Validation of TAM Model on Social Media Use for Collaborative Learning to Enhance Collaborative Authoring

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ABSTRACT Increased impact of technology leads numerous studies to conduct research on the effect of social media on performance. Very limited of such studies have tried to observe and record the use of social media for collaborative learning as a way to improve collaborative authoring. This paper tries to the validation of the technology acceptance model (TAM) on social media use for collaborative learning to enhance collaborative authoring among research students. To achieve the study objective, this paper employed a questionnaire as the main data collection method and distributed it to 1118 responses of various researchers from the Universiti Teknologi Malaysia (UTM) all of whom use social media. The findings were obtained via a quantitative research method, structural equation modeling (SEM-AMOS). The findings from our empirical study indicate that all the hypotheses were supported; we demonstrate that the use of social media positively and significantly related to collaborative authoring through collaborative learning between researchers in higher education. Therefore, the proposed model will help academic and decision-makers formulate the strategies that can encourage students and researchers to use social media to improving collaborative authoring through collaborative learning.

INDEX TERMS TAM model, social media use, collaborative learning, collaborative authoring.

I. INTRODUCTION

Recent advances in Information and Communication Technology have motivated the need for adaptation of new models of teaching and learning in educational institutions [1]. Social media has become the mixing pot for all forms of communication on all levels and it emerged in current generations of Internet and technology as a very prominent means of distribution and dissemination of various information mainly among students at the higher level of education. Parallely various academic activities, higher education organizations and faculties amplified the use of various social media tools in education. The use of such social media has been growing rapidly and changing how student communicate, interact or learn. Instead of just being the indirect user of the

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information, higher education students are actively partaking in the making of the knowledge. Considering education broadly as a part of the social activity, various educators of the world have been started accepting the importance of the social media in making the learning experience better and at the same time enhancing it. Explain that people with similar interests communicate, interrelate and the get the opportunity to create, share, and exchange ideas and solutions of the problems through internet is known as social networking [2]. Education in the recent times has been moving towards collaborative learning and taking advantage of the latest technology and social media. Collaborative learning is an educational style that emphasizes on cooperative efforts among students, faculty, and administrators. It refers to one of the top effective teaching approaches and it involves methodologies and environments wherein which learners perform a common task, with each depending on and accountable on each other.

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In a collaborative learning, individuals can be few or they can be more (small or large group), with each individual having different abilities or intelligence levels. This method of teaching enables students to contribute and share their ideas with the rest of the members of the group. The method facilitates good and effective interaction among individual members for a more pleasant learning surrounding [3]. The main idea behind a collaborative learning system is to enable individuals to use technology in their discussions on content, opinions, encounters, experience and technologies [4]. It permits students to uphold continuous engagement and connect their knowledge with the outer world. Students can use social network as educational platforms to construct and share knowledge while supporting their self-representation and social acceptance [5]. In this regard, Wolf *et al.* [6] argued the promotion of more effective collaborative learning and the understanding as to the communication between students and teachers regarding their training. While students have not been too inclined towards the extant interacting platforms with their teachers concerning their training, they are receptive to new social media that can work towards learning facilitation with teachers. In this background, online collaborative tool and collaborative authoring environment will work towards supporting the students' online collaborative efforts. In such an environment, some of the activities are interactive educational multimedia; for instance, Author ware and HyperCard, multimedia formats in different forms (bitmap graphic, vector graphic, etc.), e-learning content editors, among others. More specifically, the grid portal technology improves the authoring support web-based collaborative group works by enhancing the speed of searching, supporting the considerable memory, high degree of visualization and enhanced computational tasks [3]. Integrating social media in the learning process is a much greeted idea since the vast majority of social media users are from the younger generations. Due to the recent evolution in the ICT and with the integration of internet in cell phones, today's students have more control on what, how and when they learn [7]. The implementation of collaborative authoring for adaptation support still remains an issue. One question in this area is how adaptation support can be collaboratively authored by a group of teachers or instructional designers. Current authoring tools support learning resources being developed through work by one or more authors. However, rather than enabling collaborative work completed through communication and coordination among authors, such tools support object reuse [8]. To address the literature gap and to provide recommendations for future research, this study presents three new insights into the effect of student intent to use social media towards collaborative learning to enhance collaborative Authoring by: (i) determining the factors that influence student intentions to use social media to participate in social media social for collaborative learning, (ii) examining relationships between all factors; (iii) investigating the significance of the validation of TAM Model on social media use for collaborative learning to enhance collaborative authoring; (iv) developing a model

for student intentions to use social media to participate in collaborative learning to enhance collaborative authoring.

II. RELATED WORK

According to [9], social media network has had a rapid and extensive significant influence in higher education field in a way that different forms of social media has transformed the way the instructors teach, students learn, education managers lead and direct learning. Due to combination of the functional use of social media among collages and the need for institutions of higher education to meet students' needs, institutions in this field are striving to develop the existence of social networking. In the study conducted by [10], they observed that educational networking can enhance the academic performance of students. They added that social networking provides an enriching learning experience through the early recognition of student needs and formative assessment, setting up of classroom community, ensuring student engagement, enhanced student achievement, sharing of knowledge and management of information among students. Along a similar line of argument, [11] related that social networking sites are effective tools to develop the essential students' skills in terms of creation of knowledge in defined or negotiated contexts, selection of relevant information, interpretation and analysis of socio-cultural context, group work and collaborative work, enhancement of communication and interpersonal skills, knowledge and information sharing, negotiation in horizontal contexts, steering clear of hierarchical relationships and knowledge exchanges. Moreover, in reaching a decision on whether to make use of individual or collaborative learning activity, the level of cognitive load that a learning task places on the cognitive capacity of the learner play the key determining factors [12]. The considerable inclination of the students for collaborative learning and learning with the help of technology and their effects may appear to indicate the effectiveness of social media support collaborative learning (SSCL) outcomes [13].

III. RESEARCH MODEL AND HYPOTHESES

This research considers the Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Perceived Enjoyment (PE) to be independent variables, and Social Media Use (SMU) for Collaborative Learning (CL) to be mediator variables. The dependent variable is Collaborative Authoring (CA). See Figure 1.

A. PERCEIVED USEFULNESS

Perceived Usefulness refers to "the extent to which individuals believe that using a particular system would enhance his or her job performance" [14]. The acceptance of Long-Term Evolution (LTE) services was investigated in terms of perceived usefulness and found to be largely influenced by user intentions to use the service [15]. Furthermore, a continued intention to use a short message service that provided utilitarian benefits to users in search of effective communication alternatives was influenced by perceived usefulness [16].
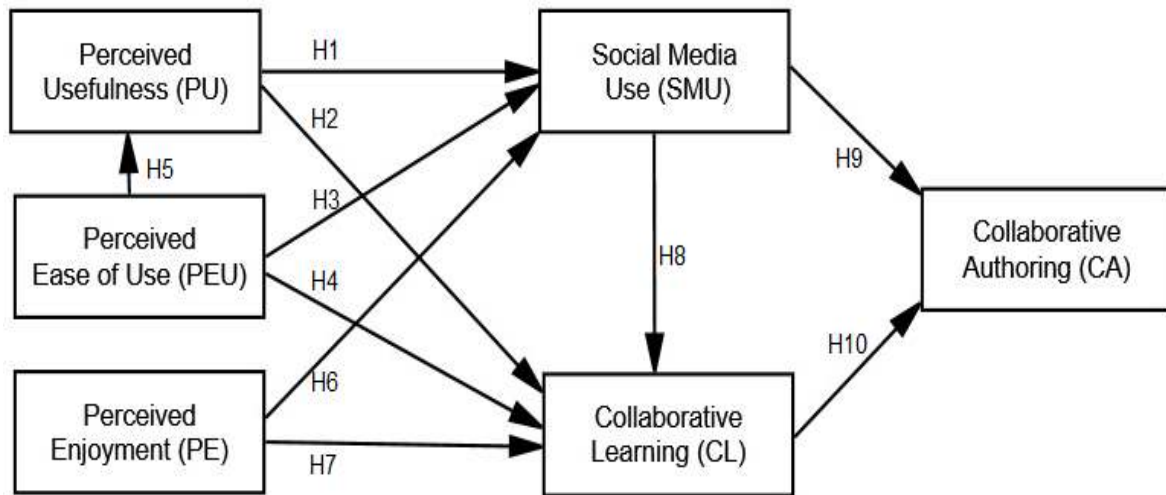
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Some researchers found that continuing intention to use social media for open learning was positively influenced by perceived usefulness. This study uses perceived usefulness to refer to student feelings of how much social media use for collaborative learning to enhance collaborative authoring. Considering the above discussion, the researchers propose the following hypotheses:

H1: There is a significant relationship between perceived usefulness and social media used.

H2: There is a significant relationship between perceived usefulness and collaborative learning.

B. PERCEIVED EASE OF USE

Perceived ease of use refers to the degree to which an individual believes that using a particular system is free of effort [17]. Davis [17] further added that perceived ease of use also influenced technology adoption through consumer attitudes in addition to behavioral intentions. These findings are in line with other studies confirming the positive relationship between perceived ease of use and attitude [14]. Also, some researchers found that continued intention to use social media for open learning was strongly influenced by perceived ease of use. Perceived ease of use was used in this study to refer to the degree to which students feel that using social media for collaborative learning to enhance collaborative authoring. Considering the above discussion, the researchers propose the following hypotheses:

H3: There is a significant relationship between perceived ease of use and social media used.

H4: There is a significant relationship between perceived ease of use and collaborative learning.

H5: There is a significant relationship between perceived ease of use and perceived usefulness.

C. PERCEIVED ENJOYMENT

Perceived Enjoyment refers to the extent to which the service offered by Learning Management Systems (LMS) is perceived to be enjoyable in its own right, separate from any expected performance consequences [18]. Several terms such as hedonic motivation, critical intrinsic and extrinsic motivation for adopting IT systems and services were used in previous research to refer to perceived enjoyment [18], [19]. The perceived values of mobile internet from cognitive elements such as usefulness and fees have perceived enjoyment as a determining factor [16]. The continuous intention of social virtual service usage is largely determined by perceived enjoyment as claimed by [20], [21]. Following [17], this study used perceived enjoyment to refer to the extent to which using social media is perceived as enjoyable in its own right, apart from any performance consequences. Therefore, this study uses perceived enjoyment to refer to the extent to which students believe that using social media for collaborative learning to enhance collaborative authoring. Considering the above discussion, the researchers propose the following hypotheses:

H6: There is a significant relationship between perceived enjoyment and social media used.

H7: There is a significant relationship between perceived enjoyment and collaborative learning.

D. SOCIAL MEDIA USE FOR COLLABORATIVE LEARNING AND COLLABORATIVE AUTHORING

According to [22], in institutions of higher learning, students are more inclined towards using the potential of social websites like Facebook in support of their learning processes compared to the faculty that primarily leverages traditional tools of teaching. Tess [23] conducted a review of social media in higher education classes and found most universities to have the infrastructure and support of social media usage, but instructors are lagging behind in their adoption of social media as a teaching tool. In fact, social network sites were found to be a social learning resource that opens up avenues for high school students to validate and carry out creative work, support peer alumni, and provide and acquire support

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from the school. In this regards, the factors examined in higher education are; faculty use [22], [24], student engagement [25], [26], effect on and relation to academic achievement [25], [27]. More specifically, Sleeman *et al.* [28] found that international students used social media for teaching and learning may have positive implications. Added to this, social media may contribute to personal learning environments as a novel pedagogical method that enhances self-monitored learning [29]. In the viewpoint of social constructivism, [30] noted its creation of compositions in relation to collaborative learning in writing classes whereas [31] found that majority of students felt that their writing interest enhanced via collaborative learning, and such learning through the use of wiki, was found to be linked to positive learning viewpoints [32]. More importantly, the extensive use of wiki technologies has opened the gateway to their application in motivating the participation of learners in collaborative learning [33]. Along the same line of study, [34] stated that Facebook use as a medium of exchange leads to an easier and versatile learning tool that expands collaborative learning while developing a strong connection among students and teachers in an engaging way. An investigation into Web 2.0-based collaborative annotation system showed that the system could lead to enhanced learning achievements in the environment of collaborative learning and this necessitates the analysis of the interaction trends that arises during this type of learning [35]. Considering the above discussion, the researchers propose the following hypotheses:

H8: There is a significant relationship between social media used and collaborative learning.

H9: There is a significant relationship between social media used and collaborative authoring.

E. COLLABORATIVE LEARNING

Collaborative learning refers to an instructional method wherein a small number of students work together and share their information and skills to achieve a specific learning aim. In the context of social networking sites, like Facebook, when effectively utilized, it can enhance the process of learning as it promotes communication, interaction, collaboration and sharing of resources. In this topic of discussion, some studies focused on the way Facebook can enhance the students' academic performance [36], other researchers reached to the conclusion that students view Facebook as first and foremost to be a social technology as opposed to a formal teaching/ learning tool [37]. Some other studies in literature like [38], [39] focused on Facebook as a learning resource promoting collaborative and cooperative learning. More specifically, [38] created Facebook pages for four university courses in his study that analyzed the perceptions of Facebook among students as an interactive learning tool. He found that students who used Facebook for academic aims related several reasons highlighting the effectiveness of the Facebook course page as a learning resource in that it increased interactive and engagement in discussions concerning the topics, and exposed students to media and learning materials. Nevertheless, some issues were voiced concerning the need

for constant update of the Facebook course activity [38]. The interaction-based approach improves the recommendation accuracy for the new-user cold-start problem by integrating preferences profile and tagging recommendation and utilizing the interaction among users and system [39]. Generally speaking, in the field of education, the social networking sites effectiveness may lead to enhanced collaborative learning outcomes as evidenced by several studies [40].The notion that social media collaborative learning through the use of Facebook, chatting, e-mail and weblog has been evidenced to assist learners and instructors in knowledge exchange and experiences that are expected to boost and support students learning and application to actual phenomena and practices. Considering the above discussion, the researchers propose the following hypothesis:

H10: There is a significant relationship between collaborative learning and collaborative authoring.

F. COLLABORATIVE AUTHORING

The ongoing studies on learning with the help of technology, collaborative authoring has been introduced as a new approach as an adaptive learning resource. The approach attempts to enhance authoring via learning standard (IMS Learning Design/IMS LD), the reutilization of existing learning materials, coupled with collaborative features. IMS LD is primarily utilized to improve the output reusability. According to [41], the results of the survey showed that the satisfaction with Digital Textbooks is much higher than that of paper textbooks. In a related study, [8] described the IMS LD approach as applying asynchronous distributed collaboration that allows collaborative work of authors towards the achievement of a goal from different places at different time periods. The authors do not necessarily need to interactively work simultaneously, but their concurrent work at certain periods should be supported. In comparison to other authoring approaches for adaptive learning, this approach's distinction is in its added collaborative features, and the employment of learning standards in the management of learning resources. One of the collaborative features used is Note it allows authors to conduct discussions and enhance their awareness [42]. The approach suggests that teachers steer clear of focusing on the creation of learning materials but rather use materials from existing open content systems. The focus should be placed on the creation of learning activities, learning surroundings, learning flows and sequence, learners and learning rules these are structured in the manifest of IMS as the major output of the authoring process. Other Note outputs contain the discussions among authors, and their updates.

IV. RESEARCH METHODOLOGY

The main data collection method employed in this study is the questionnaire administered among Malaysian higher education researchers. Data collection is conducted through a quantitative method that is reliable, valid and proven to provide reliable information to achieve the study objectives.

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TABLE 1. The demographic factors analysis.

Demographic Factors	Categories	Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	507	45.3	45.3	45.3
	Female	611	54.7	54.7	100.0
	Total	1118	100.0	100.0	
Age	30 and above	315	28.2	28.2	28.2
	27-29	714	63.9	63.9	92.0
	24-26	62	5.5	5.5	97.6
	21-23	27	2.4	2.4	100.0
	Total	1118	100.0	100.0	
Education	Master	489	43.7	43.7	43.7
	PhD	597	53.4	53.4	97.1
	Post-Doctoral	32	2.9	2.9	100.0
	Total	1118	100.0	100.0	
Specialization	Social Science	237	21.2	21.2	21.2
	Engineering	358	32.0	32.0	53.2
	Science and technology	523	46.8	46.8	100.0
	Total	1118	100.0	100.0	

The study sample comprises of researchers who were requested to provide information concerning their experiences of using social media for collaborative learning and its effects on their collaborative authoring. The main study question to be addressed is "What is the relationship between TAM Model on social media use for collaborative learning to enhance collaborative authoring?" The next sections describe the methods used to determine the answer to this question.

A. SAMPLE

Study data was collected with the help of survey questionnaire administered to 1118 researchers in the academic session 2017/2018. The researchers were requested to provide information concerning their experiences with social media use in collaborative learning, and its influence on collaborative authoring. This study used the quantitative method of data collection and analysis to test the proposed hypotheses. Systematic random sampling method was used to choose the sample allowing equal chance for every researcher in the target population to be selected. AMOS Version 23 was used for analysis.

B. INSTRUMENTS AND MEASUREMENT MODEL

The study used a five-point Likert scale was adopted for the questionnaire items (with 1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree, and %: percentage) to measure the questionnaire items. Fine-tuning of the questionnaire was carried out according to the study by [24], [27], [43], with the reliability of factors reported at 0.913. The influence of collaborative learning on collaborative authoring through social media were viewed in four scopes namely, collaboration in learning experience, co-creating the learning experience, freedom of co-creation, and freedom of participation [44]. Moreover, collaborative

authoring is demarcated based on three dimensions namely, enhanced concept comprehensiveness, improved learning experience of the model, and improved understanding of the behavioral concept as suggested by [45].

V. RESULT AND DISCUSSION

In this research the demographic factors was classified according to gender, age, education and specialization. Regarding the age, 507 of the respondents were male and 611 were female with the percentages of (45.3%) and (54.7%) respectively. Based on age, 315 (28.2%) of the respondents were 30 and above, and 714 respondents forming (63.9%) of the respondents were between the ages of 27-29. 62 respondents forming (5.5%) of the respondents were between the ages of 24-26. And 27 respondents forming (2.4%) of the respondents were between the ages of 21-23. Demographic factors of education, master level 489 respondents with the percentages of (43.7%), PhD level 597 respondents with the percentages of (53.4 %), and Post-Doctoral 32 respondents with the percentages of (2.9%). Demographic factors of specialization factor, 237 of the respondents from social science with the percentages of (21.2%), 358 of the respondents from engineering with the percentages of (32.0%), and 523 of the respondents from science and technology with the percentages of (46.8%).

The social media use, collaborative authoring relationship through collaborative learning was found to have Cronbach's Alpha reliability of 0.913, on the basis of standardized items for the three factors. The analysis of the data collected was carried out through the two-step procedure established by [46]. First, the measurement model was examined for its reliability, and convergent and discriminant validity. Second, the structural model was examined to examine the proposed

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TABLE 2. Convergent validity.

No	Factors	Code	Factor Loading	Composite Reliability	Average Variance Extracted (AVE)	Cronbach's alpha
1	Perceived Usefulness (PU)	PU1	0.812	0.819	0.608	0.911
2		PU2	0.791			
3		PU3	0.778			
4		PU4	0.823			
5	Perceived Ease of Use (PEU)	PEU1	0.754	0.907	0.621	0892
6		PEU2	0.854			
7		PEU3	0.750			
8		PEU4	0.739			
9	Perceived Enjoyment (PE)	PE1	0.811	0.896	0.597	0.877
10		PE2	0.738			
11		PE3	0.799			
12		PE4	0.817			
13	Social Media Use (SMU)	SM1	0.772	0.917	0.611	0.913
14		SM2	0.846			
15		SM3	0.829			
16		SM4	0.839			
17		SM5	0.735			
18		SM6	0.794			
19		SM7	0.703			
20		SM8	0.712			
21	Collaborative Learning (CL)	CL1	0.728	0.831	0.582	0.861
22		CL2	0.784			
23		CL3	0.714			
24		CL4	0.789			
25		CL5	0.761			
26		CL6	0.812			
27		CL7	0.800			
28	Collaborative Authoring (CA)	CA1	0.729	0.903	0.641	0.839
29		CA2	0.766			
30		CA3	0.749			
31		CA4	0.745			
32		CA5	0.766			
33		CA6	0.753			
34		CA7	0.776			
35		CA8	0.728			

relationships among the constructs in terms of strength and direction.

A. CONVERGENT VALIDITY OF THE MEASUREMENTS

The composite reliability values obtained are presented in Table 2, and they clearly range from 0.819 to 0.917, all exceeding the cut-off value of 0.70. Added to this, the Cronbach's Alpha values ranged from 0.839 to 0.913, all exceeding the cut-off value of 0.70. Moreover, the average variance extracted (AVE) values ranged from 0.582 to 0.641, all exceeding the recommended value of 0.50. This indicates that the entire factor loadings are significant and exceed 0.50, and thus meeting the recommendations provided [47], [48].

The CFA results of the measurement model are displayed in Table 2.

B. DISCRIMINANT VALIDITY OF THE MEASURES

Discriminant validity examines the level to which a concept and its indicators differ from one concept to another [46]. According to the obtained AVE values, all the values surpassed 0.50 (cut-off value) with p = 0.001, indicative of the fact that discriminant validity is supported for all constructs [48]. Also, Hair et al. [46] explained that the correlations of items in any two constructs should not be more than the square root of the average variance shared by them in one construct, see Table 3.

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TABLE 3. Discriminant validity with means and standard deviation (S.D).

Factors	PU	PEU	PE	SMU	CL	CA	Means	S.D
Perceived Usefulness (PU)	**0.877**						3.5523	0.61101
Perceived Ease of Use (PEU)	0.411	**0.917**					3.6410	0.60971
Perceived Enjoyment (PE)	0.528	0.538	**0.892**				3.5948	0.68210
Social Media Use (SMU)	0.348	0.437	0.379	**0.925**			3.5420	0.67761
Collaborative Learning (CL)	0.428	0.345	0.459	0.539	**0.896**		3.5569	0.63229
Collaborative Authoring (CA)	0.532	0.428	0.399	0.491	0.521	**0.926**	3.7581	0.69230
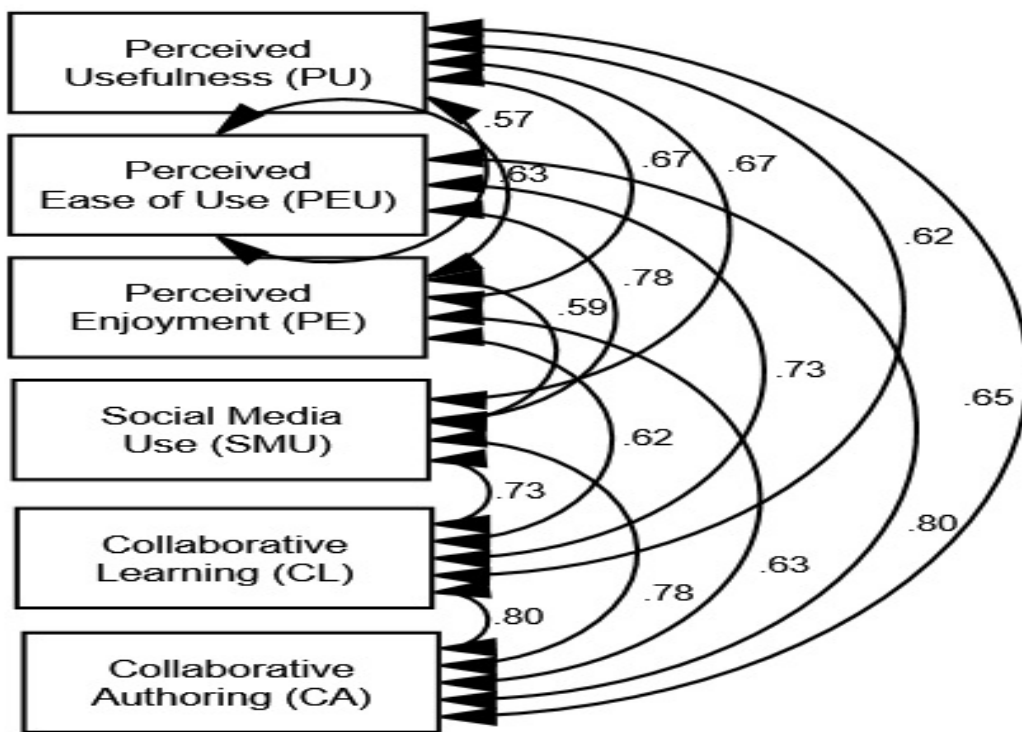
FIGURE 2. Measurement model.

TABLE 4. Fit indices for the measurement model.

Model	χ2	df	χ2/ df	RMR	NFI	RFI	IFI	TLI	CFI	RMSEA
Base	1832.213	219	8.366	.028	.921	.927	.934	.936	.938	.046

C. MEASUREMENT MODEL ANALYSIS

The present study made use of structural equation modeling (SEM) as the primary statistical method for analyzing data with confirmatory factor analysis (CFA) in AMOS 23. The overall goodness-of-fit was analyzed through the use of fit indices (χ^2, df, χ^2/df, RMR, NFI, RFI, IFI, TLI, CFI and RMSEA). Based on the findings of the initial CFA,

an acceptable overall model fit was supported. Figure 2 and Table 4 presents the measurement model results.

D. STRUCTURAL MODEL ANALYSIS (RESULTS OF HYPOTHESIS TESTING)

The next step in SEM involves the CFA testing of the structural framework. The structural model analysis results are
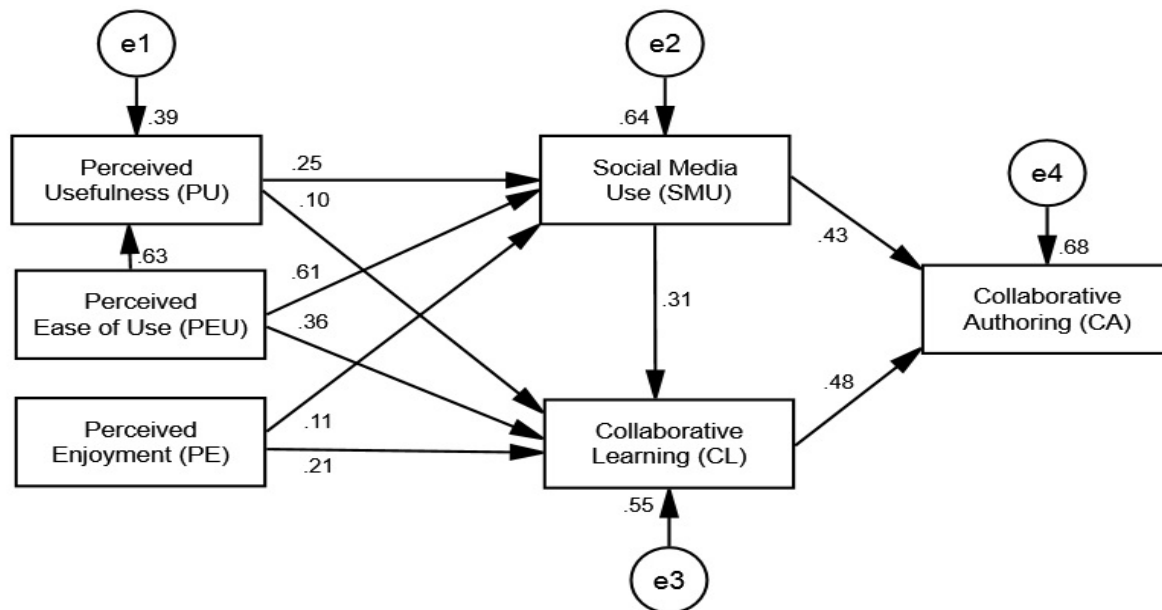
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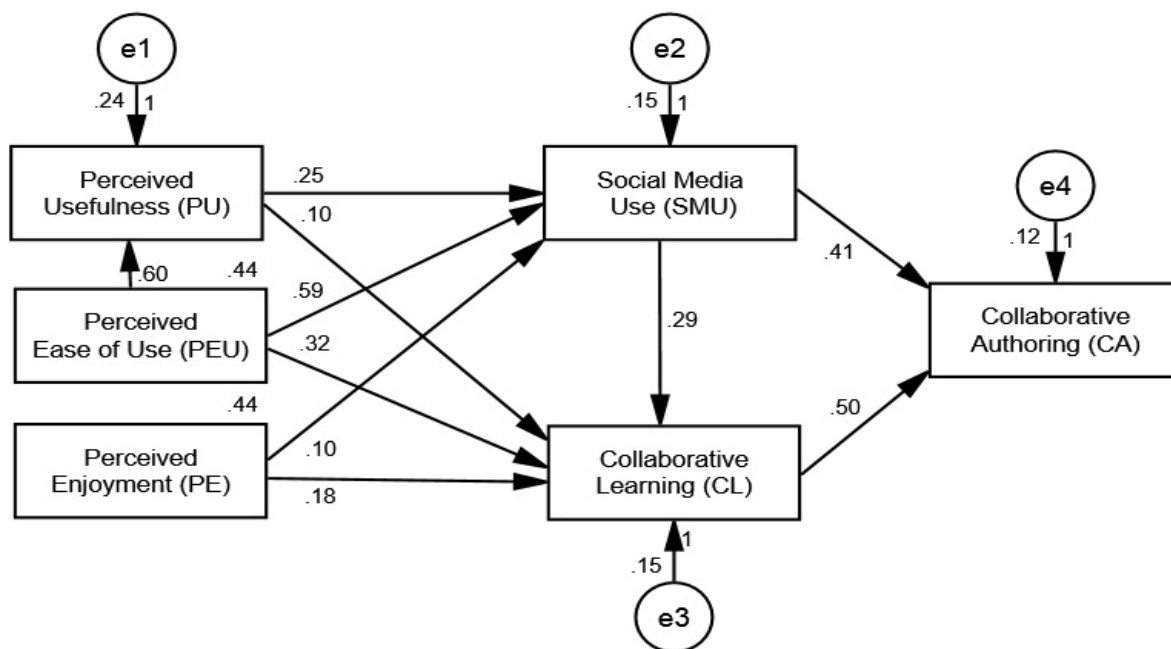**FIGURE 3.** Results of the proposed model (path).

FIGURE 4. Results of the proposed model (hypotheses estimate).

presented in Figure 3 and Figure 4. Also, Table 5, it is evident that the key statistics obtained are very good indicating model validity and the green light for further hypothesis testing. The results of this study support the hypotheses framework concerning the relationship between the variables included in the model.

The parameters of unstandardized coefficients and standard errors of the structural framework are shown in Table 5.

Based on the obtained results, the relationship between perceived usefulness and social media use achieved the following results ($\beta = 0.249$, t = 7.281, p < 0.001). Therefore, the first hypothesis is positive and supported. The second hypothesis is also positive and supported, as the analysis indicates a relationship between perceived usefulness and collaborative learning ($\beta = 0.097$, t = 2.654, p < 0.001). The next direct effect is the relationship between perceived ease of use and social media use achieved the following

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TABLE 5. Hypotheses testing results.

H	Independent	Relationship	Dependent	Path	Estimate	S.E.	C.R.	P	Result
H1	PU	⟶	SMU	.252	.249	.034	7.281	0.000	Supported
H2	PU	⟶	CL	.101	.097	.036	2.654	0.000	Supported
H3	PEU	⟶	SMU	.612	.586	.030	19.719	0.000	Supported
H4	PEU	⟶	CL	.361	.317	.038	8.282	0.000	Supported
H5	PEU	⟶	PU	.633	.598	.029	20.779	0.000	Supported
H6	PE	⟶	SMU	.114	.104	.031	3.377	0.000	Supported
H7	PE	⟶	CL	.213	.183	.032	5.739	0.000	Supported
H8	SMU	⟶	CL	.311	.291	.039	7.362	0.000	Supported
H9	SMU	⟶	CA	.432	.412	.029	14.148	0.000	Supported
H10	CL	⟶	CA	.484	.500	.030	16.551	0.000	Supported

TABLE 6. Mean interval used in analysis [48].

Mean interval	Respondents' Level of Degree of Agreement
1.00 – 2.32	Low level
2.33 – 3.65	Medium level
3.66 – 5.00	High level

results (β = 0. 586, t = 19.719, p < 0.001). Thus, hypothesis number 3 is positive and supported. Moreover, hypothesis number four is a positive and supported, as the analysis also indicates a strong relationship between perceived ease of use and collaborative learning (β = 0.317, t = 8.282, p < 0.001). Therefore, the hypothesis is positive and supported. Also, the relationship between perceived ease of use and perceived usefulness indicates a strong relationship (β = 0.598, t = 20.779, p < 0.001). Therefore, the first hypothesis number 5 is positive and supported. The next direct effect is the relationship between perceived enjoyment and social media use achieved the following results (β = 0. 104, t = 3.377, p < 0.001). Therefore, the hypothesis number 7 is positive and supported. The next hypothesis is also positive and supported, as the analysis indicates a relationship between perceived enjoyment and collaborative learning (β = 0.183, t = 5.739, p < 0.001). The results of hypothesis number 8 is positive and supported the relationship between social media use and collaborative learning achieved the following results (β = 0.291, t = 7.362, p < 0.001). Also, hypothesis number 9 the relationship between social media use and collaborative authoring is positive and supported with (β = 0.412, t = 14.148, p < 0.001). Finally, the results also confirm that relationship between collaborative learning and collaborative authoring is positive and supported with (β = 0.500, t = 16.551, p < 0.001). In sum, all the hypotheses were supported.

E. DESCRIPTIVE AND ANALYSIS OF TAM MODEL WITH SOCIAL MEDIA USE

The characteristics are: perceived usefulness, perceived ease of use, perceived enjoyment, social media use, collaborative learning, and collaborative authoring. The analysis comprises mean, standard deviation and the level of TAM Model on using social media for collaborative learning to enhance collaborative authoring. The mean interval score identifies the importance of each item based on the level of agreement per variable under a factor as illustrated in Table 6.

The result show the majority of students agrees and strongly agrees to use social media is usefulness. In other words, social media use has an influence on perceived usefulness, which in turn affects students' collaborative learning and collaborative authoring. These results are consistent with [49], [50], who argued that social media tools are useful for collaborative learning. See Table 7.

As shown in Table 8, the majority of students agrees and strongly agrees to use social media is ease of use. In other words, social media use has an influence on perceived ease of use, which in turn affects students' collaborative learning and collaborative authoring. These results are consistent with [49], [50], who argued that social media tools are useful for collaborative learning.

Furthermore, the result shows the majority of students agrees and strongly agrees to use social media is usefull and enjoyable. In other words, social media use has an influence on perceived enjoyment, which in turn affects students' collaborative learning and collaborative authoring. These results are consistent with [51], who argued that social media tools are useful for collaborative learning. See Table 9,

Also, the result in in Table 10, the majority of students agrees and strongly agrees to use social media used for collaborative learning. In other words, social media use has an influence on collaborative learning, which in turn affects students' collaborative authoring. These results are consistent

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TABLE 7. Measuring perceived usefulness on social media use for collaborative learning.

Factor	Code	1	2	3	4	5	Mean	S.D
		f (%)	f (%)	f (%)	f (%)	f (%)		
Perceived Usefulness	PU1	4 (0.4)	26 (2.3)	300(26.8)	552 (49.4)	236 (21.1)	3.89	.769
	PU2	2 (0.2)	31 (2.8)	275 (24.6)	556 (49.7)	254 (22.7)	3.92	.771
	PU3	8 (0.7)	33 (3.0)	256 (22.9)	540 (48.3)	281 (25.1)	3.94	.812
	PU4	16 (1.4)	43 (3.8)	370 (33.1)	479 (42.8)	210 (18.8)	3.74	.856

TABLE 8. Measuring perceived ease of use on social media use for collaborative learning.

Factor	Code	1	2	3	4	5	Mean	S.D
		f (%)	f (%)	f (%)	f (%)	f (%)		
Perceived Ease of Use	PEU1	9 (0.8)	37 (3.3)	352 (31.5)	502 (44.9)	218 (19.5)	3.79	.819
	PEU2	9 (0.8)	43 (3.8)	348 (31.1)	553 (49.5)	165 (14.8)	3.74	.785
	PEU3	29 (2.6)	123(11.)	396 (35.4)	432 (38.6)	138 (12.3)	3.74	.934
	PEU4	5 (0.4)	60 (5.4)	406 (36.3)	492 (44.0)	155 (13.9)	3.65	.799

TABLE 9. Measuring perceived enjoyment on social media use for collaborative learning.

Factor	Code	1	2	3	4	5	Mean	S.D
		f (%)	f (%)	f (%)	f (%)	f (%)		
Perceived Enjoyment	PE1	8 (0.7)	16 (1.4)	204 (18.2)	521 (46.6)	369 (33.0)	4.10	.791
	PE2	9 (0.8)	21 (1.9)	198 (17.7)	537 (48.0)	353 (31.6)	4.08	.797
	PE3	6 (0.5)	20 (1.8)	191 (17.1)	532 (47.6)	369 (33.0)	4.11	.781
	PE4	9 (0.8)	23 (2.1)	248 (22.2)	571 (51.1)	267 (23.9)	3.95	.783

TABLE 10. Measuring social media use for collaborative learning and collaborative authoring.

Factor	Code	1	2	3	4	5	Mean	S.D
		f (%)	f (%)	f (%)	f (%)	f (%)		
Social Media Use	SMU1	19(1.7)	63 (5.6)	375 (33.5)	457 (40.9)	204 (18.2)	3.68	.893
	SMU2	8 (0.7)	69 (6.2)	349 (31.2)	509 (45.5)	183 (16.4)	3.71	.838
	SMU3	8 (0.7)	54 (4.8)	397 (35.5)	492 (44.0)	167 (14.9)	3.68	.811
	SMU4	8 (0.7)	48 (4.3)	350 (31.3)	518 (64.3)	194 (17.4)	3.75	.814
	SMU5	12 (1.1)	56 (5.0)	400 (35.8)	463 (41.4)	187 (16.7)	3.68	.848
	SMU6	6 (0.5)	73 (6.5)	374 (33.5)	495 (44.3)	170 (15.2)	3.67	.830
	SMU7	4 (0.4)	45 (4.0)	283 (25.3)	534 (47.8)	252 (22.5)	3.88	.811
	SMU8	8 (0.7)	44 (3.9)	289 (25.8)	536 (47.9)	241 (21.6)	3.86	.822

with [50], [52], who argued that social media tools are useful for collaborative learning and collaborative authoring.

Moreover, the result in Table 11, the majority of students agrees and strongly agrees the collaborative learning enhance collaborative authoring. In other words, collaborative learning has an influence on collaborative authoring, these results are consistent with [50], [52], who argued that social media tools are useful for collaborative learning and collaborative authoring.

Finally, the results also in Table 12, the majority of students agrees and strongly agrees the collaborative authoring is positive and supported with social media use for collaborative learning. In other words, social media use for collaborative learning has an influence on collaborative authoring; these results are consistent with [50], who argued that social media tools are useful for collaborative learning and collaborative authoring.

VI. DISCUSSION AND IMPLICATIONS
The SEM results indicated that positive and significant effect of TAM Model (perceived usefulness, perceived ease of use and perceived enjoyment) on social media for collaborative learning to enhance collaborative authoring. This study is successful highlighting the role of important variables as independent variables integrated in the comprehensive model. The results are showing significant and positive relationship

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TABLE 11. Measuring collaborative learning for collaborative authoring.

Factor	Code	1	2	3	4	5	Mean	S.D
		f (%)	f (%)	f (%)	f (%)	f (%)		
Collaborative Learning	CL1	13 (1.2)	51 (4.6)	332 (29.7)	523 (46.8)	199 (17.8)	3.75	.838
	CL2	6 (0.5)	38 (3.4)	332 (29.7)	561 (50.2)	181 (16.2)	3.78	.772
	CL3	11 (1.0)	67 (6.0)	308 (27.5)	530 (47.4)	202 (18.1)	3.76	.852
	CL4	21 (1.9)	52 (4.7)	331 (29.6)	487 (43.6)	227 (20.3)	3.76	.892
	CL5	11 (1.0)	60 (5.4)	305 (27.3)	544 (48.7)	198 (17.7)	3.77	.836
	CL6	11 (1.0)	53 (4.7)	327 (29.2)	551 (49.3)	176 (15.7)	3.74	.813
	CL7	9 (0.8)	62 (5.5)	355 (31.8)	501 (44.8)	191 (17.1)	3.72	.839

TABLE 12. Measuring collaborative authoring.

Factor	Code	1	2	3	4	5	Mean	S.D
		f (%)	f (%)	f (%)	f (%)	f (%)		
Collaborative Authoring	CA1	8 (0.7)	61 (5.5)	327 (29.2)	527 (47.1)	195 (17.4)	3.75	.830
	CA2	6 (0.5)	46 (4.1)	269 (24.1)	588 (52.6)	209 (18.7)	3.85	.786
	CA3	7 (0.6)	56 (5.0)	302 (27.0)	542 (48.5)	211 (18.9)	3.80	.822
	CA4	12 (1.1)	39 (3.5)	333 (29.8)	533 (47.7)	201 (18.0)	3.78	.816
	CA5	10 (0.9)	52 (4.7)	322 (28.8)	551 (49.3)	183 (16.4)	3.76	.812
	CA6	8 (07)	44 (3.9)	334 (29.9)	550 (49.2)	182 (16.3)	3.76	.793
	CA7	8 (07)	52 (4.7)	328 (29.3)	520 (46.5)	210 (18.8)	3.78	.827
	CA8	7 (0.6)	47 (4.2)	331 (29.6)	532 (47.6)	201 (18.0)	3.78	.808

between TAM Model (perceived usefulness, perceived ease of use and perceived enjoyment) with social media use and collaborative learning. Also, social media use and collaborative learning showing significant and positive relationship with collaborative authoring. These results are consistent with those reported by [2], [24], [50]–[54]. All the proposed hypotheses were supported and accepted. On the other hand, the results contradict with those reported by [36], [54]–[56] that showed a negative relationship between social media and collaborative learning. These findings are also in line with previous literature on social media tools and their functional effectiveness [57]. This study found a positive effect from student intentions to use social media from perceived usefulness, perceived ease of use, and perceived enjoyment. These factors enhanced collaborative authoring through TAM Model on social media for collaborative learning. The study also found that supporting complementary TAM Model on social media for collaborative learning is needed more by students on campus than face-to-face conferences [58]. This study highlighted the effectiveness of using social media for collaborative learning and collaborative authoring over face-to-face methods. Therefore, related literature and student exchanges that develop research skills further support these findings. From the literature, it was found that some studies such as Molinillo *et al.* [59] contradict this study's findings and other studies such as Schoor and Bannert [60] support this study's findings. Schoor and Bannert [60] further highlighted that there was no significant relationship between enjoyment and intentions to use social media due to student's high level

of proficiency in using related information technology. The relationship between social media use for collaborative learning and collaborative authoring was observed to be dampened by cyber stalking [61]. Thus, this study proposes that intentions to use social media are not directly influenced by student enjoyment, which directly influences collaborative authoring and may have an indirect effect through social presence or other external factors. Another possible reason for this is related to student perceptions. Perceptions of multiple social networking tools and ease of use and enjoyment might play a role in such cases. These studies further explained this by stating some time is wasted using these tools for useless activities such as posting useless comments or browsing webpages [62]. Such activities were also highlighted for their potential negative influence on student behavior and performance [63].

This study supports the key role of social media in the enrichment of the skills among researchers via their peer interactions. Their satisfaction in using social media boosts their technology use coupled with different applications, and in turn, this use enhances their skills and improves their academic achievement through collaborative authoring via collaborative learning.

The findings indicate that need for educational institutions to facilitate a collaborative learning environment in order to improve the researchers' performance this is consistent with [64]. This study also indicated that when collaboration among researchers and students with supervisors and teachers, increases their critical thinking ability and their

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learning performance. More specifically, this study found that 990 respondents (88.6%) consider the use of social media as useful in collaborative learning, and paves the way for them for collaborative authoring. On the other hand, 128 respondents (11.4%) indicated their non-use of social media for collaborative authoring. Finally, this research also contributes to theory by proposing collaborative learning as a mediating factor between social media and collaborative authoring. Empirical findings supported that the relationship between social media and collaborative authoring to be more significant, with the indirect effect stronger than the direct effect. Hence, it can be concluded that collaborative learning has a key role to play in enhancing collaborative authoring among students and researchers [24], [54], [56], [58], [61]. The study recommends that students make use of the resources they have to achieve collaborative learning to increase their collaborative authoring. The study also recommends that students willing to use social media should be encouraged to enroll in collaborative learning rather than being forced. Through such practices, institutions can make use of all the components and tools available for the learning process. The study maintains that students should be encouraged to use social media for collaborative learning as it positively influences their collaborative authoring in higher education. Furthermore, students should be assisted by lecturers and supervisors in case they have any inquiries about the use of social media or knowledge sharing. Lecturers and supervisors should provide students with information that enhances student learning experiences and improves their research skills. Based on the recommendations of this study, effective anti-bullying programs should be implemented by policymakers in universities. Such procedures should be taken into consideration to stop or at least lessen cyber stalking and bullying due to their negative influence on student educational attainment. Therefore, contributed develop a model for identifying the significant factors that are anticipated to play a major role on social media use for collaborative learning to enhance collaborative authoring.

VII. CONCLUSION AND FUTURE WORK

In the present work, the relevant role of TAM Model on social media use for collaborative learning to enhance collaborative authoring was examined among researchers in a Malaysian higher education institution. A total of 1118 valid responses were collected, and SEM was used to test and validate the model and the research hypotheses. The findings supported all hypotheses of TAM Model on social media use for collaborative learning, with collaborative authoring as the mediating variable. In other words, validation of TAM model on social media use for collaborative learning to enhance collaborative authoring, and social media use significantly influences the researchers' collaborative authoring, but with collaborative learning, such influence becomes manifold. As a consequence, educational institutions are suggested to encourage researchers to leverage social media for their collaborative learning to enhance their collaborative authoring.

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