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Gamified online business simulation: enhancing student motivation in entrepreneurship

Ayatulloh Michael Musyaffi[1], Mario Colega Oli[2], Mely Mentari[3], Bambang Afriadi[4]
[1]Department of Accounting, Faculty of Economic, Universitas Negeri Jakarta, Jakarta, Indonesia
[2]Department of Education, Cagayan State University, Tuguegarao, Philiphines
[3]Department of Education, Azzahra Institute, Cirebon, Indonesia
[4]Department of Education, Universitas Islam Syekh Yusuf, Tangerang, Indonesia

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ABSTRACT

Entrepreneurship education is growing because of innovative technologies such as artificial intelligence (AI)-based business simulation and gamification. However, there are different responses to gamification-based learning. This study aims to identify the factors that influence learning in gamified business simulation using the self-determination theory (SDT) approach. This study uses a quantitative approach with an online survey of 160 university students learning entrepreneurship through an enterprise resource planning (ERP) based business simulation enhanced with AI and gamification elements. Data were analyzed using importance-performance map analysis (IPMA) to evaluate four primary constructs: autonomy, competence, presence, and relatedness. The analysis results show that the presence construct is fundamental and performs well. While relatedness is fundamental, its performance needs to be improved. The autonomy and competence constructs perform adequately but do not require significant changes. The results also emphasize the importance of strengthening the elements of realism and social interaction in gamified business simulations. Developers and educators should improve the presence and relatedness elements to increase student motivation and engagement. Periodic evaluations and adjustments according to student needs are also necessary to ensure the long-term effectiveness of the simulation. This research provides valuable insights for developing more effective technology-based learning methods in supporting entrepreneurship education.

Corresponding Author:

Ayatulloh Michael Musyaffi
Department of Accounting, Faculty of Economic, Universitas Negeri Jakarta
Rawamangun, Pulo Gadung, East Jakarta, Jakarta 13220, Indonesia
Email: musyaffi@unj.ac.id

1. INTRODUCTION

In the current digital era, the entrepreneurship learning process is increasingly developing by utilizing various innovative technologies to improve student learning outcomes [1]. One innovative approach that is starting to be widely applied is artificial intelligence (AI)-based business simulation with a gamification approach that can be done online. The simulation offers an interactive learning experience and can help students understand the complexities of the business world with a fun, gamified approach [2]. Thus, the variety of learning types, especially in business simulation, is a potential solution to increase student engagement and motivation to learn, thus significantly improving learning outcomes [3].

While gamification in business simulation has many advantages, some issues still need to be addressed. The main gaps is the need for high-quality simulation games, especially those tailored to

residential simulations, limiting their widespread use in business education [4]. In addition, there needs to be more consistency between the skills sought by entrepreneurs and those possessed by students, which can be reduced through business simulations [5]. Thus, this results in a need for more interest in entrepreneurship among students [6], [7]. However, despite the positive acceptance of business simulations, the absence of access through these tools is one of the barriers due to the considerable cost of using AI gamification-based business simulations [2]. In addition, the concept of gamification itself still needs to be better understood and mature, with varying interpretations and a need for more significant promotion within organizational and educational environments to develop participants' experience and understanding [8].

Previous studies have investigated the impact of gamification in various educational settings, showing its potential to enhance engagement and learning outcomes. However, these studies have not explicitly addressed the influence of gamification-based business simulations on specific constructs such as autonomy, competence, and relatedness within the context of entrepreneurship education [2], [8]. The gamification literature often emphasizes game elements and motivational triggers but lacks a comprehensive framework that explains how these factors interact to modify behavior toward business goals [9]. Thus, further research is needed on features in business simulations, such as avatars and competitive elements that can help achieve learning outcomes and improve the user experience [1], [10]–[12]. Incorporating concepts and theories in gamification-based learning is essential to ensure that the gaming experience leads to learning [13], especially in online-based gamification learning where students focus on in-game elements rather than interaction [1]. Although online learning offers numerous advantages for lecturers, students, and institutions in the educational process, studies have shown that only 15% of online learning initiatives achieve success. In contrast, 40% experience partial failure, while the remaining 45% result in complete failure [14]. Based on research from the conversation, post-pandemic online learning has become a new habit for universities in Indonesia [15].

Self-determination theory (SDT) is essential in understanding motivational dynamics in gamification, especially in business simulation games. SDT argues that motivation is driven by fulfilling three innate psychological needs: Competence, relatedness, and autonomy [16], [17]. In business simulation games, these needs can be effectively met through well-designed gamification elements, thereby improving learning outcomes and entrepreneurial intentions. Hoang *et al.* [18] found that business simulations have been shown to significantly increase students' entrepreneurial intentions by enhancing students' self-efficacy. The integration of well-designed game elements to meet the needs of competence, relatedness, and autonomy has been shown to improve student engagement and learning outcomes in higher education settings [19]. Gamified learning methods also support intrinsic motivation by increasing the AUT of student learning tasks, resulting in higher perceptions of autonomy and competence [20]. While the use of gamification features such as social interaction, achievement, and immersion further strengthens students' intrinsic motivation [21]. Thus, the synergy between gamification and simulation methods is essential to develop practical training tools that enhance learning, engagement, and motivation [22]. Therefore, this research aims to identify factors that influence gamification-based business simulation learning through a self-determinant theory approach. We found that the presence construct is fundamental and performs well, while relatedness is fundamental but needs improvement. Autonomy and competence constructs perform adequately but do not require significant changes. The proposed learning method in this study tended to have an inordinately higher proportion of engagement and motivation as realism and social interaction elements were strengthened. Our findings support the notion that incorporating gamification features such as social interaction, achievement, and immersion can significantly boost intrinsic motivation [21].

2. METHOD

2.1. Research design

The researcher used a quantitative approach with an online survey aimed at university students studying entrepreneurship through a business simulation. The business simulation was an enterprise resource planning (ERP) enhanced with AI-gamification elements. The main objective of the data collection was to assess how the gamification experience in the ERP simulation affects students' learning motivation in the context of entrepreneurship. The target population for this study was university students enrolled in entrepreneurship learning. A total of 223 respondents were selected for participation in the study. The sample for the study was obtained through a census technique, where participants who had already participated in the gamification-based ERP business simulation online were selected. Respondents were asked to complete the questionnaire voluntarily after they completed the entrepreneurship module. However, of the 223 respondents, only 160 were willing and had complete data. Therefore, the final data collected was 160 respondents.

2.2. Instrument and measurement

Each item and question from this research is compiled based on the problems that occur and adjusted to previous references. There are four constructs, namely autonomy, competence, presence, and relatedness with a total of 12 questions. The question items in each construct are explained in detail in Table 1

Table 1. Questionnaire

Variable	Item	Questionnaire	Sources
Autonomy	AUT1	I can voice my opinions in the gamified business simulation.	[23]–[25]
	AUT2	I can share my ideas in the gamified business simulation.	
	AUT3	I can address problems in my way in the gamified business simulation.	
Competence	COM1	I can complete tasks in the gamified business simulation.	[24]–[26]
	COM2	I am confident in completing tasks in the gamified business simulation.	
	COM3	I am efficient at completing tasks in the gamified business simulation.	
Presence	PRS1	I am part of an honest company during the gamified business simulation.	[25]
	PRS2	I am managing an honest company during the gamified business simulation.	
	PRS3	I am making accurate decisions during the gamified business simulation.	
Relatedness	RTD1	I have strong relationships with my friends in the gamified business simulation.	[23], [25]
	RTD2	I receive support from my friends during the gamified business simulation.	
	RTD3	I provide support to my friends in the gamified business simulation.	

2.3. Data analysis

After collecting the data, the researcher conducted a descriptive quantitative analysis to explore the respondents' answers. Researchers ensure that each item has a guaranteed level of validity and reliability. The respondents' validity was measured by evaluating the loading factor and average variance extracted (AVE). After that, based on Hair and Alamer [27], the minimum acceptable value for the loading factor is 0.7, and the AVE is 0.5. Meanwhile, respondent reliability is measured by evaluating CA and CR with a minimum value of 0.7 [27]. After that, the data is analyzed in depth to get a mapping of each construct. Then, to obtain the performance and importance level of each construct, an importance-performance map analysis (IPMA) evaluation is carried out, which is divided into 4 quadrants, namely quadrant I (keep up), quadrant II (education), quadrant III (do better), and quadrant IV (no change) [28].

3. RESULTS AND DISCUSSION

3.1. Validity and reliability evaluation

In the first stage of evaluating validity and reliability using the PLS approach, researchers used several validity measurements through overloading and AVE. Cronbach Alpha (CA) and composite reliability (CR) evaluations were used to ensure reliability. Validity analysis using AVE aims to evaluate how well the construct explains the variance of the indicators that have been measured. Based on Table 2, the AVE value of autonomy is 0.798, indicating a solid understanding of the variance in each item. The same thing is also seen in competence (0.860), presence (0.882), and relatedness (0.884). The results of this evaluation show that each construct in this study can effectively explain the variance measured by the indicator. In addition, to evaluate discriminant validity, one must look at the outerloading value. Outerloading shows the strength of the relationship between the items in each indicator and the construct. The outer loading value exceeds 0.7, indicating a solid representation in each construct so that the validity of each item is guaranteed [27]. Based on the evaluation of Table 2, all indicators in this study have an outer loading of more than 0.7; for example, for autonomy, indicators such as AUT1 have a loading of 0.920, while for competence (COM3), the most significant value is loading 0.952. So, these indicators are not only statistically valid but also relevant for the construct being measured.

Table 2. Validity and reliability analysis

Variable	Item	Outer loading	AVE	CA	CR
Autonomy	AUT1	0.920	0.798	0.873	0.922
	AUT2	0.904			
	AUT3	0.855			
Competence	COM1	0.888	0.860	0.918	0.948
	COM2	0.940			
	COM3	0.952			
Presence	PRS1	0.917	0.882	0.933	0.957
	PRS2	0.960			
	PRS3	0.940			
Relatedness	RTD1	0.949	0.884	0.934	0.958
	RTD2	0.933			
	RTD3	0.938			

After evaluating validity, the next step is to analyze discriminate reliability through CA and CR. CA and CR measure the internal consistency and reliability of each construct. Based on Table 2, the CA and CR

values exceed 0.7, indicating high reliability in internal measurement. The autonomy construct has a CA of 0.873 and a CR of 0.922, indicating that the indicators of this construct are consistent and reliable. Competence, presence, and relatedness also showed high CA and CR values, confirming internal stability in the tested research. Overall, based on the evaluation of each section, the constructs and items showed good quality. Each construct successfully explained the significant variance of its indicators and showed strong internal consistency. So, the measurement evaluation has been fulfilled regarding the validity and reliability of items and constructs.

3.2. Descriptive analysis

The autonomy construct in the context of this study refers to gamified business simulation to increase students' entrepreneurial desire, especially regarding participants' ability to voice their ideas and opinions in handling problems. Based on Table 3, most respondents (30.8%) answered the score strongly agree, indicating a high level of autonomy in conducting simulations. AUT1 has the highest score in each item in answering strongly agree and agree (73.9%), thus indicating that business simulation gamification learning provides opportunities for participants to voice opinions. According to previous research, gamification methods can give users the authority to voice opinions [2], [10]. In comparison, AUT2 (72.7%) of participants can share their ideas on the platform so that participants can support personal expression. AUT3 has a lower score (62.8% for score 4 and 5). The result shows that there is a need for more flexibility in methods that participants can use to solve the problem. The autonomy construct can increase participants' instrinsic motivation and engagement in learning business simulation gamification compared to other constructs such as competence and presence. This is because autonomy is directly related to active and creative interaction as shown in items AUT1 and AUT2. In AUT3, although participants have a voice in the simulation, they do not always feel they have enough freedom to apply their solutions effectively. Based on empirical evidence, gamification features such as social interaction, achievement, and immersion can positively impact intrinsic motivation when aligned with students' psychological needs, including autonomy [21]. In addition, satisfaction, needs, and autonomy are essential elements to enhance students' experience and continuous engagement [29].

Table 3. Descriptive analysis

Variable	Item	Scale (%)					Average
		1	2	3	4	5	(scale 1-5)
Autonomy	AUT1	2.5	3.7	19.9	39.1	34.8	3.993
	AUT2	3.1	3.1	21.1	43.5	29.2	3.895
	AUT3	2.5	5.0	29.8	34.2	28.6	3.778
	Average AUT	2.7	3.9	23.6	38.9	30.8	3.855
Competence	COM1	0.6	5.6	22.4	37.3	34.2	3.982
	COM2	3.1	3.1	21.1	43.5	29.2	3.895
	COM3	2.5	5.0	29.8	34.2	28.6	3.778
	Average COM	2.1	4.6	24.4	38.3	30.6	3.886
Presence	PRS1	3.7	4.3	14.9	32.3	44.7	3.992
	PRS2	2.5	3.7	14.3	36.6	42.9	3.985
	PRS3	3.1	1.2	19.3	34.2	42.2	3.985
	Average PRS	3.1	3.1	16.1	34.4	43.3	3.987
Relatedness	RTD1	2.5	2.5	11.8	33.5	49.7	4.209
	RTD2	2.5	3.1	15.5	30.4	48.4	4.093
	RTD3	1.9	3.1	11.8	26.7	56.5	4.288
	Average RTD	2.3	2.9	13	30.2	51.6	4.197
Overall average		2.6	3.7	19.7	35.8	38.2	3.906

The competence aspect is measured through the participants' ability to complete tasks, their confidence, and the efficiency of completing tasks in the business simulation. Item COM1, the majority of respondents (71.5%) gave scores of 4 and 5, thus indicating that gamification-based business simulations have effectively ensured participants are competent in completing tasks. While COM2 has a high level of agreement (72.7%), it strongly agrees that business simulations support participants in building their confidence and abilities. This will allow participants to feel capable and confident in their ability to complete the tasks at hand, as shown by items COM1 and COM2. In COM3, as many as 62.8% of participants scored 4 and 5. This score is slightly lower than the other two items, so there is room for improvement in supporting participants to be more efficient. The fact also shows that users feel less supported in terms of efficiency. Users also felt that tasks or instructions in the simulation were only sometimes organized to maximize operational efficiency. Improving the user learning experience is essential to ensure they leave the simulation feeling satisfied and thus motivated to learn entrepreneurship. Gamified classes have increased student

competence compared to non-gamified classes, especially in intrinsic aspects [20], [30], [31]. Competence satisfaction is essential because it provides adrenaline and satisfaction to increase student understanding [32], [33]. Then, when presented in a way that supports autonomy, it can increase feelings of competence, thus improving intrinsic motivation and performance [34], [35].

In the presence construct, the level of user feelings in a business simulation environment is measured, including the role of a company and managing it in reality. Based on the evaluation results in Table 3, most respondents in this study strongly agreed (43.3%) that the perceived business simulation provides an opportunity for realistic and impactful decision-making. The business simulation platform can respond to decisions in real time. For example, if users increase prices or add employees, it will have an impact on sales or the burden felt by the company. So, the decision-making process is vital to the platform. This can train students to make decisions quickly in addition to learning the business process of students in entrepreneurship. This is evidenced by students' answers that they feel like they are part of a real company (77%). This shows that the business simulation platform successfully creates user involvement in managing company operations. This will have an impact when students do entrepreneurship in real life. In addition, students also agreed that the business simulation platform (79.5% for "strongly agree" and "agree" answers) provides a realistic experience and flexible decision-making opportunities that impact the company as a whole (76.4%). The easier it is to use the system, the more the user's ability to understand will increase, causing continuous adoption of the system [36]–[40]. This increases student motivation and learning as they can experience real consequences. The greater the system interaction can satisfy users, the more significant the increase in student learning [15], [21], [41], [42].

The relatedness construct shows how strong relationships and social support students feel when using gamification-based business simulations. This construct is important because it increases the attachment between participants, creating a more positive learning experience. According to Kashive and Mohite [6], a more genuine experience will increase the positive learning experience. So, do not be surprised if most respondents, as much as 81.8%, agreed that relatedness impacts student entrepreneurial learning. relatedness is also the construct with the most significant impact compared to autonomy, competence, and presence. This is because students play in groups in business simulation learning and require excellent cooperation to win. In addition, the chat feature for groups and the game as a whole also helps participants communicate so that coordination improves. The results of this study are also evident from the 83.2% who felt that learning business simulation has a strong relationship with other student friends, indicating that business simulation games successfully create an environment that supports stronger social relationships. In addition, students also received support from friends during the simulation with a response of 78.8%. This confirms that learning gamification-based business simulation provides a good space for participant interaction and support. Students also agreed that the simulation platform can support friends with a percentage of 82.2%. This confirms that students not only receive support but are also active in providing support to others. Student entrepreneurship learning is influenced by environmental support, including support from others such as friends, colleagues, and family.

3.3. Important-performance map analysis

IPMA refers to the importance and performance level of each construct in this study, namely autonomy, competence, presence, and relatedness. Based on Hsu [28], the IPMA measurement consists of four quadrants: quadrant I (keep up), quadrant II (education), quadrant III (do better), and quadrant IV (no change). The autonomy construct is measured through participants' ability to voice opinions, share ideas, and deal with problems in their own way. According Table 4, the autonomy construct has an importance value of 0.129 and a performance value of 72.948, which indicates that this aspect has a low level of importance and performance in the learning context. At the item level, the evaluation shows that all items in the autonomy construct (AUT1, AUT2, AUT3) are also in quadrant IV. Item AUT1 has an importance value of 0.050 and a performance of 75, AUT2 has an importance value of 0.051 and a performance of 73.137, and AUT3 has an importance value of 0.044 and a performance of 70.342. These results show that although participants felt they could voice their opinions and share ideas in the simulation, there were other priorities for improvement. Students felt quite comfortable with the autonomy provided, and improvements in this area would probably not significantly increase learning motivation or performance. Thus, the results of this IPMA evaluation suggest that the autonomy construct does not require significant change at this time. Focus and resources can be redirected to other more critical areas for learning improvement. It is crucial to keep monitoring this area periodically to ensure that student needs and preferences stay the same over time, but at present, autonomy can be maintained without significant changes.

IPMA's evaluation of the competence construct shows that this aspect is in quadrant IV (no change). The competence construct is measured through participants' ability to complete tasks, confidence in their abilities, and efficiency. Based on the analysis, the competence construct has an importance value of 0.168

and a performance value of 73.425, which indicates that the competence aspect has a relatively low level of importance and performance in the learning context. Thus, resources can be allocated to other areas more critical for learning improvement. Focus can be shifted to other aspects such as presence or relatedness, which show a need for further attention and improvement.

Table 4. IPMA-functional barrier (construct)

Variable	Importance	Performance	Category
Autonomy	0.129	72.948	Q4 (no change)
Competence	0.168	73.425	Q4 (no change)
Presence	0.529	77.912	Q1 (keep up)
Relatedness	0.107	81.476	Q2 (education)
Average	0.233	76.440	

Based on Figure 1, a look at the presence construct shows that this aspect is in quadrant I (keep up) which means it has a high level of importance and performance. The presence construct measures the extent to which participants feel like part of an honest company in a business simulation. The analysis results show that the presence construct has an importance value of 0.529 and a performance of 77.912, indicating that this aspect is essential and performs very well in the learning context. The evaluation results show that presence is a significant area and performs well, but there is room for improvement. Improvement efforts should focus on strengthening students' sense of presence and engagement in the simulation by adding more interactive elements and realistic scenarios. Thus, presence should remain the main focus, and improvements in this area will significantly improve student motivation and learning outcomes.

The relatedness construct shows that this aspect is in quadrant II (concentrate here) with an importance value of 0.107 and a performance of 81.476, indicating that it is essential but can still be improved. These results show that although the social support and interaction between participants in the simulation is essential, the performance of this aspect still needs improvement. Participants stated that they felt a strong connection with their peers in the simulation, but there is room to strengthen this social support further. The evaluation suggests that the relatedness construct is a critical area that requires immediate attention. Social interaction and support in the simulation are essential to increase participants' motivation and learning engagement. Additional features that enable deeper interaction and more robust social support are needed to improve performance in this aspect, such as better communication features, collaborative tasks, and feedback mechanisms between participants. By improving the relatedness aspect, students' learning experience in the simulation will be more positive and support better learning outcomes.

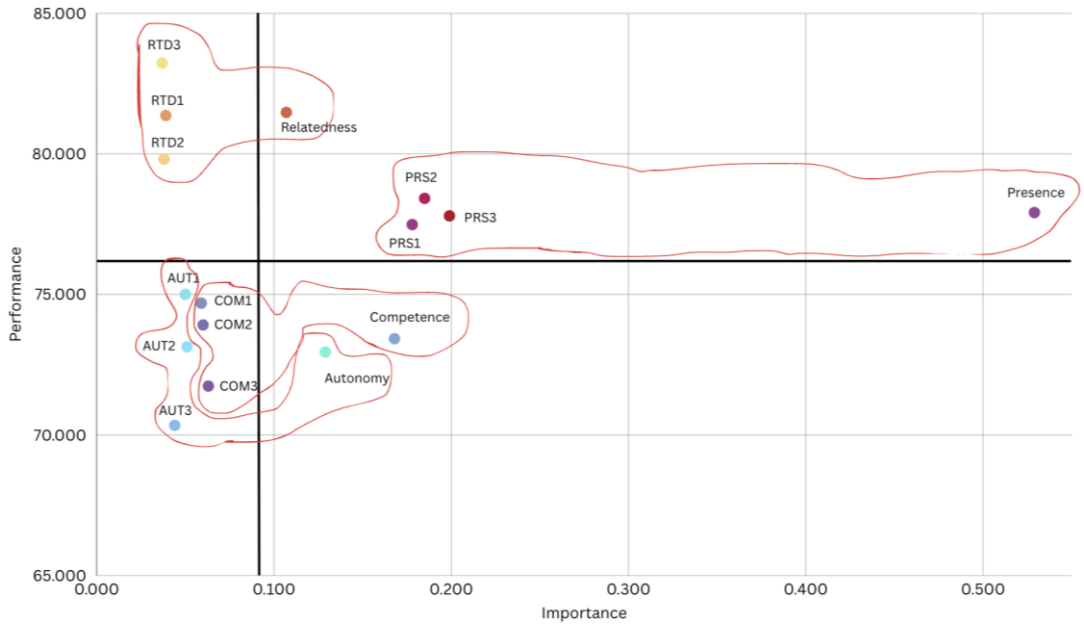

Figure 1. IPMA-functional barrier

4. CONCLUSION

This research explores the role of AI-based business simulations with a gamification approach in increasing entrepreneurial students' learning motivation. Using the SDT approach and IPMA analysis, this research assesses four primary constructs: autonomy, competence, presence, and relatedness. The research results show that each construct impacts student learning motivation differently. The research on the autonomy construct shows that learning using business simulations effectively provides participants autonomy to voice students' ideas and opinions. However, there are limits to the flexibility of methods to address problems using business simulations. Meanwhile, the competency aspect is also assessed positively, showing that the simulation supports participants in completing tasks and builds self-confidence, although there is room for improvement in efficiency. The presence scored highly on feeling like part of an honest company, indicating the importance of real-time and interactive elements in the simulation. Meanwhile, relatedness stands out as the construct with the most significant impact, indicating that social support and interaction between participants are essential for effective learning. Therefore, gamified business simulation effectively increases participants' autonomy, competence, and sense of presence, with the need to strengthen social support and interaction between participants to achieve better learning outcomes. Thus, increasing the relatedness aspect must be a top priority to create a more supportive learning environment, increasing student motivation, and engagement.

The research results show that the presence aspect is essential for creating a realistic and immersive learning experience for students. Therefore, business simulation developers must ensure that elements that support engagement and realism, such as realistic business scenarios and real-time responses to decisions, are well integrated into the simulation platform. Second, the relatedness aspect shows that social support and participant interaction greatly influence motivation and learning engagement. This implies that features facilitating communication and collaboration between participants must be strengthened. Effective social interactions in simulations increase intrinsic motivation and support more profound and meaningful learning. Third, even though the autonomy and competence aspects show adequate performance, it is essential to continue to monitor and assess student needs and preferences over time. This ensures that the learning experience remains relevant and meets student expectations. However, further and in-depth studies may be needed to confirm its generalizability across different educational contexts and student populations, especially regarding long-term impacts on entrepreneurial intentions and real-world business skills.

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Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Ayatulloh Michael Musyaffi	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓
Mario Colega Oli		✓				✓		✓	✓	✓				
Mely Mentari		✓				✓	✓	✓		✓		✓		
Bambang Afriadi	✓		✓	✓			✓			✓	✓		✓	

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [AMM], upon reasonable request. The data are not publicly available due to privacy or ethical restrictions.

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BIOGRAPHIES OF AUTHORS

Ayatulloh Michael Musyaffi is a lecturer in the Department of Accounting at the Faculty of Economics, Universitas Negeri Jakarta. He has published numerous articles on research topics such as accounting information systems, accounting education technology, financial technology, and cloud accounting. In addition to his research articles, he has authored several books on accounting information systems, computerized accounting, and research methodology. His extensive contributions to both academic literature and practical applications in the field have established him as a notable figure in accounting education and technology. He can be contacted at email: musyaffi@unj.ac.id.

Mario Colega Oli is a lecturer in the Department of Education at Cagayan State University, Philippines. He has published research in several international journals, focusing on mathematics education, educational technology, and educational evaluation. His extensive work in these areas highlights his expertise and contribution to the field of education. He can be contacted at email: Mariooli696@yahoo.com.

Mely Mentari works at Azzahra Institute as an analyst and researcher, primarily focusing on educational technology, primary education, and religious education. Additionally, she serves as a lecturer at Universitas Terbuka. Her work involves analyzing and conducting research to advance knowledge and practices in these areas, contributing significantly to the development of educational methodologies and approaches. She can be contacted at email: melymmusyaffi@gmail.com.

Bambang Afriadi is a lecturer in the Department of Education at Universitas Islam Syekh Yusuf. His academic focus is on educational evaluation and educational management. He has also authored various books in the field of education, contributing significantly to the academic and practical understanding of these subjects. He can be contacted at email: bambang.afriadi92@gmail.com.