The Intelligent Silaturrahmi-Based Gamification Mechanics Model for Improving Small and Medium Enterprise Collaboration

Fitri Marisa [1,7], Muhammad Rudiansyah [2], Rinto Alexandro [3], Novi Dian Nathasia [4], Bambang Pudjoatmojo [5,7], Anastasia L Maukar [6]

[1] *Department of Informatics Engineering, Widyagama University of Malang, Malang, Indonesia*
[2] *Department of Management, STIMI Banjarmasin, Banjarmasin, Indonesia*
[3] *FKIP, Universitas Palangka raya, Palangkaraya, Indonesia*
[4] *Fakultas Teknologi Komunikasi dan Informatika, Jakarta, Universitas Nasional, Indonesia*
[5] *School of Applied Science, Telkom University, Bandung, Indonesia*
[6] *Department of Industrial Engineering, President University, Bekasi, Indonesia*
[7] *Center for Advanced Computing Technology (C-ACT). Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka, Melaka, Malaysia*

Abstract **– This study aims to present an attractive collaboration platform to motivate SME players in collaborating activities to support their business development. Therefore, this article introduces the proposed new model, "Intelligent Silaturrahmi-based Gamification Mechanics (ISb-GM)." This model embodies the gamification mechanics of collaboration based on the cultural parameter of "silaturrahmi" found in previous research. The consideration of choosing this parameter is to increase the closeness of the relationship in collaboration. The model is also equipped with an intelligent system to extract the knowledge needed in the collaboration process. The parameter "silaturrahmi" serves as a reference for scenario mechanics to measure the collaboration performance of each player. The intelligent system functions to complement data extraction needs to provide recommendations for suitable SME partners to collaborate. This model is represented in a collaboration gamification prototype and experiments; it is proven to show performance effectively for collaborating media and measure the collaboration performance of each player.**

Keywords **– SME collaboration, collaboration parameter, gamification collaboration, intelligent silaturrahmi-based mechanics.**

DOI: 10.18421/TEM113-25
https://doi.org/10.18421/TEM113-25

Corresponding author: Fitri Marisa,
Department of Informatics Engineering, Widyagama University of Malang, Malang, Indonesia
Email: fitrimarisa@gmail.com

Received: 25 April 2022.
Revised: 31 July 2022.
Accepted: 06 August 2022.
Published: 29 August 2022.

© 2022 Fitri Marisa et al; published by UIKTEN. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 License.

The article is published with Open Access at https://www.temjournal.com/

1. Introduction

Collaboration is a collaborative activity in groups to achieve mutually beneficial goals [1], [2]. Collaboration is carried out in various fields, and most of them are in the business sector, especially Small and Medium Enterprise (SME) [3], [4], [5]. Collaboration in SMEs plays an important role because the strength of collaboration determines the existence and development of businesses [6], [7]. However, until now the development of SME collaboration is still not optimal due to various problems [8], [9], [10]. The problems that can be identified so far that most research is still limited to discussing include: factors that affect collaboration [10], defining collaboration principles [11], initiating collaboration model concepts [12], lack of strategies for determining suitable collaboration partner references, and application of collaboration models [6], [7], still limited to temporary case settlement [3], [4], [5]. Meanwhile, our previous research has found a cultural-based collaboration parameter "Silaturrahmi" to measure collaboration performance which has adaptive advantages and can strengthen relationships, but this has not been applied in a collaboration model [13].

In addition, previous research also found the fact that the motivation for SME collaboration is still low, where there is a reluctance to collaborate because SME actors do not feel the benefits of collaboration for their business [4], [5], [7]. From the problems that have been identified, a research gap can be formulated, namely collaboration activities require collaboration model innovations that attract interest and accommodate needs and can also measure collaboration performance with tested and adaptive parameters for users [3], [4], [5].

Several approaches can be applied to realize the proposed model. This research uses a gamification approach as a model platform to produce a model that attracts interest, increases retention, and motivates users [14]. Gamification is an approach to modeling non-game systems by adopting game components to create a more attractive system to increase user motivation and retention [15], [16], [17]. The model is focused on creating new collaboration-themed mechanics that are used to determine the player's steps in collaborating. To improve its performance, the model uses an intelligent system approach (Fuzzy-AHP and K-Means) to produce a recommendation system that can support the needs of players in making decisions in collaborating activities [18], [19], [20].

The recommendation system is used to make it easier for players to choose suitable partners and SME segmentation compatible with each other. Meanwhile, to produce adaptive collaboration parameters, the model uses a parameter approach based on "silaturrahmi" culture with the consideration that its principles are easier to accept and absorb by users [21], [13], [22]. The "Silaturrahmi" parameter is realized in mechanics with scenarios and the calculation of the score found in previous studies. The four parameters are Relationship Building (RB), Reciprocal Sustainment (RS), Reciprocal Assistant (RA), and Active Support (AS) [13]. The proposed mechanics model is realized in a web-based Intelligent Silaturrahmi-based Gamification Mechanics (ISb-GM) application prototype. Each player collects a score from the game that has been applied in the mechanics. The score can describe the performance of their collaboration.

This article reports the results of our research on the performance of the ISb-GM model. In the experiment, the prototype was tested with 293 users consisting of SME players in one province. The prototype demonstrates the model's ability to become a medium for interactive collaboration activities, presenting recommendations for suitable partners while recording and displaying player performance scores in personal dashboards and leaderboards. This research resulted in 3 contributions, first is the definition of a new model of gamification-based collaboration for SMEs with a "Silaturrahmi" cultural approach and Intelligent system. The second is an SME collaboration gamification application prototype, and the third is a recommendation system formula in choosing the right collaboration partner.

2. Research Method

The research method (Figure 1) is divided into seven (7) activities, starting from defining collaboration parameters to experimenting to prove the performance of the gamification model of working friendship parameters.

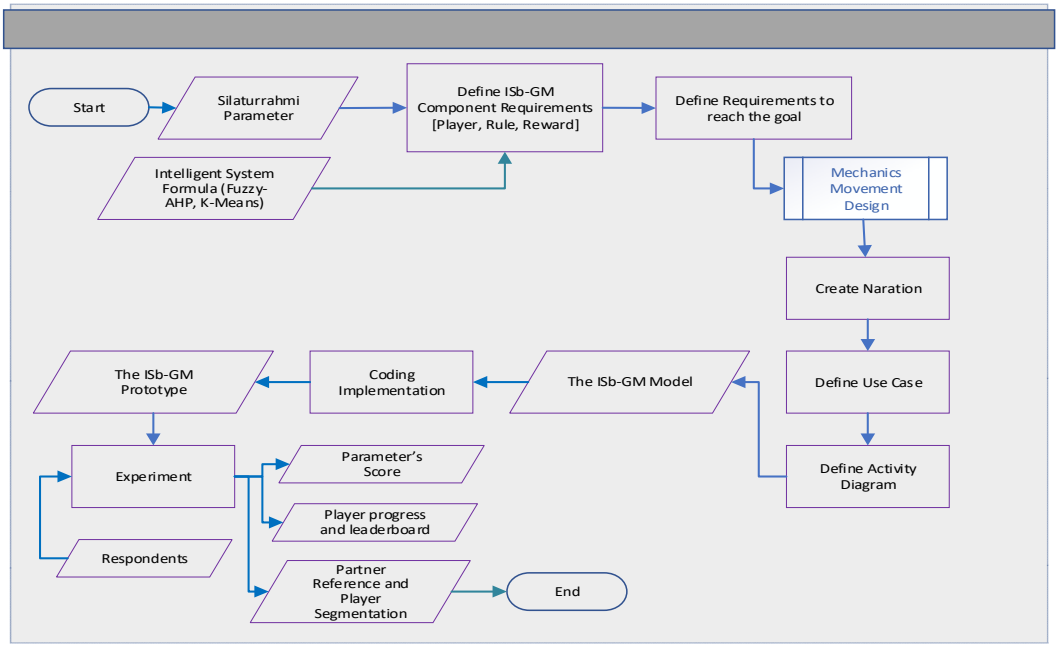

Figure 1. Research Method

2.1. Defining "Silaturrahmi" Parameter

The initial stage is to define the collaboration parameters. It aims to determine reference parameters to measure collaboration performance. Four "Silaturrahmi" parameters, namely RB, RS, RA and AS which have been studied in previous studies [13], are implemented in this test by defining a scenario of collaboration steps for each parameter.

2.2. Defining Intelligent System Formula

The second stage is to define a recommendation model system formula that supports players' needs for suitable partner references and player segmentation that functions to place players in one group with players who have the exact needs. These two formulas are built using the Fuzzy-AHP algorithm to produce a partner reference recommendation system and K-Means to generate player segmentation. This recommendation model is helpful to help players make the right decisions in collaborating with partners.

2.3. Defining ISb-GM Component Requirements and Goal

The third stage is to define all the requirements for gamification components. The player's rules and rewards are defined in the mechanics scenario and the goals to be achieved. Table 1 describes all the mechanical components that have been made.

Table 1. ISb-GM Mechanics Requirement

Requirements of Mechanics	**Definition**
Player / Partner	SME Actor
Indicator	Used to determine the success of collaborating, four indicators that determine success are determined, taken from 4 parameters tested in experiments. 1) Relationship Building (RB) Is how much activity/progress in cooperating 2) Reciprocal Sustainment (RS) Is how much activities/progress support/take care of each other 3) Reciprocal Assistant (RA) It is how much the activities help each other 4) Active Support (AS) Is how much activity/progress related to the initiative to assist/play a role in collaboration
Mechanics of Game	1. Registration 2. Login 3. Invite Friend 4. Friend Suggestion 5. Accept Invitation 6. Community Discussion a. Post Information (IDEA and PROBLEM) b. Solving the problem 7. Intelligent System a.Ranking of the Number Top Players with identity (berbasis Fuzzy AHP) b. SME Segmentation (berbasis K-Means)

2.4. Creating The Narrations

In order to detail the mechanic's steps, narrative elaboration is needed in this case. The narration is realized in a mechanics scenario (Table 2) based on the modules and actors described in Table 1. The mechanics explain the details of the player's steps and the score obtained from each step.

Table 2. ISb-GM Mechanics Scenario

Mechanics Name	Detail of Mechanics Requirement	Parameter Involved Step and Score		
		Parameter / Actor	**Step**	**Score**
Registration	Includes player registration mechanism [username, password, SME name, full name, name of SMEs, types, products sold, market share, marketing system, turnover, capital, age of SMEs	RB / Player	Fill in the complete identification data	20
		RB / Player	Fill in the identity data but not complete	10
Login	Includes player login mechanism	RB / Player	Doing score login activity	5
Invite Friend	Includes the mechanism for making friends with other players, in this case it is required that there must be confirmation of approval from the confirmed partner	RB / Player	Carry out activities to invite partners	10
Friend Suggestion	Includes the mechanism of recommending other players to partners	AS / Player	Friend suggestion request accepted	20
		AS / Player	if friend suggestion is not accepted	5
		RS / Player	Friend suggestion request accepted	10
		RS / Player	if friend suggestion is not accepted	5
Accept Invitation	Includes mechanism for accepting friend requests	RB / Player	Accept invitation	10
		RS / Player	Accept invitation	5
		RA / Player	Accept invitation	5
Community Discussion	Includes a collaboration content mission mechanism consisting of:			
	a. a. Post Ideas or Information	AS / Player	Received a “Salut” response from a partner	20
		AS / Player	Received a “Neutral” response from a partner	5
		AS / Player	Received a “Less relevant” response from a partner	0
		RA / Player	Received a “Salut” response from a partner	20
		RA / Player	Received a “Neutral” response from a partner	5
		RA / Player	Received a “Less relevant” response from a partner	0
		RS / Partner	Activity Partners respond to post ideas	10
	b. Posting Problem	RS / Partner	Partners respond to problems and Player’s rate “Good and relevant”	20
		RS / Partner	Partners respond to problems and Player’s rate "Not relevant"	2
		RA / Partner	Partners respond to problems and Player’s rate	20

Mechanics Name	Detail of Mechanics Requirement	Parameter Involved Step and Score		
		Parameter / Actor	Step	Score
			"Good and relevant"	
		RA / Partner	Partners respond to problems and Player's rate "Not relevant"	2
		AS / Partner	Partners respond to problems and Player's rate "Good and relevant"	5
		AS / Partner	Partners respond to problems and Player's rate "Not relevant"	1

2.5. Defining Use Case and Activity Diagram

The fifth stage is to define use cases and activity diagrams for each mechanics module that has been compiled in the scenario (Table 2). It serves to translate and clarify the workflow mechanics and facilitate implementing the coding prototype. Use cases and activity diagrams are made in four modules: correspondence, posting ideas, posting problems, and intelligent systems. In Figure 2, we present the flow of the correspondence use case, which is the mechanics path's starting point.

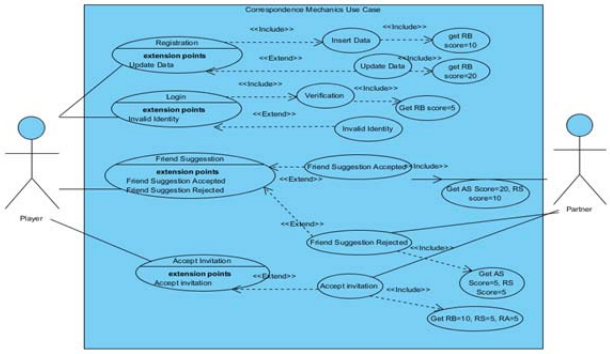

Figure 2. Use Case of Correspondence

2.6. Coding The Prototype

The sixth stage is implementing the coding prototype built based on the web following the scenario, use case, and activity diagram flow. It also uses alpha testing to ensure the correctness of the logic and flow of the prototype.

2.7. Experiment The Prototype

The last stage is the prototype is tested for all the flow and functions. As many as 293 respondents were selected from SME players spread across several regions in one province of the East Java. They were given time to operate the prototype for two weeks. All activities are recorded in the prototype and all the scores generated are also recorded. The score results are displayed in a personal scoreboard and leaderboard as a form of collaboration performance progress.

3. The Proposed Model

The proposed model (Figure 3) is built on two mechanics, namely the mechanics of "silaturrahmi" collaboration and the mechanics of intelligent-Silaturrahmi.

3.1. "Silaturrahmi" Collaboration Mechanics

This mechanic embodies the performance of four parameters (RB, RS, RA, AS) [13] in the gamification platform. The four parameters are translated into narrative and step scenarios, each of which is scored. This mechanic consists of four activities: correspondence to make friends, posting ideas to translate activities to convey ideas to the community, and posting problems to translate activities to convey problems to the community to get solutions. All activities are scored, and the scores obtained are presented in person and leaderboard modes. The total personal score is calculated based on the total score obtained on the four parameters to provide information on the player's performance against each parameter. The leaderboard score is presented with a ranking model based on the highest total score from each player to provide information on player performance compared to other players.

3.2. Intelligent- "Silaturrahmi" Mechanics

This mechanic is built to translate the recommendation model pattern to support decisions in collaboration. The pattern of SME reference is compiled using the Fuzzy-AHP [23], [24] algorithm to provide recommendations for suitable partner references to collaborating based on four criteria, namely scope, market, product, and marketplace. Pattern clustering compiled using the K-Means algorithm [25], [26] is used to present current players' segmentation and positioning information. Players are positioned in clusters that match the similarity of data where the criteria used are scope, market, product, and marketplace. Both patterns aim to optimize relevant partner reference information so that collaboration runs more optimally.

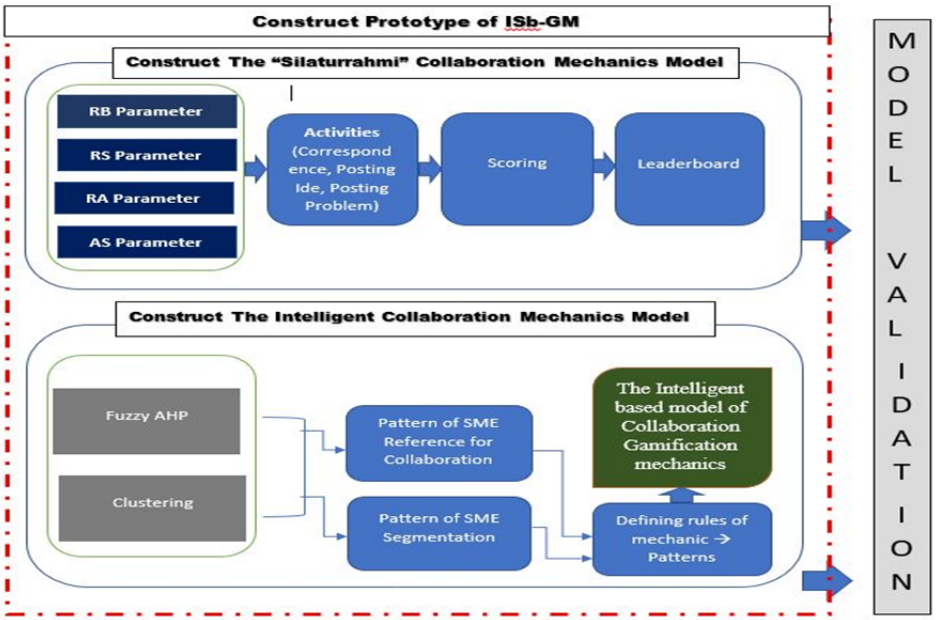

Figure 3. The Proposed Model

4. The Experiment Results and Discussions

Experiments were carried out by 293 respondents, each of whom operated a prototype from player registration, logging in to playing collaboration mechanics. Respondents were given time to operate the prototype for two weeks. Figure 4 shows a prototype of the ISb-GM model that focuses on performance parameters. The left side displays the menu for each mechanical activity, including registration and friendship to carry out correspondence activities. The "silaturrahmi" menu is used to carry out the activity of posting ideas and problems that can be responded to by all players, and the SME reference-segmentation menu creates an intelligent pattern system. Personal score recording is presented above according to the four parameters involved. Players can view their score updates and compare each score's acquisition for self-evaluation of the progress of the collaboration that has been carried out. The leader board is presented in the middle of the interface to emphasize that all players quickly see it at all times. The leader board displays scores based on the player's highest total score to the lowest visualized in the progress bar graph.

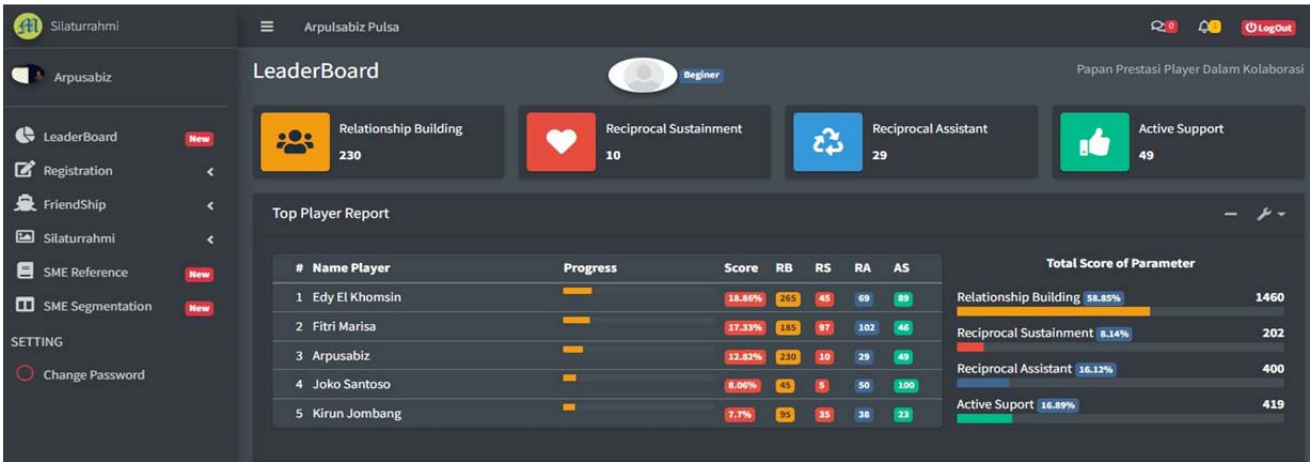

Figure 4. ISb-GM Prototype

Figure 5 and Figure 6 show the implementation of the intelligent pattern system. The SME reference (Figure 5) presents the results of ranking scores based on fuzzy calculations with four predetermined criteria. SME in the first ranking means showing the recommendation of the most suitable SME partner to collaborate with them. The interface is presented in the form of a progress bar visualization placed in the middle position on each player's dashboard to make it easier for players to see it. SME segmentation (Figure 6) presents the results of grouping players according to similar characteristics and needs. The K-Means pattern is determined in this experiment, and the number of clusters is three with four criteria.

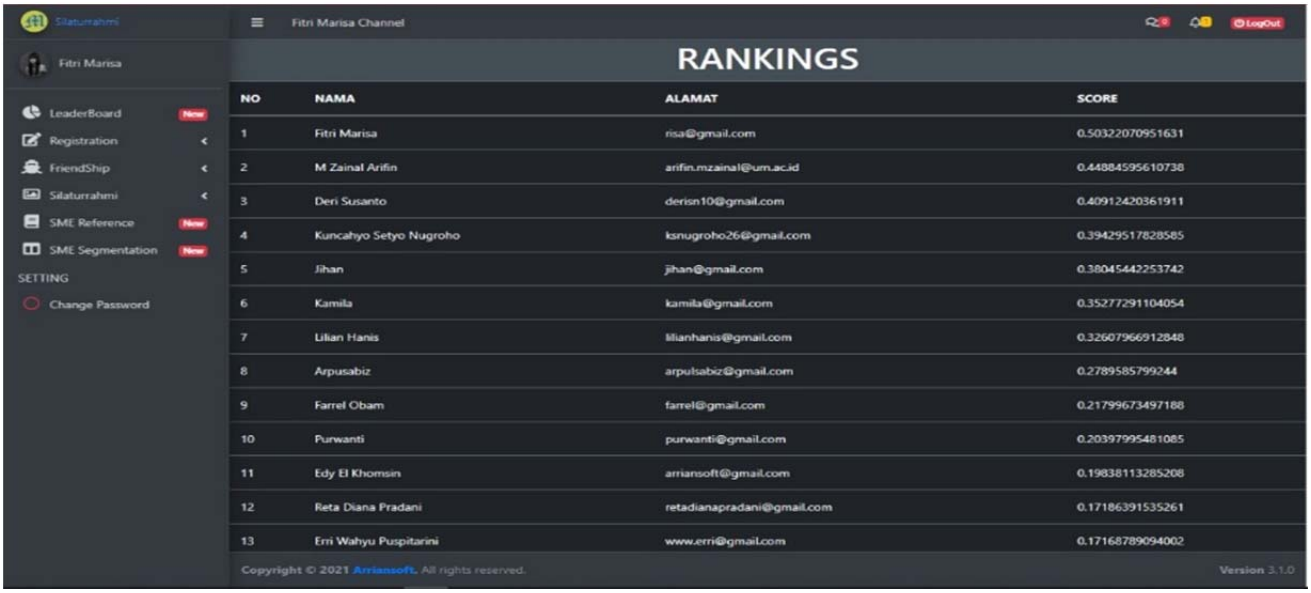

Figure 5. Recommendation model of SME Reference

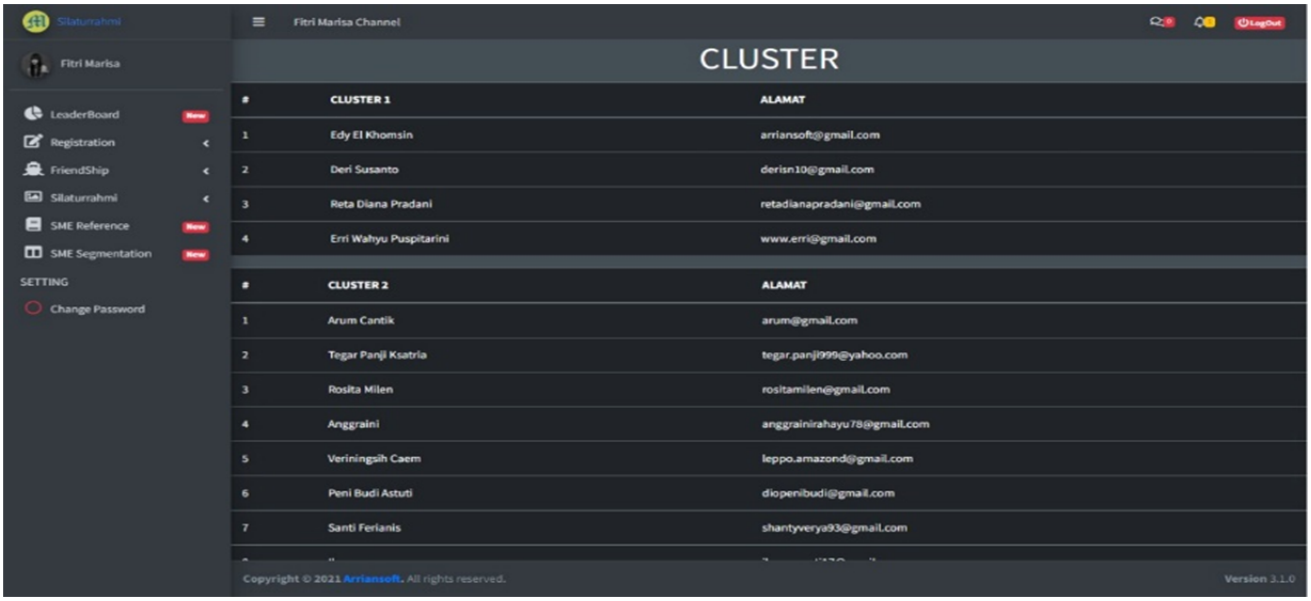

Figure 6. Recommendation Model of SME Segmentation

Based on the experimental results, the prototype can show performance reliability as a medium for SME collaboration in the gamification platform. The prototype can realize the performance of the "silaturrahmi" parameter in recording collaboration progress scores by the types of activities carried out by players. Players can also access their score progress and find out the retention of their collaboration activities compared to other players. This condition is expected to become self-evaluation data and motivate players to improve collaborative activities further.

The prototype can also provide a suitable partner reference in collaborating through the SME reference module. This condition is expected to help SMEs determine partners to cooperate so that collaborative activities become more targeted. In addition, players can also find their position in the SME group with similar characteristics and interests by accessing the SME segmentation module. This condition is expected to provide information on which partners are suitable to work with and which partners are not and can position SMEs in groups according to their needs.

5. Conclusion and Future Works

Intelligent Silaturrahmi-Based Gamification Mechanics (ISb-GM) is to provide a more engaging collaboration atmosphere and increase player motivation and retention. The proposed collaborative gamification model has demonstrated this function effectively using the experimental test of SME respondents. Future research work will focus on evaluating the technology acceptance of ISb-GM in order to determine the level of user acceptance of the application.

References

[1]. Fernández-Olmos, M., & Ramírez-Alesón, M. (2017). How internal and external factors influence the dynamics of SME technology collaboration networks over time. *Technovation*, *64*, 16-27. doi: 10.1016/j.technovation.2017.06.002

[2]. Adornes, G. S., & Muniz, R. J. (2019). Collaborative technology and motivations: utilization, value and gamification. *Innovation & Management Review*, *16*(3), 280-294.

[3]. Proenca, J. C. (2019). Service design for innovation in small and medium businesses. *Global Business Administration Journal*, *3*(2), 29-38.

[4]. Haziri, F., Chovancová, M., & Fetahu, F. (2019). Game mechanics and aesthetics differences for tangible and intangible goods provided via social media. *Management & Marketing. Challenges for the Knowledge Society*, *14*(2), 176-187.

[5]. Taghezout, N., & Reguieg, S. (2017). Supporting multi-agent coordination and computational collective intelligence in enterprise 2.0 platform. doi: 10.9781/ijimai.2017.07.001

[6]. Shambayati, H., Nikabadi, M. S., Firouzabadi, S. M. A. K., & Rahmanimanesh, M. (2020). Partner selection in Virtual enterprises using the Interval Neutrosophic fuzzy approach. *Neutrosophic Sets and Systems*, *35*(1), 387-406.

[7]. Sultan, S., van Dijk, M. P., & Omran, O. (2020). Emergence and development of low-tech clusters: an empirical study of five Palestinian clusters. *EuroMed Journal of Business*, *15*(2), 129-149. doi: 10.1108/EMJB-07-2019-0100

[8]. Bhagavatam, S. D. (2017). A study on Issues and Challenges faced by SMEs: A Literature Review a Study on Issues and Challenges Faced By Sme‟ S: A. *Research Journal of SRNMC*, *1*(3).

[9]. Llave, M. R. (2017). Business intelligence and analytics in small and medium-sized enterprises: A systematic literature review. *Procedia Computer Science*, *121*, 194-205. doi: 10.1016/j.procs.2017.11.027

[10]. Patricio, J., Axelsson, L., Blomé, S., & Rosado, L. (2018). Enabling industrial symbiosis collaborations between SMEs from a regional perspective. *Journal of cleaner production*, *202*, 1120-1130. doi: 10.1016/j.jclepro.2018.07.230

[11]. Ferrada, F., & Camarinha-Matos, L. M. (2019). A modelling framework for collaborative network emotions. *Enterprise Information Systems*, *13*(7-8), 1164-1194. doi: 10.1080/17517575.2019.1633583

[12]. Costa, E., Soares, A. L., & De Sousa, J. P. (2016). Information, knowledge and collaboration management in the internationalisation of SMEs: A systematic literature review. *International Journal of Information Management*, *36*(4), 557-569. doi: 10.1016/j.ijinfomgt.2016.03.007

[13]. Marisa, F., Ahmad, S. S., & Yusoh, I. M. (2021). Constructing the Novelty of SME Collaboration Parameter in Gamification Based on “Silaturrahmi” Culture. *Journal of Theoretical and Applied Information Technology*, *99*(20).

[14]. Marisa, F., Ahmad, S. S. S., Yusoh, Z. I. M., Maukar, A. L., Marcus, R. D., & Widodo, A. A. (2020). Evaluation of student core drives on e-learning during the covid-19 with octalysis gamification framework. *International Journal of Advanced Computer Science and Applications*, *11*(11). doi: 10.14569/IJACSA.2020.0111114

[15]. Chou, Y. K. (2019). *Actionable gamification: Beyond points, badges, and leaderboards*. Packt Publishing Ltd.

[16]. Landsell, J., & Hägglund, E. (2016). Towards a Gamification Framework: Limitations and opportunities when gamifying business processes. Institutionen för informatik, Umeå University.

[17]. Kasurinen, J., & Knutas, A. (2018). Publication trends in gamification: A systematic mapping study. *Computer Science Review*, *27*, 33-44. doi: 10.1016/j.cosrev.2017.10.003

[18]. Ajdari, P., & Talebi, K. (2015). The effect of networking behavior on the reduction of innovation obstacles to small and medium-sized enterprises. *International Journal of Academic Research in Business and Social Sciences*, *5*(3), 419.

[19]. Oussous, A., Benjelloun, F. Z., Lahcen, A. A., & Belfkih, S. (2018). Big Data technologies: A survey. *Journal of King Saud University-Computer and Information Sciences*, *30*(4), 431-448. doi: 10.1016/j.jksuci.2017.06.001

[20]. Isinkaye, F. O., Folajimi, Y. O., & Ojokoh, B. A. (2015). Recommendation systems: Principles, methods and evaluation. *Egyptian informatics journal*, *16*(3), 261-273. doi: 10.1016/j.eij.2015.06.005

[21]. Inchamnan, W. (2019). The Gamification Design Process for the Aging Society in Thailand. *Humanities & Social Sciences Reviews*, *7*(1), 47-54. doi: 10.18510/hssr.2019.716

[22]. Seise, P. C. (2020). Localized Islamic Concepts in Diplomacy: The Example of Silaturahmi. *Prodising ISID*, (1), 21-27.

[23]. Wang, Y., Xu, L., & Solangi, Y. A. (2020). Strategic renewable energy resources selection for Pakistan: Based on SWOT-Fuzzy AHP approach. *Sustainable Cities and Society*, *52*, 101861. doi: 10.1016/j.scs.2019.101861

[24]. Priyantina, R. A., & Sarno, R. (2018, September). Measuring maturity index of risk management for IT-governance using fuzzy ahp and fuzzy topsis. In *2018 International Seminar on Application for Technology of Information and Communication* (pp. 17-22). IEEE. doi: 10.1109/ISEMANTIC.2018.8549732

[25]. Jahwar, A. F., & Abdulazeez, A. M. (2020). Meta-heuristic algorithms for K-means clustering: A review. *PalArch's Journal of Archaeology of Egypt/Egyptology*, *17*(7), 12002-12020.

[26]. Ahmed, M., Seraj, R., & Islam, S. M. S. (2020). The k-means algorithm: A comprehensive survey and performance evaluation. *Electronics*, *9*(8), 1295. doi: 10.3390/electronics9081295