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Enhancing The Awareness of Mechanization Adoption in Agriculture Through Game-Based Learning

Yuanita Handayati, Nur Arief Rahmatsyah Putranto, and Himawan Nur Ardhito
School of Business and Management, Institut Teknologi Bandung

Abstract. *This research implements game-based learning to build rice farmers' awareness of the importance of using mechanization or advanced technology in agriculture. The use of mechanization is one way to increase farming productivity and efficiency, improve the quality and added value of products, and empower farmers. This study examines farmers' attitudes towards the adoption of mechanized methods and proposes a suitable game-based learning approach. First, qualitative methods were employed to develop the game by gathering information, pilot testing, and asking for feedback from farmers. Then, the quantitative method is applied to assess the game's effectiveness using a post- and pretest questionnaire. Cluster analysis was also conducted to determine the proper learning approach based on the farmers' characteristics. The game-based approach is shown to shed light on fostering the adoption of mechanized methods. There are two clusters identified. On average, the first cluster has a younger age, higher educational background, and more positive attitudes toward using mechanized methods. The second cluster, on average, has an older age, a lower educational level, and lower scores in their attitudes toward the adoption of mechanization. The findings also suggest that the farmers in the first cluster may be reached using a pedagogy-based approach, whereas the second is likely to be more receptive to an andragogy-based approach.*

Keywords: *Agriculture; rice farmers; mechanization method; game-based learning; learning approach*

Abstrak. *Penelitian ini menerapkan pembelajaran berbasis permainan untuk membangun kesadaran petani padi akan pentingnya menggunakan teknik mekanisasi dalam pengelolaan lahannya. Selain itu, penelitian ini mengkaji sikap petani terhadap adopsi metode mekanisasi dan mengusulkan pendekatan pembelajaran yang sesuai dengan karakteristik petani. Pertama, metode kualitatif digunakan untuk mengembangkan permainan dengan mengumpulkan informasi, melakukan uji coba, dan meminta umpan balik dari petani. Kemudian, metode kuantitatif diterapkan untuk menilai keefektifan permainan dengan kuesioner post and pre-test. Analisis klaster juga dilakukan untuk mengetahui pendekatan pembelajaran yang tepat berdasarkan karakteristik petani. Pembelajaran berbasis permainan telah terbukti membantu mendorong petani melakukan adopsi metode mekanisasi. Ada dua klaster yang teridentifikasi. Klaster pertama memiliki usia yang lebih muda, latar belakang pendidikan tinggi dan rata-rata memiliki skor sikap menggunakan metode mekanisme yang lebih tinggi. Klaster kedua memiliki usia yang lebih tua, tingkat pendidikan yang lebih rendah juga skor yang lebih rendah dalam sikap mereka terhadap adopsi rata-rata. Hasil penelitian juga menunjukkan bahwa petani di klaster pertama dapat didekati dengan menggunakan pendekatan berbasis pedagogis, sedangkan klaster kedua dapat didekati dengan pendekatan berbasis andragogi.*

Katakunci: *Pertanian; petani padi; metode mekanisasi; pembelajaran berbasis permainan; pendekatan pembelajaran.*

*Corresponding author. Email: yuanita@sbm-itb.ac.id
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Introduction

The agricultural sector is one of the leading sources of livelihood for the Indonesian people. According to the Statistics Agency, in 2018, the forestry and fishery sectors contributed to 30.46% of the total jobs.

The highest demand for agricultural commodities is rice, which is also the leading staple food. According to the Ministry of Indonesia Agriculture, in 2018, Indonesia's population was 267 million and its rice demand was 33.47 million tons.

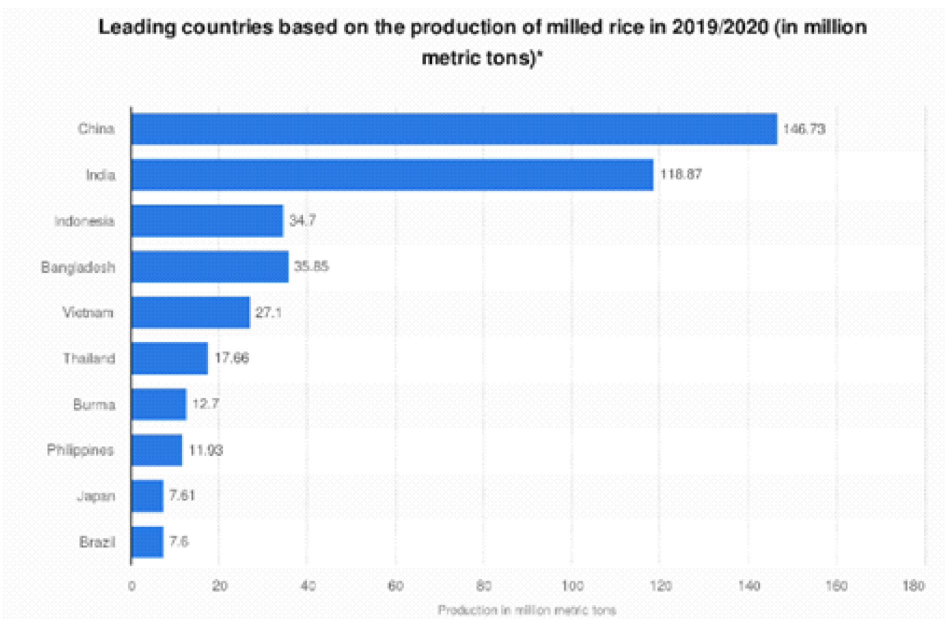


Figure 1.
Rice Producer Countries (Source: US Department of Agriculture 2021)

Figure 1 shows that Indonesia is among the top five rice-producing countries in the world. However, its agricultural practices are not yet optimal compared to the large consumption demand (Indonesia Investments, 2017).

Both mechanized and non-mechanized farming techniques are used in Indonesia. Mechanization uses agricultural machinery to increase the productivity and efficiency of farming, increase rice quality, add products, and empower farmers (Djamhari, 2009; Aldillah, 2016). The modern mechanical farming system involves agrimotors, tractors, planters and harvesters, fertilizers, pesticides, new crop varieties and livestock with enhanced genetic potential (Jaslam, 2017). Although technology has a beneficial impact on rice production, these mechanized methods have never been fully used by the small-scale farmers that account for 90% of rice production in Indonesia (Panuju et al., 2013; Indonesia Investments, 2017); the reasons vary from limited capital to lack of education access (Sims & Kienzle, 2006; Suryahadi & Hadiwidjaja, 2011). Although the government has already put effort into stimulating technological innovation and providing subsidized fertilizers, this solution is not widely spread across small-holder farmers in Indonesia. A previous study by Mariyono (2014) regarding a similar problem highlighted the adoption of new technology as a way forward. Thus, this research is intended to test farmer acceptance of mechanization in agriculture.

According to West Java's Central Statistics Agency (2018), three districts in West Java, namely Indramayu, Karawang, and Subang, are the most extensive rice producers.

Rice production in Indramayu had reached 1.392 million tons by September 2018, Karawang had reached 1.124 million tons, and Subang had reached 0.991 million tons. In another district, Kongsijaya, farmers are divided into several smallholder farming groups. In this paper, the subject will be a group of farmers called "Sri Rahayu 3 Kongsijaya," which consists of 82 members – 25 of whom have been identified as the most active members. These active members gather on many occasions, such as for routine meetings and thanksgiving, and keep in touch with one another. The farmers apply different farming techniques within the group. The seniors use the non-mechanized way, whereas the younger farmers wanted to use mechanization techniques with the help of advanced technology to keep up with changing times. The technologies present are 4-wheel tractors, planting machines and combine harvesters.

The technologies for harvesting in mechanization are available for the group, but some seniors have never used them. This indicates that technologies that have been given to the farmers are ineffectively deployed. This affects the rice supply chain in the district, where the group of farmers cannot produce premium unhulled rice quality needed to meet the market demand quantity. Game-based learning was chosen to enhance the involved farmers' knowledge and awareness to solve the problem.

Typically, games fulfill learning experiences (1993), provide an enjoyable learning environment (Oblinger, 2004), encourage game players and successfully solve underlying problems (Zichermann & Cunningham, 2011; Kapp, 2012). This research answers whether game-based learning is suitable for farmers and effectively enhances their awareness of mechanization adoption. The paper utilized pretest and posttest questionnaires to determine the effectiveness of the game treatment.

Furthermore, this study classifies the farmers' characteristics to identify which approach is suitable for whom. The results add value to the literature on enhancing farmers' awareness toward adopting the mechanization method. In addition, the game created also provides a novel approach.

Literature Review

Agriculture Supply Chain

Agriculture is defined as the many ways in which crop plants and domestic animals sustain the global human population by providing food and other products (Harris & Fuller, 2014). More specific terms also exist under the label of "agriculture," such as cultivation, horticulture, arboriculture, vegeculture, and livestock management (Harris et al., 2014). The agriculture sector remains an essential means for sustainable growth and reducing poverty (Pal et al., 2018). As regards the agriculture supply chain in Indonesia, most smallholding to medium-sized farmers sell their surplus produce directly to the local mills, keeping the rest for their own use (Muthayya et al., 2014). The rice milling factory plays two roles: (1) cleaning, dehusking, and polishing rice and (2) supplying rice through wholesale traders to markets where there is more demand and where rice is sold at higher prices.

The agriculture supply chain involves several processes and facilities: purchasing before production, cultivating and breeding agricultural products, farm processing, distribution and final consumption (Wang et al., 2013). The agriculture supply chain is often generalized as another supply chain that includes all interactions between suppliers, producers, distributors, and customers (Heizer & Render, 2005). In the study by van der Vorst et al. (2007), agri-food chains and networks play a vital role in providing access to markets for producers from developing countries as well as local, regional, and export markets.

Producers' roles in the agricultural supply chain are characterized by the seasonality of production, which results in a long production time, as well as the variability of supply in quality and quantity (van der Vorst et al., 2005). Everywhere in the agri-supply chain, from upstream to downstream, demand in the market is often uncertain. From the small-scale farmers' side, Ye et al. (2017) found that small farmers usually behave risk-aversely due to their constrained resources under uncertain yield and demand conditions. In the case of mechanized agriculture, this risk-averse tendency translates to a reluctance to adopt new technologies and techniques.

Game-based learning

To address farmers' lack of motivation to implement mechanization methods in their farming, this research proposed game-based learning as a solution to introduce and emphasize the importance of mechanization. Game-based learning mainly emphasizes gameplay with defined learning outcomes (Shaffer et al., 2005). A logical extension of this concept is that the game-for-learning design process entails balancing the need to cover the subject matter and emphasize gameplay (Plass et al., 2010). Serious games, gamification and game-based learning are distinguished from entertainment-oriented games because, although often fun, they are designed for primary purposes other than recreation and amusement (Davidson, 2008; Hamari & Koivisto, 2015). Rollings and Adams (2003) described gameplay as a causally relevant series of challenges in a simulated environment.

For this study, educational games or game-based learning focuses on educating by simulating the actual situation. Educational games aim to engage and motivate players through direct game-world encounters (Kiili, 2005). According to the book by Kapp (2012), learning professionals are finding success applying game-based sentience to the development of instruction. The use of game features in a non-game context may encourage motivation and engagement in learning (Alsawaier, 2018).

Kapp (2012) also discusses the following characteristics of game-based education:

1. Game-based learning promotes learning by laying the roots on the game. It is easier to follow the process when assimilating the concepts.
2. The game creates a virtual environment where actual scenarios (simulations) are recreated.
3. Game-based learning is a valuable training tool because it combines elements of gaming: challenges, imagination, inspiration, simple measures of achievement (levels, rating, score), and satisfaction by achieving goals.
4. Game-based learning approaches are the best guarantee to keep participants motivated: participants receive continuous, personalized input that gives them information about their success.

Games generally provide a physical learning environment for problematic learning. Learning structures such as games encourage subjects to discover new concepts and ideas instead of memorizing content provided by others (Kiili, 2005). When creating a game-based learning concept, one should also determine their game's principles and mechanisms. A study by Perrotta et al. (2013) defined game-based learning as extracting the fundamental principles, which are intrinsic motivation to play, learning process through intense enjoyment and fun, contextualized and goal-oriented authenticity, self-reliance (passions and interests that lead to a will to specialize), and experiential learning. The mechanisms constructed from Perrotta et al. (2013) include rules, fictional setting, clear but challenging goals, advanced interaction, and the human element that allows people to share experiences and build bonds. The use of elements or mechanisms based on game-based learning requires careful planning to ensure successful implementation (Werbach & Hunter, 2012); otherwise, projects may be poorly designed to encourage learners and provide the framework for immersive learning. In other words, to create an effective game, the game-based mechanism should be constructed carefully to achieve effectiveness.

Based on Khan and Pearce (2015), there are several types of gamified methods to relieve and engage subjects: blended learning, including computer games, role-playing games, business simulation games, and instructional board games. The board game is one of the best examples of game-based learning for understanding the processes and results of teamwork (Anania et al., 2016). Furthermore, board games have been found to effectively influence attitude (Phuong & Nguyen, 2017).

Perceived usefulness and social influence

The effectiveness of the game board was evaluated by two variables, namely perceived usefulness (PU) and social influence (SI). PU is an idiosyncratic user perspective regarding the possibility of using specific system applications to improve tasks' performance (Surendran, 2012). Ajzen and Fishbein (1980) defined PU as "the degree to which a person believes a particular system would enhance his or her job performance." Davis (1989) defines PU as the prospective user's subjective probability that using a specific application system will enhance their job or live performance. PU is viewed as the determinant of intention, which, in turn, determines use (Davis, 1989; Al-Suqri & Al-Aufi, 2015). Shorten by Al-Suqri and Al-Aufi (2015), and Perceived Usefulness measures the extension to a person's belief that using a system enhances performance at any working conditions.

William et al. (2015) stated that SI is a proven condition where human encouragement could influence others' attributes. Based on Venkantesh et al. (2003), SI is described as the degree to which an individual perceives how essential others believe the use of a system or technology to be. This study seeks to confirm the hypothesis that the game-based learning approach will have a significant and positive post-treatment change on the components of attitude toward using (Perceived Usefulness and Social Influence) and overall results toward adopting the mechanization method.

This research also proposed a suitable learning approach for farmers, employing Individual Learning Approaches Theory, which is divided into two approaches: pedagogical and andragogical. Pedagogy is essentially instruction-based; information is formally conveyed from one who knows to one who does not. Andragogy differs from pedagogy in that it focuses on adult learning (Nkungula, 1996). In this case, adult learning has four assumptions that define the term *andragogy*. First, the learner is perceived as being more self-directed and independent. Second, actual experiences the fundamental for understanding. Third, learning to take place effectively. Last, readiness to learn and paramount orientation of education (Knowles, 1980).

Research Methodology

This study was conducted over 6 months. It consists of exploratory case-solving research that employs both qualitative and quantitative approaches. The investigation began with problem identification by conducting preliminary research through observation, in-depth interview, and field study in the Sri Rahayu 3 Kongsijaya group of farmers in Indramayu Regency. All the processes are conducted offline. The interviewees are the chief of the Sri Rahayu 3 Kongsijaya group of farmers, the owner of a milling factory that buys the unhulled rice from the farmers, and farmers actively involved in the Kongsijaya Group.

The data obtained from preliminary research was applied in devising and developing the game. Next, this study outlines the conceptual framework that adopted perceived usefulness (PU) (Davis, 1989), social influence (SI) (William et al., 2015) and attitude towards using (AT) (Surendran, 2012). These attributes will be the basis for pretest and posttest questionnaires to assess the effectiveness of the game-based learning on attitudes toward agricultural mechanization.

The questionnaires used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to evaluate the degree level of each variable. A Likert scale is suitable for a latent variable (Joshi et al., 2015). It may also reduce the frustration level of the respondents, thereby increasing response rate and quality (Babakus & Mangold, 1992).

The steps to create the game form were to identify what fits with the farmers' situation. This process is not just about creating a game that gives a learning lesson; it also applies the game thinking to how the players perceive the experience and continue to develop by getting feedbacks. According to Taspinar et al. (2016), game design is mainly based on these aspects: player types as stereotypes, develop from players characteristics, and game mechanics as instruments to appeal to players. Board games are perceived as more accessible and valuable than other types of gamified treatment design (Taspinar et al., 2016). Thus, for the ease and convenience of the subjects (farmers), a board game model is chosen to simulate the events that happened in real life.

After the game form is set, the next phase is to consider the game's content, which consists of rules, actors and roles, players, and game type (i.e., competition or collaboration). Competition motivates players to compete until they gain rewards. Consequently, it will enhance the awareness of their knowledge. Collaboration, in contrast, is an external event that encourages the players to do something actively. The purpose of each type is to spur the players' extrinsic motivation. Rewards, grades, completion, contestant, or evaluation by others are the relevant elements of external motivation unrelated to the task value (Alsawaier, 2018).

This research aims to increase farmers' awareness of the benefits of adopting mechanization in agriculture. To achieve this goal, the game is made more focused on the information conveyed to the player. Therefore, regardless of whether the player wins or loses, they will still benefit from the game created.

In addition, considering the age range and education of the players, this game is designed with a low level of complexity (not too many rules for players to understand). Thus, players of any age group and educational background can easily understand the game and enjoy playing it.

To ensure this, before this game is used for the study, a trial process is carried out by involving six farmers within the group currently available in Kongsijaya, Widasari, Indramayu. The farmers played the game and gave input regarding whether they found it challenging to play the game, whether they enjoyed the game, and whether the purpose of the game to convey the importance of mechanization had been achieved. These inputs then become material used to develop games that are in accordance with the profiles of the farmers. This trial also served as pilot testing to test and validate whether the game met the requirements of satisfaction and relevance to the actual situation.

In addition, when playing this game, some assistants will help farmers understand and play it, ensuring that the information intended to be provided is appropriately conveyed. These assistants (or "facilitators") are themselves farmers who have been trained to master the game. While the researcher act as an observer to monitor the behavior of the farmers. The purpose of selecting farmers as the facilitators is to ensure that they can mix well with the players, who are also farmers. Eighteen farmers join this research as players. The demography data of the farmers involved in this research can be seen in Table 1.

Table 1.
Demography Of Respondent

Demography	Characteristics	Number of People
Gender	Male	18
	Female	0
Age	21–30 years	4
	31–40 years	2
	41–50 years	6
	51–60 years	0
	61–70 years	6
Educational background	Elementary School	10
	Middle School	3
	High School	3
	University	2

To gather more insight, a focused group discussion was conducted after the match. The questions for the focused group discussion included *Why was it like that? Will you adopt the use of mechanization in the next cultivating season? Will you dry the unhulled rice in the next cultivating season? What are your experiences and knowledge obtained after the game?*

The final phase is cluster analysis to further identify the most appropriate learning approach based on the players' backgrounds. This study applied two-step clustering analysis by using SPSS. Two-step cluster analysis is a statistical method to classify similar groups or "clusters" within data sets of people or items (Norusis, 2011). Two-step cluster analysis is also considered more robust and precise than conventional clustering approaches such as the k-means clustering algorithm (Norusis, 2007). Three further advantages of two-step cluster analysis are: 1) the ability to segment data simultaneously based on any method of data calculation; 2) the ability to decide the number of clusters automatically; and 3) the ability to identify the importance of each item in the cluster solution (Tkaczynski, 2016). For example, although some behavioral studies traditionally use psychographics (e.g., motivations, perceptions, interests) or behavioral variables (e.g., participation in physical activity, media use, club membership) as the first phase of group classification of segments (e.g., people), the importance of these variables may be minimal or even insignificant in differentiating cluster solutions. Moderately explanatory variables (e.g., age and gender) are often used as a post-analysis validity measure to separate psychographic or behavioral items (e.g., Atlantis et al., 2009; Dietrich et al., 2015) that could provide significant differences in a cluster solution.

Results and Discussion

The purpose of this study is to increase farmers' awareness regarding the benefits of mechanization in agriculture. Therefore, one limitation of this research is that it focuses only on the perception aspect of farmers regarding the benefits of mechanization, rather than on farmers' behavior in using agricultural technology. The use of the game will change only the farmers' perception; many other factors may influence their actual use of the technology.

The research started from the Sri Rahayu 3 Kongsijaya group farmers, most of whom still use non-mechanized methods to cultivate paddy. This approach decreases the quantity and the quality produced, preventing the farmers from meeting demand. Another information is that after the paddy is harvested, farmers choose to keep it before selling or after harvest. This conceptualization leads to the proposed game design to solve the farmers' awareness of its supply chain.

Moreover, based on the interviews, observation, and field study, this study identified two main problems: the harvesting method and lack of willingness to learn. It was found that the farmers do not cooperate harvesting the rice. In this case, there are two methods used within the group: mechanized and conventional. The different approaches caused difficulties for the group to fulfill the demand because each method produced varying qualities and quantities of unhulled rice, which is also affected by the operational costs. Further, most members are reluctant to learn the mechanization method. The group itself finds difficulties teaching, training and empowering farmers to adopt better ways of cultivating rice.

Currently, 75% of the total farmers from the Sri Rahayu 3 Kongsijaya group tend to use the non-mechanized method. In comparison, 25% of the farmers used the mechanized process, but only 10% used it effectively. The technologies used in the group are: 4-wheeled tractor, planting machine and combine harvester. Regarding the operational cost, the non-mechanized method has a higher price than the mechanized process because it requires more supplements for the paddy.

Each method offers its own advantages/ Mechanization is faster in cultivating, eventually producing higher-quality rice. However, the conventional, non-mechanized method produces more quantity than the mechanization method. The farmers' prices would be Rp6,500–6,900 for premium rice and Rp4,500–5,500 for medium-to-low rice quality. There are also three options for the farmers in post-harvesting: 1) Sell directly to the milling factory or intermediaries; 2) keep and wait for the government's price floor; or 3) dry the unhulled rice, then sell it after it has been dried.

This information is the basis of the board game's formulation. The board game made for the players is simple yet educational. The players themselves are farmers within the Sri Rahayu 3 Kongsijaya group, which has been divided into two groups. To access farmers' intrinsic motivation, the game should be made as understandable as possible. This game-based learning procedure includes rules to guide the players and to describe the game.

Furthermore, the game-based learning process is about competition amongst the players. The pilot testing of the game includes questions based on satisfaction, reliability, and recommendation. From the results, all six of the farmers who played during the pilot phase reported being satisfied with the game. They also reported that the game is understandable and able to simulate real-life situations.

The final form of the game-based learning used in this study is a fun board game with rules and other features to guide players along with the game. The actors involved in the game are the farmers, bankers who collect and distribute game currency, and moderators as the game manager. The finalized game form is shown in Figure 2; the rules are shown in Figure 3.

The results of pretest and posttest questionnaires elaborated the variables of the inquiry into each construct (PU, SI and AT). The construct includes descriptive analysis and statistical analysis. Thus, the data given from the surveys was used to answer the hypothetical tests.

Figure 2.
Board Game Design

Game Rules:

- 5 players
- Each players get Rp100.000 for initial capital
- The game prepared 4 fields for each players:
  - The players may cultivate or not
  - The players may choose whatever the methods are
  - 1 Field for 1 Method
- There are two methods: A & B
- Method A: needs 3 periods to harvest
- Method B: needs 2 periods to harvest
- Each fields cost Rp20.000 to cultivate
- Post-harvest→ the players may choose whether the unhulled rice goes to Storage or Dryer
- The amount of harvested unhulled rice depends on the harvest card based on each chosen method
- If goes to Storage = Sell directly
- If goes to Dryer = Needs 1 extra period to be dried, then goes to Storage to be sold
- Wet unhulled rice medium sold for Rp10.000/ton
- Wet unhulled rice premium sold for Rp15.000/ton
- Dried unhulled rice medium sold for Rp20.000/ton
- Dried unhulled rice premium sold for Rp25.000/ton
- The amount of unhulled rice sold depends on demand and quality
- There will be middleman demand's card that is drawn every 3 rounds
- At each three periods, the middlemen will offer farmers to purchase grain/unhulled rice that are still unharvested
- Unsold unhulled rice stays at the storage
- There are event cards for giving information of incidents

The winner is based on the profit and total quantity of sold unhulled rice.

Figure 3.
Board Game Rules

Table 2.
Respondents' Responses Regarding Perceived Usefulness (Pretest & Posttest)

Code	Measures	1	2	3	4	5	Total
				Pretest			
PU1	Mechanization method can save more time in cultivating	5.56%	0.00%	11.11%	38.89%	44.44%	100%
PU2	Mechanization method can produce better unhulled rice quality	0.00%	0.00%	11.11%	22.22%	66.67%	100%
PU3	Mechanization method can help produce unhulled rice in accordance with the demand	5.56%	0.00%	27.78%	33.33%	33.33%	100%
PU4	Mechanization method eases cultivation	0.00%	0.00%	11.11%	16.67%	72.22%	100%
				Posttest			
PU1	Mechanization method can save more time in cultivating	0.00%	0.00%	0.00%	50.00%	50.00%	100%
PU2	Mechanization method can produce better-unhulled rice quality	0.00%	0.00%	0.00%	50.00%	50.00%	100%
PU3	Mechanization method can help produce unhulled rice in accordance with the demand	0.00%	0.00%	16.67%	50.00%	33.33%	100%
PU4	Mechanization method eases cultivation	0.00%	0.00%	0.00%	22.22%	77.78%	100%

In Table 2 on PU1 in pretest, 44.44% of the total respondents answered that they strongly agree with the statement that "Mechanization method can save more time in cultivating." For the PU2 construct, 66.67% of the total farmers answered '5' or strongly agreed that the mechanization method could produce better-unhulled rice quality.

For the PU3 construct, 66.66% of the total respondents answered '4' or '5' (evenly split), indicating agreement that mechanization method could help produce unhulled rice to meet demand. In the last construct of the variable, PU4, 72.22% of the total respondents strongly agreed that "Mechanization method eases the cultivation" statement.

Meanwhile, in the posttest on PU1, there is a significant difference wherein 100% of the total farmers who played the game agreed or strongly agreed that the "Mechanization method can save more time in cultivating." The same pattern is seen for PU2; all respondents agreed that the mechanization method can produce better unhulled rice quality.

For PU3, 83.33% of the total respondents answered '4' or '5,' which indicates they agree that the mechanization method can help produce unhulled rice to meet demand. On PU4, 77.78% of respondents strongly agreed that "Mechanization method eases cultivation" after the treatment.

Table 3.
Respondents' Responses Regarding Social Influence (Posttest)

Code	Measures	1	2	3	4	5	Total
				Pretest			
SI1	Farmers around me use mechanization methods in cultivating	5.56%	0.00%	22.22%	44.44%	27.78%	100%
				Posttest			
SI1	Farmers around me use mechanization methods in cultivating	0.00%	0.00%	11.11%	61.11%	27.78%	100%

Table 3 explains the respondents' responses regarding the SI variable before the treatment. There is only one construct in the SI variable because it is suitable for adjusting to the situation of Sri Rahayu 3 Kongsijaya group members. On the pretest,, 44.44% of farmers answered '4' to Si1 and 27.78% answered '5'; thus, most agreed with the statement, "Farmers around me use mechanization method in cultivating." After the treatment (i.e., after playing the game), the percentage of '4' answers rose to 61.11% while the '5' responses remained unchanged at 27.78%.

Table 4.
Respondents' Responses Regarding Attitude Towards Using Variable (Pretest & Posttest)

Code	Measures	1	2	3	4	5	Total
				Pretest			
AT1	I like to use the mechanization method in cultivating	22.22%	0.00%	22.22%	27.78%	27.78%	100%
AT2	I want to use the mechanization method in cultivating	5.56%	0.00%	27.78%	16.67%	50.00%	100%
				Posttest			
AT1	I like to use the mechanization method in cultivating	0.00%	0.00%	5.56%	44.44%	50.00%	100%
AT2	I want to use the mechanization method in cultivating	0.00%	0.00%	0.00%	44.44%	55.56%	100%

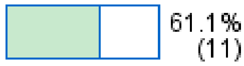
Table 4 describes the respondents' responses regarding the variable of attitude towards using (AT) the mechanization method in cultivating. Before treatment, the results on question AT1 construct ("I like to use mechanization method in cultivating") are almost evenly distributed across '1' to '5.' However, after the treatment, most (94.44%) farmers agreed or strongly agreed ('4' or '5').

For AT2 ("I want to use the mechanization method in cultivating"), 66.67% answered '4' or '5' on the pretest, whereas after treatment, 100% of the total respondents answered '4' or '5,' showing that they agree or strongly agree that they would like to use the mechanization method in cultivating. The focused group discussion consists of 12 items observed and adjusted to the ideal characteristics of farmers. The farmers undertake the treatment divided into groups of 5.

This study highlighted some significant findings. Almost every farmer agreed to use the mechanization method in the next period of cultivating. The reasons they cited included that mechanization goes faster, produces better quality, is up-to-date and can fulfill premium rice demand. Farmers also concurred that they should dry the unhulled rice before it gets sold to obtain a higher value. However, some still thought that it is better to sell it whenever demand arrives.

Furthermore, farmers also differed in opinion on whether they should sell it to the intermediaries. Some who answered "no" have dependency issues, which also means they do not understand the market. In the risk-taker characteristic, the view polarized into the one that will take the risk and the other that avoid it. The reason for preventing taking debt is they afraid they could not pay it back.

Table 5.
Cluster Analysis

Cluster	1	2
Size	 61.1% (11)	 38.9% (7)
Inputs	AT1 4.00 (45.5%)	AT1 1.00 (57.1%)
	Age 38.36	Age 57.57
	Education 2 & 3 (36.4%)	Education 1 (100%)
	PU1 4.27	PU1 3.14
	PU2 4.18	PU2 3.29
	PU4 4.36	PU4 3.43
	Farming experience 1 (81.8%)	Farming experience 4 (57.1%)
	AT2 5.00 (63.6%)	AT2 3.00 (57.1%)
	PU3 4.09	PU3 3.14
	SI1 3.55	SI1 4.29

Furthermore, the two-step cluster analysis began by inputting the data from the questionnaire. The result shows in Table 5 that there are two farmer clusters created. The first cluster sized 61.1% (11 respondents) from 18 respondents. From the AT1 (attitude towards using) question construct, 45.5% of 11 respondents were answering '4' on the scale of 1–5 ("Strongly Disagree–Strongly Agree"), which means they mostly agree. Within the first cluster, the 11 respondents averaged 38.36 years old, meaning that most farmers or respondents in this cluster are the younger ones. The following input describes the farmers' educational background.

On the PU1, PU2 and PU3 question constructs in cluster 1 scores averaged 4.27, 4.18 and 4.36, respectively. Regarding duration of farming experience, the researchers grouped farmers into four categories: 1 (1–10 years farming experience), 2 (11–20 years), 3 (21–30 years) and 4 (<31 years). As a result, 81.8% of 11 respondents in cluster 1 are mostly below ten years in harvesting, indicating that most persons in cluster 1 are not seniors. Proceeding to the AT2 construct, 63.6% of 11 persons answered '5' on the scale of 1–5. On the PU3 construct, 11 respondents scored an average of 4.09.

Proceeding to the final input, SI1, respondents in the first cluster scored 3.55 on average. For the second cluster, the size of the population in cluster 2 is 7 respondents (38.9%). From the AT1 construct, 57.1% of 7 respondents answered '1' on a scale of 1–5. Given that the average age in cluster 2 is 57.57 years old, the farmers in this cluster are the elders. 100% of the respondents within the second cluster have the same educational background, which is '1,' meaning that all seven respondents ended their education at the elementary level. On the PU1, PU2 and PU3 question constructs, cluster 2 scores lower than cluster 1 with 3.14, 3.29 and 3.43, respectively. On duration of farming experience, most (57.1%) farmers or respondents in cluster 2 have been farming for more than 31 years (4), which indicates that most farmers in cluster 2 are seniors. Proceeding to the AT2 construct, 57.1% of 7 persons answered '3' on the scale of 1–5. For the PU3 construct, seven respondents scored an average of 3.14. Finally, on the SI1 question construct, respondents in cluster 3 scored 4.29 on average.

Clusters have different backgrounds (age, education levels, duration of farming experience and technology adoption) based on perceived usefulness (PU), social influence (SI) and attitude towards using (AT). In cluster 1, most farmers or respondents are younger than the population in cluster 2, with an average age of 38 years. Moreover, more respondents belonging to cluster 1 have a higher educational level: middle school and high school. This indicates that the respondents in cluster 1 are more likely to be accustomed to instruction-based learning. Therefore, cluster 1 is suited to the pedagogical approach. According to Conole et al. (2004), “pedagogical constructivism” refers to a theory of development or learning that suggests that individual learners actively construct meaning around phenomena, and these constructions are idiosyncratic, depending in part on the background knowledge of the learner. Conclusively, the approach must take place by doing instruction-based learning as the younger individuals with a higher educational level learn from absorbing information around them.

In the cluster 2, the population is older, with an average age of 57 years. On the other hand, all respondents in cluster 2 are those who had an elementary level in their educational background. Nevertheless, more farmers in the second cluster have longer experience in cultivating, as shown by the data. Thus, the approach that is more suitable for the second cluster is the andragogical approach. In the andragogical approach, the type of engagement for this cluster is all about involvement, which stimulates the learning from a given experience. Thus, giving examples and showing results to the farmers in this cluster could boost their knowledge.

Conclusion

This research aims to measure the effectiveness of game-based learning by determining the adoption of a technology based on its perceived usefulness and social influence. The findings gave the theoretical impact in terms of a research framework analyzing perceived usefulness (PU), social influence (SI), and attitude towards using (AT) combined with the game-based learning theory. Also, the framework used to measure game-based learning effectiveness.

In the first step of creating the game design, there are two problematic situations identifies. The issues listed are the harvesting method and lack of willingness to learn. After interviewing the involved party, information was summarized to design the game. The first game design was pilot-tested, and the researchers took six farmers to do the pilot test. The six farmers gave feedbacks to improve the board game. This board game has the rule to play, and the desire of the expected farmers to play is as simple as it can draw. Therefore, the board game is the game-based learning type that is most suitable that the researcher can propose.
On measuring game-based learning effectiveness, the results from pretest and posttest questionnaires were compared. The results show significant differences in the answers from perceived usefulness construct,

social influence construct and attitude towards using construct. Most of the responses from every construct were improved, where the farmers' answers changed to "Agree" and "Strongly Agree". Therefore, the treatment proved to be sufficient to enhance the farmers' awareness and knowledge toward the mechanization method adoption.

the respondents, the researchers used Two-step clustering that is considered more robust and precise than other clustering methods. The results divided respondents into 2 clusters. The first clusters consisted of 11 respondents with an average age of 38.36. Most educational backgrounds are middle school (2) and high school (3) and lesser farming experience which determines that cluster 1 are not seniors. While, the respondents in cluster 1 have a more significant average in each variable construct of perceived usefulness, social influence and their attitudes toward using overall. After analyzing the results, a pedagogical approach is more suitable for younger farmers with higher levels of education.

In contrast, cluster 2 consisted of 7 persons with higher average age, 100% of them are only through elementary school for the educational background, but they are more experienced in cultivating. The opposite of cluster 1, respondents in cluster 2 have a lesser average in each variable construct of perceived usefulness, social influence, and attitudes toward using overall. Therefore, the andragogical approach is more suitable for older farmers with lower levels of education.

There are some practical recommendations for the farmers. First, farmers should be more aware of the advantages that technology provides in harvesting. Second, they should consider changing from conventional methods to adopt the available technology for harvesting. In doing so, the farmers that have not taken the technology effectively should get more examples of actual results of the mechanization method. g methods, i.e., pedagogical and andragogical.

Third, farmers should be willing to learn based on their ways of learning, whether it is pedagogical (instruction-based) or andragogical (with experiences). If the farmers have a higher educational background, instructors should stimulate them by giving instructions where they seem to understand by following the instructions. In contrast, older farmers with less education should be taught using examples from the surroundings, which they will combine and compare with their previous experience.

The implication for the government is to participate in Indonesian agriculture development, particularly in rice production. The government should observe and supervise the farmers' use of the proper farming techniques. Furthermore, the government should provide more coaching or sharing knowledge on how to most efficiently implement the mechanization method. This treatment or coaching should be based on the unique background defined by pedagogical and andragogical learning types. For instance, go directly to the field to be involved and know more about the situation, accommodate goods and capital and give routine checks or monitoring, and require farmers to have fun training to enhance their knowledge and experience.

Future research should further evaluate whether game-based learning has affected the attitude changes by confirming the relevant variables. Also, it would be useful to evaluate the increase in rice quality resulting from mechanization methods. Finally, another study should compare the two the relative effectiveness of the two teaching methods, i.e., pedagogical and andragogical.

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