JOIV : Int. J. Inform. Visualization, 6(3) - September 2022 710-717

INTERNATIONAL JOURNAL ON INFORMATICS VISUALIZATION

journal homepage : www.joiv.org/index.php/joiv

User Motivation Level Analysis of SME Collaboration Gamification

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***Abstract*— One of the problems of SME is the low motivation to collaborate; the lack of research on exploring the motivation to collaborate is an issue that needs to be focused on solving. Objectives. This research aims to explore the level and type of motivation that influences SME's interest in collaborating to provide new insights for SME managers to apply appropriate treatment in developing collaborative activities. This study analyses six octalysis core drives that affect user interest in the use of SME collaboration gamification applications involving 293 SME respondents in the East Java Province. The research method is descriptive and quantitative, using Smart PLS, with a path analysis and analysis model. This study formulates six hypotheses to determine the effect of six core drives on using the collaborative gamification system. The results showed that the four constructs had a *p*-value less than 0.05 and a *T*-Statistic value greater than 1.96, while the other two constructs produced the opposite value. This finding reveals that four core drives (Epic Meaning, Development, Social Influence, and Avoidance) affect user interest in using collaborative gamification applications. In contrast, two core drives (Ownership and Unpredictable) do not affect it. The implication of this study is a recommendation for developers of collaboration-gamification systems to consider the results of this hypothesis, especially the role of core-drive catalysis as a reference in revising or developing collaborative gamification systems. Future work could apply the TAM model to analyze the technology acceptance rate of this system.**

***Keywords*—Core drive analysis; collaboration gamification; small medium enterprise; path analysis.**

Manuscript received 14 Feb. 2022; revised 8 Apr. 2022; accepted 20 May 2022. Date of publication 30 Sep. 2022.

I. INTRODUCTION

Small and Medium Enterprise (SME) is an essential sector in supporting the country's economy, [1], especially in developing countries such as Indonesia [2] [3]. Currently, various challenges for SMEs, such as the problem of collaboration [2], [4]–[6]. Low motivation is one of the crucial problems for SMEs in collaborating [2], [4]–[6]. One solution that SMEs can do is to develop innovations related to collaboration that can increase the motivation to collaborate [6].

Therefore, a collaboration gamification application has been built as a form of innovation that is expected to increase SME actors' motivation to collaborate. The gamification approach was chosen as gamification is a game-based approach, and it is proven to increase the retention and motivation of non-game system users [7], [8]. The collaborative gamification system was evaluated with an octalysis framework that divides motivation into eight core drives to determine the magnitude of the role of motivation [9],[10]. The octalysis framework states that everyone is carrying out activities is driven by one to eight core drives, including Epic meaning/Purpose, Development, Empowerment, Ownership, Social Influence, Scarcity, Unpredictability, Avoidance [9], [11]–[13]. These eight core drives can be used as a motivational measurement tool that we want to know [9].

Meanwhile, DaSilva [14] developed a core-drive motivation measuring tool specifically for gamification by adopting eight core drives octalysis, resulting in 6 validated core drives (Epic meaning, Development, Ownership, Social Influence, Unpredictability, Avoidance). They can be used to

measure the gamified system's motivation types. Thus, this study uses the DaSilva approach [14] to evaluate user motivation for the SME collaboration application system in more detail.

This study aims to determine what core drives affect the use of the collaboration gamification system, and it can be used to evaluate the collaboration system development in the future. This study will add new core drives that affect collaboration gamification and core drives that do not. The findings of this study can also be utilized to make recommendations to developers of collaborative gamification systems to use the findings of this hypothesis as a guide when changing the system they have constructed. Another implication of this research is that it can be used as a reference for further collaborative research to consider the results of testing this hypothesis in optimizing the role of core drives in their research.

A. SME Collaboration

There have been studies that discuss SME collaboration. Patricio's research [5] places collaboration as a form of SME innovation realized in an industrial symbiotic partnership idea. Leckel [15] proposed the idea of Local Open Innovation, namely facilitating collaborative innovation activities. Shirazi [16] proposed collaboration as one of the essential criteria in ERP activities. Wai [17] Apa [18] and Kurdve [19] developed a collaboration model of SME with industry which aims to bring groups of different domains (SME, Industry and University) closer together to maximize the potential for positive collaboration between them. Meanwhile, Villa [20] developed a collaboration model with similar domains (producer network). Shirazi [17] places collaboration as an essential element in the supply chain. Ajdari [6] analyzes that there are still few approaches in developing media for collaboration that are applied. Because of this, the proposed collaboration models that focus on digital-based media are one of the ideas that can be realized [21]–[23].

B. Collaboration Gamification.

Gamification has become integrated with modern society's culture to increase user engagement and motivation [7], [8] and attempt to influence user behavior [7], [8]. *Gamification* is a process that replicates the experience of playing an enjoyable game [7], [8]. Gamification aims to combine functionality and engagement to boost functionality, productivity, and satisfaction, expand experience opportunities, influence behavior, and have a positive business impact [24]. Gamification is comprised of three critical components that are inextricably linked to how the mechanics (M) generate the game's dynamics (D) and create an aesthetic (A)/emotional atmosphere for players [24]–[26]. So, based on the problem of the weak motivation for SME collaboration, the gamification approach can be chosen as a collaboration platform.

Several studies on collaborative gamification have been carried out, and some are still in the development process. McGregor [27] and Steffen [28] developed collaborative gamification in software engineering. The field of education has also been carried out by Weithof [29], Knutas [30] and Nofal [31], whom both developed a collaborative gamification model of the learning process. Ardones [32] also evaluates gamification in the Waze app in the social contribution app.

C. Octalysis Gamification Framework.

Yu-kai Chou devised the Octalysis architecture, which is based on eight main drives (Fig. 1) to provide a unique context for completing actions [9], [10], [25]. According to the Octalysis method, no action occurs without an initial impulse [9], [10]. Octalysis divides its eight basic drives into two categories: right brain (creativity, expression) and left brain (analytical thinking) [9], [10], [25]. Additionally, the second group is divided into the top (white hat) and bottom (black hat) (black hat). The white hat contributes to good motivation by providing significance and a sense of control. In comparison, a black hat serves as a disincentive but might inspire balance to attain maximum outcomes [9], [10], [25].

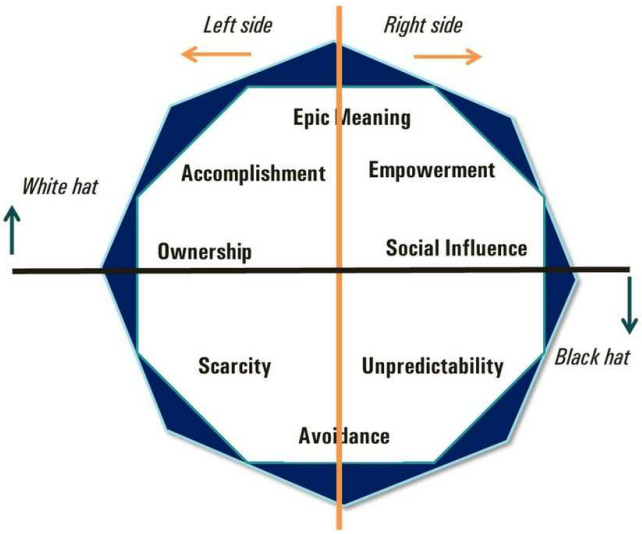

Fig. 1 Octalysis Framework [10]

II. MATERIALS AND METHOD

D. Hypothesis Development.

1) Purpose/Epic Meaning: Purpose / Epic Meaning is the drive to work based on public interest above personal interest [9], [10]. Meanwhile, in this study, let us consider the contribution of users of the Waze application in providing route references in Gustavo's research [32]. Epic Meaning can be related to its effect on collaborative gamification systems. So that the first hypothesis can be stated as H1 = There is a significant effect of Purposes / Epic Meaning on using the collaborative gamification system.

2) Development: Development is a drive to carry out activities based on specific achievements that provide benefits [9],[10]. Based on the expected achievements of collaborators, especially SMEs in collaboration, it is to achieve specific goals according to their domain [20],[33]. So in this study, Development can be related to its effect on the use of the collaborative gamification system. So that the second hypothesis can be stated as H2 = There is a significant effect of Development/Accomplishment on using the collaborative gamification system.

3) Ownership: Ownership / Possession is a drive to carry out activities based on wanting to explore themselves and hoping to have territory and freedom to explore in the following activities [9], [10]. Previous studies have applied gamification in collaborative activities in the software engineering domain, allowing users to explore ideas [27], [28]. So, in this study, ownership can be related to its effect on using the collaborative gamification system. So that the third hypothesis can be stated as H3 = There is a significant effect of Ownership/Possession on using the collaborative gamification system.

4) Social Influence: Social Influence is the drive to carry out activities based on being motivated by others who do them, either by feeling inspired and cooperating or competitive [9],[10]. Previous studies have applied gamification in producer network collaboration activities [20] and multi-domain collaboration between SMEs and industry [18], [19], where these activities cannot be carried out alone. So, in this study, Social Influence can be related to its influence on the use of the collaborative gamification system. So that the fourth hypothesis can be stated as H4 = There is a significant effect of Social Influence on using the collaborative gamification system.

5) Unpredictability: Unpredictability is the drive to carry out activities based on being motivated not to miss opportunities [9],[10]. Previous studies have applied gamification in sustainable collaboration activities in various fields to achieve specific goals. Routine and incidental activities are implemented to achieve the goal, of course, [20], [18], [19]. Based on these opportunities, Unpredictability can be related to using the collaborative gamification system. So that the fifth hypothesis can be stated as follows:

H5 = There is a significant effect of Unpredictability on using the collaborative gamification system.

6) Avoidance: Avoidance is a drive to carry out activities based on wanting always to be involved in the activity in question due to fear of missing out on good opportunities that might exist [9],[10]. Previous studies have applied gamification in sustainable collaboration activities in various fields to achieve specific goals. Some events or opportunities are not routine to achieve goals, of course, to achieve goals of course [18]–[20]. So based on these opportunities, avoidance can be related to its effect on using the collaborative gamification system. So that the sixth hypothesis can be stated as H6 = There is a significant effect of avoidance on using the collaborative gamification system.

E. Sample and Procedure

The data were obtained from data on the drivers of SMEs in the province of East Java, Indonesia. This consideration was taken because East Java is the SME base with the largest number of SME in Indonesia [34]. Data was collected online, which had previously been explained to the respondents. The source of the questionnaire adopted the concept of octalysis framework in Marisa's study [13], [11] and gamification characteristics in DaSilva's study [14]. This study uses six core drives as a construct that is investigated for its effect on collaborative gamification. Each construct consists of 3 indicators that refer to the characteristics of Octalysis [11] and indicators that have been determined in DaSilva's research [14]. Data was obtained from distributing questionnaires with 21 questions that instrument experts validated. The population consists of 1100 SME movers. The sample is determined using the Slovin:

$$N = \frac{N}{(1+(N\ x\ 0.5^2))} \quad (1)$$

where n= sample and N= population. So, the total sample is 293 respondents. The answer scale uses a Likert 1-7 and 21 question items [13].

F. Measurement.

The questionnaire was divided into seven groups according to the construct. Six constructs are independent variables whose influence is investigated, and one construct is the dependent variable, namely collaborative gamification. Six groups of independent variables consist of: “Epic meaning”, “Development”, “Ownership”, “Social Influence”, “Unpredictable” and “Avoidance”. One group of dependent variables is “collaboration gamification”. The measurement scale used is a Likert scale with 7 answers consisting of: 1 = "Strongly disagree", 2 = "Disagree", 3 = "Disagree somewhat", 4 = "Agree", 5 = "Neutral", 6 = "Agree". somewhat” and 7=” Strongly agree”. Epic meaning is measured in 3 indicators to determine the magnitude of the motivation regarding participation in collaborative gamification is to engage with a goal greater than oneself.

Development is measured in 3 indicators to determine the motivation regarding participation in collaborative gamification to achieve achievement. Ownership is measured in 3 indicators to determine the magnitude of the motivation regarding participation in collaborative gamification to explore self-creativity and self-expression so that it is accommodated in the followed system. Social Influence is measured in 3 indicators to determine the magnitude of the motivation to participate in collaborative gamification to make partners self-inspiration to get involved in the system. Unpredictability is measured in three indicators to determine participation in collaborative gamification for getting good opportunities while in the system. Avoidance is measured in 3 indicators to determine the level of motivation regarding participation in collaborative gamification due to the fear of missing out on good opportunities if they are not in the system.

G. Analysis Method.

The analytical technique used in this study is SEM (Structural Equation Modelling) with two (two) stages, namely the measurement model and the structure model [35], [36].. In smart PLS, the measurement model step obtains the value of the outer model, which contains Convergent Validity, Internal Consistency Reliability, and Discriminant Validity[35], [36]. Convergent Validity is used to determine the Validity of each relationship between the indicator and its construct or latent variable [35]. The indicator is considered an appropriate measuring tool if the loading factor value is > 0.7 [35]. *Internal consistency* is defined as an estimate of reliability based on the inter-correlation of an observed or analyzed indicator variable. Internal Cohesion The term "reliability" is frequently used interchangeably with "Composite Reliability" [35]. Meanwhile, *Discriminant*

Validity is defined as the extent to which a construct is distinct from other constructs in an established empirical standard [35].

III. Result and Discussion

A. Convergent Validity.

Convergent validity is used to test the close relationship between the indicator and its construct. The results of the Convergent Validity test are seen in 2 ways. First, based on the value (outer loading), with the condition that an indicator is said to be the right measuring tool if the outer loading value is > 0.7. Second, based on the AVE value with the prerequisite, the AVE value must be greater than 0.5 [35]. Table I shows the outer loading value of the 21 indicators in this evaluation, and there are 20 indicators greater than 0.7 and 1 indicator (X6.1) with the opposite value. It means that a total of 20 indicators have a close relationship with the construct, so it can be said that the indicator is valid as a measuring tool for the constructed variable. This test is also strengthened by the Average Variance Extracted (AVE) value of each construct having a value > 0.5 (Table I).

TABLE I
OUTER LOADING VALUE

Indicators	Avoidance	Development	Collaboration Gamification	Ownership	Purpose	Social Influence	Unpredictable
X1.1					0.835		
X1.2					0.857		
X1.3					0.873		
X2.1		0.885					
X2.2		0.905					
X2.3		0.878					
X3.1				0.879			
X3.2				0.935			
X3.3				0.875			
X4.1						0.847	
X4.2						0.908	
X4.3						0.853	
X5.1							0.873
X5.2							0.871
X5.3							0.882
X6.2	0.910						
X6.3	0.902						
Y1			0.866				
Y2			0.875				
Y3			0.839				

TABLE II
AVE VALUE

Construct	Average Variance Extracted (AVE)
Avoidance	0.822
Collaboration Gamification	0.791
Development	0.740
Ownership	0.804
Purpose	0.731
Social Influence	0.757
Unpredictable	0.766

B. Discriminant Validity.

Discriminant validity is used to test the closeness of the relationship between indicators and their constructs compared to indicators in other constructs. A good indicator is if it has a closer relationship with its construct than with other constructs. The results of the Discriminant Validity test are viewed in 2 ways. First, based on the Fornell Larcker Criterion value (square root of the AVE value), with the condition that an indicator is said to be an appropriate measuring tool if the Fornell Larcker Criterion value is greater than the relationship between constructs/correlation coefficient between variables. Second, based on the value of cross-loadings, with the condition that the indicator must have a cross-loadings value that is greater than the other indicators [35].

TABLE III
FORNEL LARCKER CRITERION VALUE

Construct	Avoidance	Collaboration	Development	Ownership	Purpose	Social	Unpredictable
Avoidance	0.906						
Collaboration	0.662	0.889					
Development	0.599	0.648	0.860				
Ownership	0.674	0.762	0.658	0.897			
Purpose	0.637	0.691	0.693	0.754	0.855		
Social	0.605	0.649	0.691	0.703	0.706	0.870	
Unpredictable	0.653	0.713	0.628	0.736	0.712	0.719	0.875

TABLE IV
CROSS LOADING VALUE

Construct	Avoidance	Collaboration	Collaboration Gamification	Ownership	Purpose	Social Influence	Unpredictable
X1.1	0.537	0.577	0.596	0.611	0.835	0.574	0.624
X1.2	0.525	0.601	0.547	0.637	0.857	0.602	0.639
X1.3	0.569	0.595	0.630	0.684	0.873	0.633	0.567
X2.1	0.576	0.885	0.582	0.627	0.640	0.583	0.613
X2.2	0.605	0.905	0.544	0.671	0.582	0.535	0.615
X2.3	0.586	0.878	0.599	0.732	0.618	0.610	0.670
X3.1	0.603	0.729	0.573	0.879	0.649	0.574	0.673
X3.2	0.617	0.662	0.597	0.935	0.687	0.643	0.682
X3.3	0.593	0.660	0.599	0.875	0.691	0.672	0.625
X4.1	0.535	0.542	0.604	0.624	0.584	0.847	0.598
X4.2	0.542	0.555	0.629	0.587	0.626	0.908	0.623
X4.3	0.501	0.602	0.569	0.627	0.634	0.853	0.657
X5.1	0.559	0.599	0.576	0.644	0.625	0.702	0.873
X5.2	0.536	0.606	0.504	0.625	0.588	0.564	0.871
X5.3	0.616	0.667	0.564	0.662	0.653	0.613	0.882
X6.2	0.910	0.610	0.554	0.651	0.602	0.588	0.611
X6.3	0.902	0.590	0.532	0.569	0.552	0.508	0.572
Y1	0.577	0.554	0.866	0.579	0.600	0.608	0.511
Y2	0.517	0.541	0.875	0.580	0.604	0.583	0.523
Y3	0.449	0.578	0.839	0.539	0.583	0.592	0.588

Table III shows that the Fornell Larker Criterion value found on the diagonal axis in Table III is greater than the variable's value below it. It means that all indicators have a close relationship with the construct compared to other constructs, so it can be said that the indicator is valid as a measuring tool for the constructed variable. Additionally, this test is bolstered by the Cross loadings value (Table IV), which indicates that each indication in the construct has a more significant value than the others.

TABLE V
CRONBACH ALPHA AND COMPOSITE RELIABILITY

	Cronbach's Alpha	Composite Reliability
Avoidance	0.783	0.902
Collaboration Gamification	0.868	0.919
Development	0.824	0.895
Ownership	0.878	0.925
Purpose	0.816	0.891
Social Influence	0.839	0.903
Unpredictable	0.848	0.908

Cronbach's Alpha is used to determine the instrument's reliability/consistency. Cronbach's alpha > 0.7 and composite reliability > 0.7 indicate that an instrument is dependable. Cronbach's Alpha and the consequent composite reliability are described in Table V. Of all constructs, a value of > 0.7 means that the instrument used in evaluating gamification characteristics is consistent and reliable.

C. Inner Model.

Structural Model Testing (Inner Model) is used to forecast causal linkages (cause-and-effect relationships) between latent variables or variables that are not readily quantifiable. The R-square for the dependent construct t-test and the significance of the coefficients of the structural route parameters were used to evaluate this model. The evaluation procedure begins with examining the R-square for each latent dependent variable. The test findings indicate that the Collaboration gamification variable has an R-Square Adjusted value of 0.584. These results indicate that 58.4% of the Collaboration gamification variables can be influenced by the six latent variables studied, while others outside the study influence 31.6%. Fig. 2 describes the Path-model structure gamification characteristics that have been carried out by the inner model process in smart PLS.

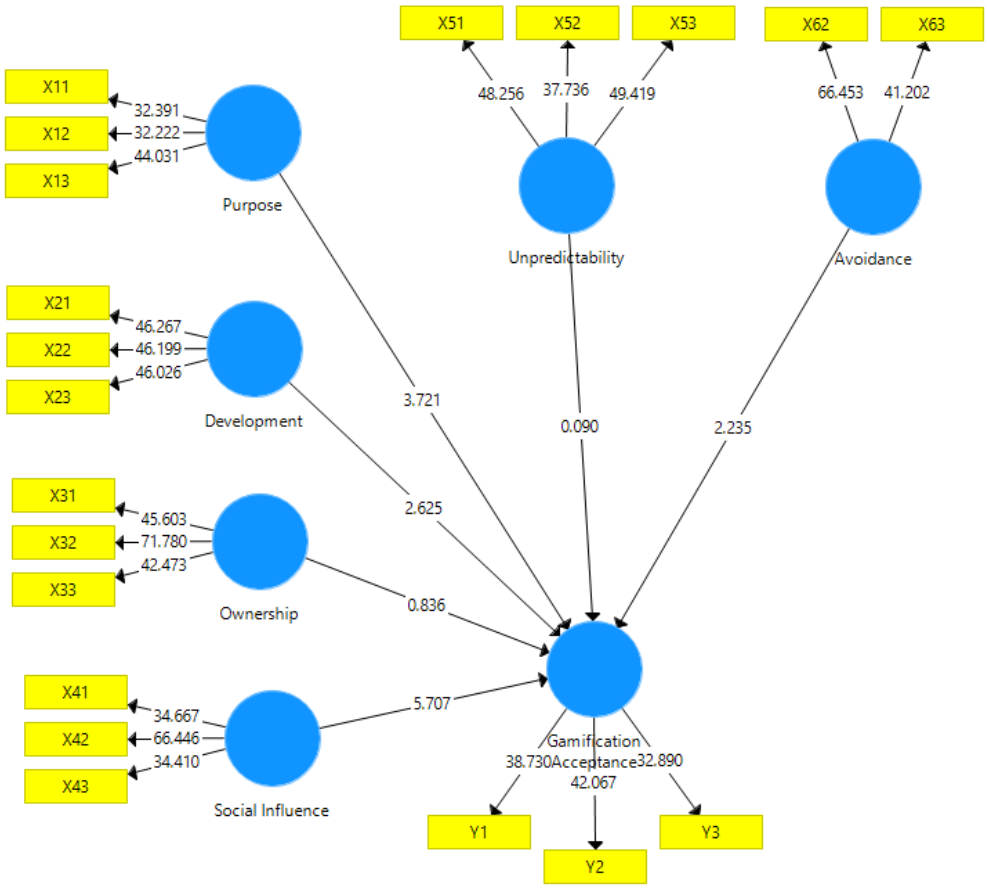

Fig. 2 Path Model of Gamification Motivation Analysis.

Meanwhile, Table VI has described the results of T-Statistics and P-Value used to test the hypothesis. T-statistics shows the relationship between indicators and their variables, where the larger the T-statistics, the more dominant the indicator in measuring the variable. By looking at the T-statistics value that must be more than the critical value (alpha 0.05) or T table = 1.96 or seeing the P value must be < 0.05, it is said that those measured in the hypothesis have a significant relationship.

TABLE VI
T-STATISTIC AND P-VALUE

Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Purpose -> Collaboration Gamification	0.259	0.259	0.070	3.721	0.000
Development -> Collaboration Gamification	0.157	0.159	0.060	2.625	0.009
Ownership -> Collaboration Gamification	0.058	0.055	0.069	0.836	0.403
Social Influence -> Collaboration Gamification	0.297	0.295	0.052	5.707	0.000
Unpredictable -> Collaboration Gamification	0.005	0.008	0.059	0.090	0.928
Avoidance -> Collaboration Gamification	0.108	0.109	0.048	2.235	0.026

D. Finding

Hypothesis 1 (H1) states that Purpose significantly positively affects Collaboration Gamification. Based on the test data (Table VI), the P-value = 0 is less than 0.05, and the T-statistics value = 3.721 is greater than 1.96. Thus, H1 is accepted. Purpose/Epic is the core drive where a person is motivated to take any action because there is an interest greater than himself and can also be caused because someone feels very needed [9]. Based on this research, epic meaning significantly affects someone's interest in running collaborative gamification applications. It can be interpreted that a person's motivation to collaborate is to develop the existence of his community and the external environment that

gets the benefits of collaboration. A person's motivation to collaborate is not always aimed at his interests. In taking advantage of this condition, developers can highlight features that can inform users about the specific goals and urgency of collaboration in the interests of many parties.

Hypothesis 2 (H2) states that Development significantly positively affects Collaboration Gamification. Based on the test data (Table VI), the P-value = 0.009 is smaller than 0.05 and the T-statistics value = 2.625 is greater than 1.96. Thus, H2 is accepted. Development is the core drive where a person is motivated to take any action because someone wants to achieve a certain achievement or achievement [9]. Based on this research, Development significantly affects someone's interest in running collaborative gamification applications. It can be interpreted that one of the motivations for someone to collaborate is to increase the acquisition of achievement and achievement. The developer can exploit this condition to add rewarding features for the achievement of the steps obtained by the user in the rules of mechanics.

Hypothesis 3 (H3) states that ownership significantly positively affects Collaboration Gamification. However, based on the test output data in Table VI, Ownership with Collaboration Gamification shows the P-value = 0.403 greater than 0.05 and T-statistics = 0.836 smaller than 1.96. Thus, H3 is rejected. Ownership is the core drive where someone is motivated to take any action because someone collects virtual goods and manages personalization more freely [9]. Based on this research, ownership does not affect a person's interest in running a collaborative gamification system. Users are not very interested in the customization that the app provides. The causes of the disinterest can be reviewed and become the subject of future research.

Hypothesis 4 (H4) states that Social Influence significantly positively affects Collaboration Gamification. Furthermore, based on the test output data in Table VI, Social Influence with Collaboration Gamification shows the P-value = 0 less than 0.05 and T-statistics = 5.707 greater than 1.96. Thus, H4 is accepted. Social Influence is the core drive where a person is motivated to take any action because it is driven by friends/partners/rivals in their environment [9]. Based on this research, Social Influence affects a person's interest in running a collaborative gamification system. The progress and activity of partners in the collaboration environment affect the user's interest in running the application. Developers can optimize the interaction features between users to facilitate communication. Installation of achievement progress in public places is also necessary to motivate and inspire users to imitate or pursue their partners.

Hypothesis 5 (H5) states that Unpredictability has a significant positive effect on Collaboration Gamification. However, based on the test output data in Table VI, Unpredictability with Collaboration Gamification shows the P-value = 0.928, which is greater than 0.05, and the T-statistics of 0.090 is smaller than 1.96. Thus, H5 is rejected. Unpredictability is the core drive where a person is motivated to take action by an unexpected opportunity that is of interest to him [9]. Based on this research, Unpredictability does not affect someone's interest in running a collaborative gamification system. Surprisingly, programs that provoke user interest do not affect the user's motivation to run the application. The causes of the disinterest can be reviewed and become the subject of future research.

Hypothesis 6 (H6) states that avoidance significantly positively affects Collaboration Gamification. Furthermore, based on the test output data in Table VI, Avoidance with Collaboration Gamification shows the P-value = 0.026, which is smaller than 0.05, and the T-statistics is 2.235, which is greater than 1.96. Meanwhile, the original sample value is 0.109 (positive). Thus, H6 is accepted. *Avoidance* is the core drive in which a person is motivated to take action for fear of missing out on specific opportunities [9]. So based on this research, avoidance affects a person's interest in running a collaborative gamification system. The concern of someone missing an opportunity is a motivation in running the application. Developers can take advantage of this by optimizing features that give confidence that every important event can be held at any time and announced in the system. It is strived for events to provide direct benefits so that users feel at a loss if they miss the opportunity.

IV. Conclusion

The results of the analysis of this study can be used as recommendations for developers of collaborative gamification systems to consider it as a reference in optimizing the role of core drives in their research. This analysis also found that user motivation in using collaborative gamification applications was not much motivated by the customization offered by the system. It is evidenced by Hypothesis 3, which investigates the effect of ownership being rejected. The rejection of Hypothesis 5 (Unpredictability) also shows that programs with uncertain offers do not affect user motivation. However, this finding contradicts the acceptance of H6 (Avoidance), which both have in common: offering something uncertain. However, the difference is that avoidance provides more certainty about the positive impact after doing it, so users are more attached to the core drive of Avoidance than Unpredictability. The acceptance of H2 (Development) and H1 (Epic Meaning) indicates that users interested in running collaborative gamification want to benefit themselves and are also motivated to advance their environment. Meanwhile, the acceptance of H4 (Social Influence) indicates that the role and progress of partners are sufficient to determine users' motivation in running collaborative gamification applications, which is usually caused by users wanting to pursue or imitate their partners (role models).

Future work could analyze the application of collaboration gamification with other measures to gain validation against collaboration applications. The next researcher can apply the Technology Acceptance Model (TAM) to determine this application's level of technology acceptance.

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