belief arrangements. First, perceived usefulness, that is associated with the belief degree of the individual for that particular system to help enhance their job performance. Second, perceived ease of use, that is associated with the belief degree which indicates that the specific system must be easy to use (Davis, 1989). The theories related to TAM directly and indirectly influence the user’s intention for a particular application. A significant role is played by TAM for communicating the Internet-based technology effectiveness to the students of universities and colleges. Various TAM

academics have raised this question, for instance, the new technology use efficacy is tested using this basis along with indicating the students' attitudes and acceptance measures when this new technology has been introduced (R. A. S. Al-Maroof & Al-Emran, 2018). Similarly, (Escobar-Rodriguez & Monge-Lozano, 2012) mentions that TAM is employed to forecast or indicate the adoption of the Moodle e-learning platform by the students of the universities. It can also be employed to look at other important factors that impact students' intention to use Moodle and their acceptance of the technology. TAM plays a key role in defining key functional consequences for Moodle acceptance and establishing interpretations of how to enhance Moodle adoption intentions.

2.2 Uses and Gratification Theory (U&G)

"U&G theory" is a form of theory that examines why people use certain media. It also looks at the gratification that comes from media use as well as availability, implying that people use media for significant and special purposes. The overwhelming bulk of "mediated communication, such as media, interactive media, and the Internet, is covered by U&G theory" (Luo & Remus, 2014). (Luo & Remus, 2014) lists a variety of reasons why people use internet apps, like entertainment, killing time, interpersonal usefulness, knowledge-seeking, and ease. Conversely, the most common reason for using these apps is to get knowledge.

As per (Shao & Kwon, 2018) the incorporation of both "novelty" and "being there" is one of the most important aspects of the U & G theory. Novelty is thought to be a fun way to spark creativity, while 'being there' applies to how social media users can feel absorbed in a filtered reality by clicking social buttons. The use of stickers in an Internet App is dependent on these two variables. Since stickers are one of WhatsApp's newest features, users can use them to satisfy their feeling of novelty. Furthermore, U&G theory emphasizes the importance of "being there," since it is one of the distinguishing characteristics of sticker use. Stickers can be included in a variety of religious and social settings to express the feeling of being one of a kind.

2.3 Development of the research model

While "TAM theory" has been widely adopted to assess technology acceptance by a large number of academics around the globe it does not include clear and comprehensive explanations for using a particular technology (R. S. Al-Maroof et al., 2020b; Alshurideh et al., 2021; Saeed Al-Maroof et al., 2021). TAM theory is focused on three major elements: simplicity, intended generality, and task-oriented elements (Shao & Kwon, 2018). These are the factors that underpin this assertion. Since TAM's appropriateness to the usefulness of use is restricted, "U & G theory" serves as a supplement that provides more information in this regard. Moreover, the U&G approach allows for a more in-depth interpretation of students' perspectives, allowing the TAM model to be broadened (Aburub & Alnawas, 2019). "Social utility, hedonic utility, and functional utility" are three utilities under U&G that correlate with the TAM measurements. The term "social utility" is used to describe interpersonal use that is closely related to perceived usefulness. WhatsApp users may create stickers that express their social attitudes toward various social events in their lives. Correspondingly, from the perspectives of novelty and enjoyment, hedonic utility is linked to perceived usefulness. Users created a variety of stickers to add a sense of humor and enjoyment to WhatsApp conversations. Eventually, when users of technology use a specific type of sticker to complete a role, the stickers are associated with the functional utility.

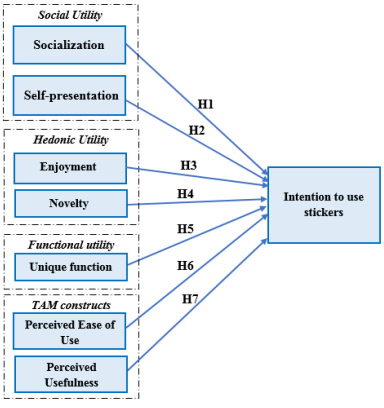

Fig. 1. Conceptual model

The research objective is to observe the social influences and the cognitive procedures which are present within the users' intention to use stickers specifically using WhatsApp. The vital theory development is associated with perceived usefulness that is included as part of three "utility categories, social, hedonic, and functional utilities". Social utility includes "socialization and self-presentation, hedonic utility includes novelty and enjoyment, and functional utility" includes the

unique functions associated with the stickers used. The research model has been developed considering the recommended model based on the TAM model (Fig. 1).

H_1: *Socialization (SOC) has a significant positive effect on intention to use stickers (STK).*
H_2: *Self Presentation (SEL) has a significant positive effect on intention to use stickers (STK).*
H_3: *Enjoyment (ENJ) has a significant positive effect on intention to use stickers (STK).*
H_4: *Novelty (NOV) has a significant positive effect on intention to use stickers (STK).*
H_5: *Unique Function (UNI) has a significant positive effect on intention to use stickers (STK).*
H_6: *Perceived Ease of Use (PEU) has a significant positive effect on intention to use stickers (STK).*
H_7: *Perceived Usefulness (PU) has a significant positive effect on intention to use stickers (STK).*

3. Methodology

The use of several graphics on styles in WhatsApp comment threads is a recent trend that has yet to catch on. To determine the efficacy and usefulness of stickers, the researcher circulated a questionnaire to groups of college students who had participated in WhatsApp's "Group Talk" function. The sample consisted of a group of university students from one of the prestigious UAE universities. The survey is an online survey questionnaire that was sent to a group of students who have used stickers in a college group talk set up for educational and academic objectives. The majority of the topics debated in the WhatsApp group talk revolve around their educational concerns, such as their course, teachers, tests, and other religious and social activities.

3.1 Sample and data collection

The time period of data collection is 01-January-22 to 01-February-2022. There were 600 questionnaires sent out randomly and 559 questionnaires were actually answered. Hence, the response rate is 93%. Since values were missing, there were 41 questionnaires that were rejected. Therefore, 559 questionnaires were considered satisfactory for the committee in terms of accuracy. (Al-Emran & Salloum, 2017) suggests that 456 responses were credible that have been obtained from the standard and acceptable sample size. This means that out of a 1500 population, 306 respondents is the acceptable sample size. Hence, the 559 sample size is quite large to neglect the specifications. For the sample size, the appropriate evaluation is the structural equation modeling that has been applied for the hypothesis's validation. The research unit applied the "SEM for the measurement model testing". The final path model has been applied as the specialized process.

3.2 Study Instrument

As stated earlier in this study, a survey instrument was employed to test hypotheses. As a result, 23 new items were applied to the survey to measure the eight constructs in the questionnaire. The sources of these constructs are shown in Table 1. To improve the study's validity, questions from previous studies were revised and updated.

Table 1
Measurement styles

Constructs	Items	Instrument	Sources
Intention to use stickers	IUS1	"I will adopt stickers through WhatsApp in my future activities assignments".	(Al-Maroof et al., 2020a; Al-Maroof et al., 2021; Shao & Kwon, 2018)
	IUS2	"I will adopt stickers through WhatsApp in my university daily".	
Socialization	SOC1	"Stickers through WhatsApp allow me to build new connections with potential friends".	(Ellison et al., 2007; Lee et al., 2016); Shao & Kwon, 2019)
	SOC2	"Stickers through WhatsApp allow me to maintain friendships".	
	SOC3	"Strengthen the tie with a friend on WhatsApp allows me to show my belongingness to a community".	
Self-presentation	SEL1	Stickers through WhatsApp allow me to participate in the discussion.	(Gan, 2017; Goffman, 1959; Shao & Kwon, 2019)
	SEL2	Stickers through WhatsApp make others perceive me as sociable.	
	SEL3	"Stickers through WhatsApp make others perceive me as keeping pace with trends".	

Table 1
Measurement styles (Continued)

Constructs	Items	Instrument	Sources
Enjoyment	ENJ1	"Stickers through WhatsApp are entertaining for me".	(Gan, 2017)
	ENJ2	"Stickers through WhatsApp are a pleasure".	
	ENJ3	"Stickers through WhatsApp are funny".	
Novelty	NOV1	"The interface of stickers through WhatsApp is different".	(Sundar & Limperos, 2013)
	NOV2	"The experience of stickers through WhatsApp is unusual".	
	NOV3	"The technology of stickers through WhatsApp is innovative".	
Unique function	UNI1	"Stickers have unique features, such as size".	
	UNI2	"Stickers have unique features, such as uniqueness and animation".	
	UNI3	"Stickers can be used in different religious and social situations".	
Perceived Ease of Use	PEOU1	"Stickers through WhatsApp make it easy to do my homework".	(Al-Maroof et al., 2020a; Al-Maroof et al., 2021; Shao & Kwon, 2018)
	PEOU2	"It is easy to use stickers through WhatsApp daily".	
	PEOU3	"Stickers through WhatsApp have features that can be easily applied".	
Perceived Usefulness	PU1	"Stickers through WhatsApp help me in my studies".	(Al-Maroof et al., 2020a; Al-Maroof et al., 2021; Shao & Kwon, 2018)
	PU2	"Stickers through WhatsApp make my daily achievements higher".	
	PU3	"Stickers through WhatsApp help me a lot in my flipped classroom".	

3.3 Survey Structure

A survey questionnaire was created and circulated to students (Salloum & Al-Emran, 2018). There are three parts to the questionnaire.

- The first segment relies on the participants' personal information.
- The second part delves into the two points that define the overall issue of the intention to use stickers.
- "Socialization, Self Presentation, Enjoyment, Novelty, Unique Function, Perceived Ease of Use, and Perceived Usefulness" are described by twenty one elements in the third segment.

The (23 items) were measured using a five-point Likert Scale with the following scales: "strongly agreed (5), agree (4), neutral (3), disagree (2), and strongly disagree (1)".

3.4 Demographics

Out of the total students, 54% were males and 46% were females. The Age of the students was 18 to 29 years for 69% respondents and over 29 years for 31% of the respondents. Most respondents had a university degree and were well-educated. Results indicate that bachelor's degree was held by 65% respondents, 19% has a Master's degree and 16% a doctoral degree. To make sure the respondent accessibility is easy and they are willingly participating, the "purposive sampling approach" has been applied (Al-Emran & Salloum, 2017). Students from several colleges have been chosen and the age group of these students is quite varied as there are several levels and programs that they have enrolled in. The SPSS has also been applied simultaneously to assess demographic information.

4. Findings and Discussion

Earlier empirical research applied the single-stage SEM analysis for validation of the hypothesized associations between the research model variables (R. S. Al-Maroof, Akour, et al., 2021; Al-Sarayrah et al., 2021; Alsharhan et al., n.d., 2022). The current research applied the hybrid SEM-ANN procedure based on deep learning. The strategy includes two stages. Firstly, the SmartPLS (Ringle et al., 2015) is applied to assess the recommended research model using the "partial least squares-structural equation modeling (PLS-SEM)". The theoretical model has an introspective feature and since the earlier literature is lacking, the PLS-SEM is applied. Official principles have been used to apply the PLS-SEM within the information systems

assessment (Al-Emran et al., 2018). The research model is evaluated with the help of a two-step procedure which are measurement model and structural model (Simpson, 1990). “The importance-performance map analysis (IPMA)” is also applied as part of the PLS-SEM to indicate the performance and importance of each of the research model features. Secondly, the PLS-SEM assessment has been analyzed, complemented as well as verified using the ANN. It also analyzes the independent variable influence over the dependent variables. The ANN has also been considered a function estimation instrument which can be applied when inputs and outputs are coordinated in a non-linear and complicated manner. There are three vital structures for ANN and they are network architecture, learning rule, and transfer function (Simpson, 1990). These have been subdivided into “radian basis, feed-forward multilayer perceptron (MLP) network, and recurrent network (Sim et al., 2014)”. MLP neural network is the commonly applied approach that includes several layers like input and output. Hidden nodes are used to link these input and output layers. There are neurons or independent variables present within the input layer which extract the raw data present and deliver to the hidden layers as the synaptic weights. The output of each hidden layer is based on the extracted activation function selected (Asadi et al., 2019; Sharma & Sharma, 2019). The activation function used widely is the sigmoidal function. Hence, the recommended research model, within the analysis, can be tested and trained through the MLP neural network.

4.1 Validity and reliability

According to (J. Hair et al., 2017), when the measurement model is being evaluated, construct reliability (such as “composite reliability (CR), Dijkstra-Henseler's (PA), and Cronbach's alpha (CA)”) and validity (such as “convergent and discriminant validity”) should be included (Aburayya, Al Marzouqi, et al., 2020). Table 2 indicates that construct reliability is evaluated using Cronbach's alpha (CA) values, 0.753 to 0.882. The threshold point is 0.7 (Nunnally & Bernstein, 1994) and the numbers mentioned are greater. Table 2 also suggests that the composite reliability (CR) values are between 0.729 to 0.927 and these are quite high as compared to the 0.7 recommended value (Dijkstra & Henseler, 2015). Similarly, the Dijkstra-Henseler's rho (pA) reliability coefficient can be applied by the analysts for construct reliability assessment and documentation. A 0.7 value or greater should be present for the reliability coefficient pA, like CA and CR for the introspective assessment for the intermediate phase, the values should be 0.80 or 0.90 (J. F. Hair et al., 2011; Henseler et al., 2009; Nunnally & Bernstein, 1994). For each measurement construct, the reliability coefficient pA is higher than 0.70 which is also shown in Table 2. The research results indicate that verification is present for construct reliability and the constructs are all error-free and can be included as part of the conclusion.

For the “convergent validity measurement”, assessment should be done for average variance extracted (AVE) and factor loading (J. Hair et al., 2017). For all factor loadings, all values were lower than 0.7, the recommended values (Table 2). The values of AVE are 0.603 to 0.812 and these are higher than the 0.5 threshold (Table 1). Keeping in mind the findings mentioned, for all constructs, it is possible to achieve the convergent validity.

Table 2
Construct reliability for student

Constructs	Items	Factor Loading	Cronbach's Alpha	CR	PA	AVE
IUS	IUS1	0.744	0.753	0.888	0.796	0.809
	IUS2	0.881				
SOC	SOC1	0.839	0.792	0.816	0.864	0.603
	SOC2	0.859				
	SOC3	0.713				
SEL	SEL1	0.855	0.856	0.913	0.859	0.777
	SEL2	0.823				
	SEL3	0.729				
ENJ	ENJ1	0.818	0.882	0.927	0.904	0.812
	ENJ2	0.843				
	ENJ3	0.738				
NOV	NOV1	0.851	0.778	0.827	0.700	0.619
	NOV2	0.822				
	NOV3	0.727				
UNI	UNI1	0.845	0.773	0.729	0.782	0.574
	UNI2	0.774				
	UNI3	0.795				
PEOU	PEOU1	0.739	0.787	0.872	0.910	0.696
	PEOU2	0.859				
	PEOU3	0.713				
PU	PU1	0.755	0.794	0.820	0.819	0.612
	PU2	0.826				
	PU3	0.868				

The discriminant validity measurement is based on two parameters that should be measured, the "Fornell-Larker criterion and the Heterotrait-Monotrait ratio (HTMT)" (J. Hair et al., 2017). The criteria is supported by the "Fornell-Larker" state since the AVEs and square roots are high as compared to the other construct correlations (Fornell & Larcker, 1981) (Table 3 results).

The "HTMT ratio" results are mentioned in Table 4 and they indicate that the 0.85 threshold value remains higher than each construct value (Henseler et al., 2015). Hence, the HTMT ratio is created. The discriminant validity is evaluated through these findings. The research results indicate that the validity, assessment and reliability of the measurement model did not suffer from any issues. Hence, using the data extracted, it is possible to validate the structural model.

Table 3
Fornell-Larcker Scale

	IUS	SOC	SEL	ENJ	NOV	UNI	PEOU	PU
IUS	**0.899**							
SOC	0.371	**0.894**						
SEL	0.474	0.365	**0.787**					
ENJ	0.599	0.279	0.287	**0.834**				
NOV	0.268	0.130	0.365	0.158	**0.785**			
UNI	0.476	0.440	0.698	0.242	0.078	**0.881**		
PEOU	0.437	0.493	0.631	0.250	0.126	0.668	**0.798**	
PU	0.473	0.456	0.658	0.364	0.365	0.766	0.568	**0.897**

Table 4
Heterotrait-Monotrait Ratio (HTMT)

	IUS	SOC	SEL	ENJ	NOV	UNI	PEOU	PU
IUS								
SOC	0.446							
SEL	0.632	0.503						
ENJ	0.729	0.330	0.416					
NOV	0.109	0.163	0.217	0.168				
UNI	0.545	0.535	0.713	0.299	0.199			
PEOU	0.544	0.588	0.782	0.311	0.270	0.674		
PU	0.764	0.646	0.268	0.731	0.294	0.228	0.554	

4.2 Structural Model Analysis

To present the interdependence of several theoretical constructs of the structural model, the structural equation model (Ahmed et al., 2021; Al-Maroof, Alhumaid, et al., 2021), Smart PLS and maximum likelihood estimation have been applied (Aburayya, Alshurideh, et al., 2020; Al-Emran et al., 2020; Alhashmi et al., 2019; Salloum et al., 2019; Salloum & Shaalan, 2019). Using these, the recommended hypothesis has been assessed. Figure 2 and Table 5 indicate that a moderate predictive power is present within the model which indicates that the percentage predicted is nearly 57% of the variance within the intention to use stickers.

The PLS-SEM technique was applied to extract the beta (β) values, t-values, and p-values for the hypotheses developed (Table 6). They are based on derived outcomes. Hypotheses H1, H2, H3, H4, H5, H6, and H7 were supported by empirical data based on data assessment. The results showed that the intention to use stickers (IUS) was significantly affected by "Socialization (SOC) (β= 0.521, P<0.001), Self Presentation (SEL) (β= 0.433, P<0.001), Enjoyment (ENJ) (β= 0.488, P<0.001), Novelty (NOV) (β= 0.664, P<0.001), Unique Function (UNI) (β= 0.595, P<0.001), Perceived Ease of Use (PEOU) (β= 0.320, P<0.05), and Perceived Usefulness (PU) (β= 0.551, P<0.05)" supporting H1, H2, H3, H4, H5, H6, and H7, respectively.

Table 5
R^2 of the endogenous latent variables

Constructs	R^2	Results
IUS	0.569	Moderate

Table 6
Results of path tests

H	Path	Path	*t*-value	*p*-value	Direction	Comment
H1	SOC → IUS	0.521	6.914	0.002	Positive	Accepted**
H2	SEL → IUS	0.433	8.231	0.000	Positive	Accepted**
H3	ENJ→ IUS	0.488	6.850	0.000	Positive	Accepted**
H4	NOV→ IUS	0.664	5.660	0.001	Positive	Accepted**
H5	UNI → IUS	0.595	15.574	0.000	Positive	Accepted**
H6	PEOU → IUS	0.320	2.134	0.023	Positive	Accepted*
H7	PU → IUS	0.551	1.320	0.036	Positive	Accepted*

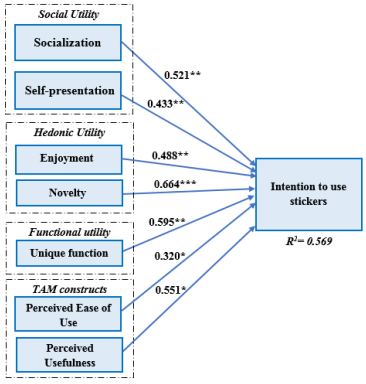

Fig. 2. The final model

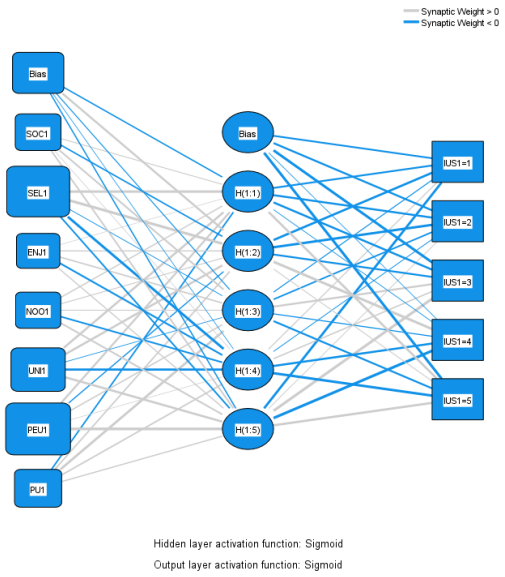

Fig. 3. ANN model

4.3 ANN Results

SPSS is used to conduct the ANN evaluation. Only the relevant predictors derived from the PLS-SEM findings are used in the ANN assessment (Alhumaid et al., 2021; Almarzouqi et al., 2022; Elareshi et al., 2022; Elnagar et al., 2021). For the ANN analysis, only the SOC, SEL, ENJ, NOV, UNI, PEOU, and PU components are taken into account. The ANN model, as illustrated in Fig. 2, has one output neuron (e.g., the intention to use stickers (IUS)) and numerous input neurons (i.e., SOC, SEL, ENJ, NOV, UNI, PEOU, and PU). A two-hidden layer deep ANN model has been applied to manage deeper learning and accommodate all output neuron nodes (V.-H. Lee et al., 2020). Within the current research, the hidden and output neurons have applied the sigmoid function as an activation function. For the recommended research model [61], efficiency can be enhanced by fixing the range for input and output neurons between [0, 1]. To make sure there is no overfitting within the ANN models, the training and testing data applied a tenfold cross-validation process using a ratio of 80:20 (Sharma & Sharma, 2019). For the neural network model's accuracy measurement can be done through the root mean square of error (RMSE). Within the ANN model, the RMSE values for training and testing data are 0.1516 and 0.1627. For the training and testing data, the variance between the standard deviation and RMSE values are very slight, 0.0048 and 0.0096, and by applying ANN, it is concluded that the research model brought forward maintains enhanced accuracy.

4.4 Sensitivity Analysis

The highest mean value and each predictor average is compared, stated in percentage, so that the normalized importance can be extracted. As shown in Table 7, the ANN model has included all predictors mean importance and normalized importance. The sensitive analysis outcomes, as mentioned in Table 7, indicate that for behavioral intention, the highly important predictor is PEOU followed by SEL and UNI. The goodness of fit must be analyzed and it is equivalent to R^2 in PLS-SEM analysis (Leong et al., 2019). This would help with the validation and authentication of the ANN application performance and accuracy. The results show that the ANN analysis (R^2 = 85.3%) predictive power is quite high as compared to PLS-SEM (R^2 = 56.9%). Furthermore, results indicate that as compared to the PLS-SEM approach, thorough endogenous constructs are articulated by the ANN technique. Additionally, the variance disparity is associated with the deep learning ANN procedure and helps in extracting the non-linear associations amongst constructs.

Table 7
Independent Variable Importance

	Importance	Normalized Importance
SOC	.080	29.5%
SEL	.255	93.6%
ENJ	.057	21.0%
NOV	.075	27.6%
UNI	.166	61.1%
PEUO	.272	100.0%
PU	.094	34.7%

4.5 Importance-Performance Map Analysis

In this research, we applied the IPMA as an enhanced approach in PLS-SEM, with behavioral intention serving as the objective factor. Ringle and Sarstedt (Ringle & Sarstedt, 2016) claim that IPMA helps in the understanding of PLS-SEM evaluation findings. In supplement to analyzing the path coefficients (– for example, importance measure), IPMA adds the average number of the underlying constructs and associated factors (– for example, performance measure) (Ringle & Sarstedt, 2016). Compounding effects represent the importance of previous variables in shaping the objective variable (behavioral intention), and the average of latent constructs' numbers indicates their performance, as per the IPMA. Figure 4 depicts the results of the IPMA. This research looked at the importance and performance of the seven factors (SOC, SEL, ENJ, NOV, UNI, PEOU, and PU). SOC has the maximum numbers for both importance and performance measures, as per the results. It is important to mention that ENJ has the second-highest importance and performance measures. SEL also has the minimum number on the performance measure, despite having the third-highest value on the importance measure.

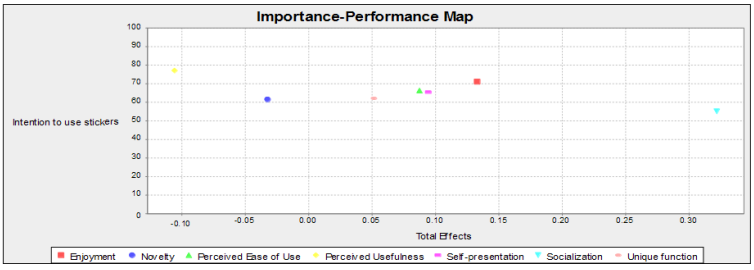

Fig. 4. IPMA results

5. Discussion

The present study fulfills a significant gap in the literature by combining two theories to make a more comprehensive conceptualization model that demonstrates people's intention to use stickers depending on key parameters. The first theory (TAM) demonstrates the degree to which technical factors influence sticker acceptance in WhatsApp. The second theory (e.g., the U&G method) seeks to address the extent to which experiences arise through engaging with the platform and influence stickers usage and implications. As a result, these two theories have been combined into a single model that demonstrates which characteristics are more prominent, and thus more effective, in the use of stickers across college students. It also aids in determining if technical factors or personal experiences have a greater impact on sticker-usage adoption.

Furthermore, the person's acceptance is influenced by factors such as PEOU, PU, etc. TAM and U&G are used in this analysis to predict and explain associations between reasons for using stickers and thoughts about using stickers in college students. Considering the findings of the analysis into account, it can be stated that “perceived ease of use, perceived usefulness, cognition, hedonic, and social integrative factors” all had a substantial impact on “college students' intention to use stickers”. Furthermore, individual relationships had a big impact on the intention to use a sticker in the UAE. This suggests that as long as students believe there are a variety of stickers available in their WhatsApp application, they will utilize them in their online and daily WhatsApp talks. They are also required to use them extensively in everyday situations to substitute long sentences and expressions. According to (S. Herring & Dainas, 2017), the regularity and variety of functionalities of these categories are projected to rise as they become more known and usable. As a result, WhatsApp's application developers should facilitate the use of these stickers in their system to make sure ease of use. As a result, we decided that the development of the use of these stickers should be centered on user-friendliness aspects.

Furthermore, the findings of this study suggest that cognitive gratification has a major impact on students' sticker usage. This is not strange considering that stickers allow individuals to communicate themselves in many ways, including by allowing them to make their stickers utilizing various apps. This feature enables personalizing and refining the various types of stickers tailored to specific requirements. Herring claims that user demographics, the subject of discourse, and the communication environment all influence emoticon use (S. C. Herring, 2007). Furthermore, the study found that hedonic had a substantial impact on stick-er usage. As a result, using stickers should be fun. Students, for example, may find it enjoyable to converse with other students by utilizing a sticker that satisfies the communicative goals. As per (Riordan, 2017), these sentiments can be employed in a variety of scenarios due to their rising ease of use, for example, they can be utilized to decipher text messages. As a result, they may be used in substitute of words in novel ways. Furthermore, this study found that social connection had a major impact on stick-er usage. As a result, creating a new line of three-dimensional stickers is crucial to project success.

Additionally, the findings reveal that personal integration did affect the intention to use stickers. One possible reason for this result is that students choose to convey their integrative concerns using alternative techniques such as emoji.

6. Theoretical implications

Considering the methodology, the earlier empirical research, which applied the SEM analysis, has been contrasted and the hybrid SEM-ANN technique is applied within the current research to establish deep learning. This would help further contribute towards literature, specifically the m-learning domain. As compared to the PLS-SEM model, the predictive power is much more efficient in the ANN model. With the help of the ANN analysis, the predictive power attained is high since it is extracted from the "deep ANN architecture's" possibility to extract non-linear relationships amongst theoretical model variables.

7. Limitations and future research

Although this study examines the importance of using stickers in higher education, it has several limitations that could serve as a springboard for additional investigation. This research was carried out in the UAE's higher education system. Additional studies in other regions, like higher education in the Gulf area, namely Oman and Saudi Arabia, could be done to validate our findings. Furthermore, future research may incorporate a variety of factors found in previous U&G analyses to suit a wide range of user needs and satisfaction. The present study focuses on a group of college students who have adopted stickers in their everyday lives. This provides researchers with an added chance to address this issue in various communities, with an emphasis on gender and age differences. Gender and age have an impact on the kind and regularity of sticker usage.

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