Examining the Roles of Self-Efficacy, Attitude and Self-Regulated Learning through Augmented Reality in Reading for EFL Learners

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A B S T R A K

Dalam beberapa tahun terakhir, lembaga pendidikan tinggi menghadapi tantangan di bidang pendidikan. Dampak teknologi digital seperti augmented reality seharusnya memungkinkan pembelajaran yang diatur sendiri. Oleh karena itu penelitian ini menganalisis hubungan antara self-efficacy, sikap dan pembelajaran yang diatur sendiri di seluruh kognisi, motivasi, perilaku, dan konteks melalui augmented reality dalam membaca untuk bahasa Inggris sebagai pembelajar bahasa asing (EFL). Data dikumpulkan dari 213 mahasiswa sarjana dalam bahasa Inggris untuk kelas tertentu (ESP) di universitas akademik di Indonesia. Penelitian ini digunakan sebagai desain penelitian survei analitik non-eksperimental dengan SmartPLS. Studi ini menilai model pengukuran pemuatan faktor, reliabilitas komposit, dan validitas konvergen, dan bootstrap yang digunakan untuk nilai-p dari koefisien jalur. Temuan penelitian ini melaporkan bahwa self-efficacy memiliki hubungan yang signifikan secara statistik dengan kognisi, motivasi, perilaku dan konteks sementara sikap memiliki hubungan yang positif secara statistik dengan motivasi dan konteks tetapi tidak dengan kognisi dan perilaku.

A B S T R A C T

In recent years, higher education institutions have faced challenges in the field of education. The impact of digital technology such as augmented reality increases the possibility of self -regulated learning. Therefore this study analyze the relationship between self-efficacy, attitude and self-regulated learning across cognition, motivation, behaviour, and context through augmented reality in reading for English as foreign language (EFL) learners. Data were collected from 213 undergraduate students in English for Specific Class (ESP) in an academic university in Indonesia. This study was used a non-experimental, analytic survey research design with SmartPLS. The study assessed the measurement model of the factor loadings, composite reliability, and convergent validity, and employed bootstrapping for p-values of the path coefficient. The findings of the study reported that self-efficacy has a statistically significant relationship with cognition, motivation, behaviour and context while attitude has a statistically positive relationship with motivation and context but not with cognition and behavior.

1. INTRODUCTION

In the past few years, higher education institutions have transformed a fundamental shift to face challenges in the educational field due to the proliferation of digital technology. As a natural effect of digital technology, augmented reality should be eased for increasing immense promise to self-regulated learning. The behavioural intentions have been examined, but fascinating technology should propel self-efficacy and attitude to leap the robustness of augmented reality to language learning (Dishon & Gilead, 2020; Yulian et al., 2022). While this previous study focused on the technology acceptance, self-efficacy and attitude, there is a notable gap related to self-regulated learning. There has been an increasingly large body of studies on augmented reality for learning. Following the trend of technological growth, several educational studies have sought to study the influence of augmented reality (AR), a technology for combining virtual information with the real environment for real-time display, on learning (Chang et al., 2022; Cheng, 2017; Hadid et al., 2019). A meta-analysis by previous study confirms that more research needs to discern significant factors related to the impact of AR particularly in the context of education (Chang et al., 2022). Additionally, they highlighted AR in language learning is likely connected to learners' positive affirmation including attitude. More studies on AR have shown the impacts of this learning environment such as in the area of engineering, construction, and manufacturing but are limited to any other educational fields (Garzón & Acevedo, 2019). Other study explored the potentialities of AR to improve

reading comprehension and examined the learners' interest to use it (Ebadi & Ashrafabadi, 2022). Another empirical study that investigated the use of augmented reality in a gamified CLIL lesson to improve students' achievement (Çelik & Yangın Ersanlı, 2022). However, little is known bearing on the psychological aspects of the importance of AR for learning English to self-regulated learning.

In language learning with technology, technology acceptance with self-efficacy and attitude are entwined especially in the higher education institutions contexts. Self-efficacy is crucial for persistence since learners are more likely to continue in the face of challenges if they think that the outcomes they accomplish are due to things in their control (Graham, 2022; Nguyen et al., 2022). The concept of self-efficacy refers to the perspicacity of possibilities in how learners perceive the task's degree of difficulty and level of confidence. Self-efficacy is defined as the learners' perception of their own value in terms of enhanced performance and capabilities (Cong & Li, 2022; Panadero, 2017). Focus areas on self-efficacy highlight learners' conviction that they can masterly employ methods requiring a high level of self-efficacy, which will result in outstanding success in language acquisition. When students do well, they develop self-confidence and believe they will succeed in their studies. Self-efficacy has been a spot of prolific research in the field of general education for many years, and it has risen to the attention of second language researchers in the last two decades (An et al., 2021; Nguyen et al., 2022). Self-efficacy refers to a learner's conviction in their capacity to perform a task successfully. Because of the outcomes of self-regulated learning, self-efficacy has an impact on the capacity to use augmented reality technology and engage in learning. Learners with a greater level of self-efficacy are more likely to engage in self-regulated learning activities such as establishing objectives, assessing progress, and altering learning tactics as needed.

While self-efficacy refers to an individual's ability to engage in the learning process, attitude relates to learners' evaluation of a particular study. A positive attitude towards augmented reality in language learning may direct the learners in self-regulated learning. Learners who have strong convictions can achieve desirable results because their positive attitudes drive their behaviour (Getie, 2020; Pan, 2020). Researchers have found that technology acceptance related to self-efficacy contributed to attitude toward self-directed learning. Learners' attitudes are likely to be the contributing factors to EFL learners' learning. Attitude refers to the component of emotional involvement that affects learning, behaviour, and inner mood. Attitude affects an individual's behaviours, inner modality and learning, so the interaction of learning and environmental element is crucial (Alhamami, 2022; Getie, 2020). The attitudes of the learners are important when learning a language as the social psychology concept of attitude toward a behaviour is crucial to elicit and investigate learners' attitudes regarding technology. Since it may affect the learning of a second language, both language instructors and students can recognize this as an important element.

Self-regulated learning is a fundamental concept of framework to interpret the elements of cognitive, emotional as well as motivational learning; this model can form an integrated and consistent framework for conducting education research (Kibirige & Teffo, 2014; Panadero, 2017). Self-regulated learning and performance refer to the procedures by which students personally activate and sustain thoughts, feelings, and actions that are consistently geared toward achieving their own objectives. Self-regulated learning refers to students' systematic efforts to govern and regulate their learning process to attain certain learning goals. Self-regulated learning is the result of the learners' efforts to create objectives, use learning techniques to accomplish those goals, monitor their own progress, and evaluate it on a regular basis (Pintrich, 2004; Supriyono et al., 2020). It is well established that being a self-regulated learner is advantageous academically, motivates learners, and is deemed necessary for good life-long learning. Self-regulated learning using augmented reality can be depicted from how learners set target goals, activate prior content knowledge, select, and adapt cognitive strategies, set task value and interest activation, manage behaviour and perceive task and context of the reading activities (Benson, 2001; Torrington et al., 2023). It is also confirmed by an empirical study that the awareness of technologies for self-regulated learning is low; thus it is worth considering to examine the relationships of dimensions of behaviour in self-regulated learning (Irving, 2006; Olubode et al., 2022). Technology offers tools that provide language learners to employ self-learning and control their learning efforts to meet their learning objectives.

Analyzing the relationship between self-efficacy, attitude and self-regulated learning in augmented reality is novel in several ways. First, it explores the direct and indirect effects and attitudes on the use of augmented reality to learners' self-regulated learning, which is a relatively new and emerging area of research in the EFL context of language learning. Augmented reality for language learning has the potential benefit to enhance learning outcomes by providing learners with an interactive and immersive experience that can facilitate self-regulated learning. However, the relationship between variables of self-efficacy and attitude in the process has not been well understood. Finally, the research has practical implications for educators and instructional designers to contemplate using augmented reality to enhance learning outcomes. By understanding the relationship between self-efficacy, attitude, and self-regulated learning, they can design effective interventions to promote self-regulated learning. This has the potential to improve educational outcomes and prepare learners for success in an increasingly technology-driven world.

Guided by the results of the technology acceptance model (TAM) on augmented reality in learning a reading skill (Siti et al., 2021; Yulian et al., 2022). This study focused on analyze the relationship between self-efficacy, attitude and self-regulated learning through augmented reality in reading for EFL learners. This study focused on addressing two key research inquiries. Firstly, it sought to explore the direct and indirect connections that exist between self-efficacy, attitude, and self-regulated learning (cognition, motivation, behaviour, and context) in the realm of reading for EFL (English as a Foreign Language) learners, all within the context of augmented reality. Secondly, the study aimed to delve into the associations between self-efficacy, attitude, and self-directed learning, specifically within the augmented reality environment for EFL reading.

2. METHOD

This study employed a non-experimental, analytic survey research design to examine the relationships between self-efficacy, attitude, and self-directed learning through augmented reality in reading for EFL learners (Verdinelli & Scagnoli, 2013). The sample selection was based on the research objective, available resources, and the nature of the population. This study employed a total sampling method. A total of 213 freshmen students studying for English for Specific Purposes (ESP) at an academic university in Indonesia. The total sampling method was used because, first the the subject is compulsory for all first-year students and they inevitably encountered the use of augmented reality in the teaching and learning activity. Under this circumstance, total sampling offered the chance to encompass the entire learner population, given that all participants would share comparable experiences. The second, the total sample used in the study inherited representativeness and minimized sampling bias. The procedures consisted of several steps. First and foremost, at the beginning of the even semester of the academic year 2022/2023, the students were introduced to, taught and instructed to use augmented reality for reading activities. The augmented reality technology was developed with marker augmented reality. In the second step, after four interval meetings of reading activity, the questionnaires were distributed to all students from 8 classes and answered immediately. This was an anonymous-based survey which assures students' confidentiality. The final step was data tabulation and running the structural equation modelling. The interface of augmented reality is show in Figure 1.

Figure 1. The Interface of Augmented Reality

Figure 2. The Interface of Augmented Reality

The questionnaires on self-efficacy and attitude were validated from previous studies (Davis et al., 2020; Schunk & DiBenedetto, 2021; Yulian et al., 2022). Self-efficacy was measured with five items and attitude consists of six items. Self-regulated learning was measured by four scales (cognition with five items), (motivation with six items), (behaviour with five items), and (context with six items). A five-Likert scale was used for the questionnaire items. Convergent and discriminant validity and composite reliability were used to establish validity and reliability. The foundations for valid criteria are average variant extracted (AVE) > 0.0, outer loading > 0.07, Cronbach's alpha > 0.06 and composite reliability > 0.07 serve as the foundation for dependable criteria (Hair et al., 2017). Structural equation modelling (SEM) was employed to examine the relationship between self-efficacy, attitude,

and self-directed learning (cognition, motivation, behaviour, and context) through augmented reality in reading for EFL learners. The study used Partial Least Square structural equation modelling (PLS-SEM) with SmartPLS with a P-value of < 0.05 to determine the effects of the significant findings. Table 1 displays the constructs of the research instruments utilized in the study.

Table 1. Research Instrument Constructs

Variable	Construct	Indicator	Underpinned Theories
Self-efficacy	SE1	Individual confidence in technological skills	(Bandura, 1977; Graham, 2022)
	SE2	Outcome expectancy	
	SE3	Comfort level	
	SE4	Motivation to act	
	SE5	Persistence intention	
Attitude	AT1	Affective evaluation	(Ajzen, 2012; Getie, 2020; R.C. Gardner, 2006)
	AT2	Cognitive evaluation	
	AT3	Instrumental evaluation	
	AT4	Experiential evaluation	
	AT5	Functional evaluation	
	AT6	Motivational orientation	
Self-regulated learning			(Pintrich, 2004)
Cognition	CG1	Goal setting	
	CG2	Monitoring	
	CG3	Adaptation	
	CG4	Intrinsic motivation	
	CG5	Time management	
Motivation	MT1	Interest	
	MT2	Attribution	
	MT3	Interest	
	MT4	Task value	
	MT5	Goal orientation	
	MT6	Goal orientation	
Behaviour	B1	Strategic planning	
	B2	Time management	
	B3	Goal setting	
	B4	Self-monitoring	
	B5	Reflection and adjustment	
Context	CX1	Task perception	
	CX2	Task adaptation	
	CX3	Task renegotiation	
	CX4	Task evaluation	
	CX5	Task value perception	
	CX6	Adaptation to changes	

3. RESULT AND DISCUSSION

Result

The first early step of data analysis was examining the outer loading score as a crucial metric as it provides valuable insights into the relationships between variables. It was used to assess the strength and significance of variables relationships and shed light on the reliability and validity of the proposed model. The validity criteria for each factor of self-efficacy, attitude, and self-regulated learning (cognition, motivation, behaviour self-efficacy) were fulfilled since the outer loadings of each indicator of both exogenous and endogenous variables are more than 0.7. The construct reliability and validity were evaluated to make sure that the scale items for the variables were internally consistent. The values were greater than > 0.05 based on the output of the average variance extracted (AVE). For discriminant validity, all variables were categorized as valid. The reliability was evaluated based on Cronbach's Alpha > 0.06 and composite reliability > 0.07 for strong analytic research findings. Based on Table 2, all variables should be desirable to be trustworthy.

Table 2. Construct Validity and Reliability

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
AT	0.911	0.913	0.931	0.693
BH	0.846	0.849	0.891	0.620
CG	0.846	0.849	0.891	0.620
CX	0.911	0.914	0.931	0.693
MV	0.911	0.914	0.931	0.693
SE	0.846	0.850	0.891	0.620

Base on Table 2 validity and reliability of all variables, probing the R-square (R^2) was mandatory to provide insights into the latent constructs, quantify the variance proportion between variables, and assess the predictive power of the proposed model. As can be seen in Table 3.

Table 3. R Square

	R Square	R Square Adjusted
Attitude	0.417	0.414
Cognition	1.000	1.000
Motivation	0.989	0.989
Behaviour	1.000	1.000
Context	1.000	1.000

Based on Table 3, the attitude was influenced by self-efficacy with an R-square value of 0.417 which indicated a small amount of variance explained, while cognition was influenced by self-efficacy with an R-square value of 1.000 which implied a significant amount of variance explained. Motivation has an R-square of 0.989, and both behaviour and context have an R-square of 1.000 which means that these variables were influenced by self-efficacy with a significant amount of variance explained. To investigate the causal relationship or correlation between exogenous and endogenous variables, the linear regression weights must be assessed. A P-value of < 0.05 is used to determine the impact of significant findings. The result of path coefficients is show in Table 4.

Table 4. Path Coefficients

	P Values
Self-Efficacy->Attitude	0.000
Self-Efficacy->Cognition	0.000
Self-Efficacy->Motivation	0.031
Self-Efficacy->Behavior	0.000
Self-Efficacy->Context	0.153
Attitude->Cognition	0.315
Attitude->Motivation	0.000
Attitude->Behavior	0.315
Attitude->Context	0.000

Based on Table 4, P Values, self-efficacy has a statistically significant influence on attitude (0.000). Similar to how self-efficacy has a substantial impact on attitude, self-efficacy has a significant impact on self-regulated learning on cognition dimension (0.000). Attitude has a considerable impact on self-efficacy on behaviour as an endogenous variable (0.000), but not on motivation (0.031), and context (0.153). Additionally, attitude has a significant effect on motivation as well as on context (0.000), but not on cognition (0.315), and behaviour (0.315). The particular indirect effects demonstrate the mediation influence of exogenous factors such as self-efficacy and attitude, as well as endogenous characteristics such as self-regulated learning namely cognition, motivation, behaviour, dan context. The result is show in Table 5.

Table 5. Specific Indirect Effects

	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
Self-Efficacy-> Attitude -> Cognition	-0.002	-0.003	0.002	1.001	0.317
Self-Efficacy-> Attitude -> Motivation	0.632	0.632	0.038	16.505	0.000
Self-Efficacy-> Attitude -> Behavior	-0.002	-0.003	0.002	1.001	0.317
Self-Efficacy-> Attitude -> Context	0.647	0.647	0.040	15.988	0.000

Base on Table 5 with a P-Value of (0.317), self-efficacy had no influence on cognition and behaviour mediated by attitude. While self-efficacy has a substantial influence on motivation mediated by attitude (P-Value 0.000) and on context mediated by attitude (P-Value 0.000). The total effect is show in Table 6.

Table 6. Total Effects

	Original Sample	**Sample Mean**	**Standard Deviation**	**T Statistics**	**P Values**
Self-Efficacy->Attitude	0.646	0.645	0.040	16.048	0.000
Self-Efficacy->Cognition	1.000	1.000	1.000	12644.564	0.000
Self-Efficacy->Motivation	0.655	0.654	0.041	16.175	0.000
Self-Efficacy->Behavior	1.000	1.000	0.000	12644.564	0.000
Self-Efficacy->Context	0.644	0.654	0.041	16.715	0.000
Attitude->Cognition	-0.002	-0.004	0.002	1.005	0.315
Attitude->Motivation	0.980	0.980	0.007	139.840	0.000
Attitude->Behavior	-0.002	-0.004	0.002	1.005	0.315
Attitude->Context	1.002	1.003	0.001	769.621	0.000

Base on Table 6, the complete degree to which endogenous variables and predictors as exogenous variables were studied in this analytic investigation. Self-efficacy has a statistically significant influence on attitude, cognition, motivation, behaviour, and context (P-Value 0.000). Attitude has no significant influence on cognition and behaviour (P-Value 0.315), while attitude satisfaction has a statistically significant influence on motivation and context (P-Value 0.000).

Discussion

The results of the current study entail several relationships that ascertain EFL learners' tendency to utilize augmented reality for learning English. The findings elucidate the significance of self-efficacy and attitude in the context of EFL learners' use of augmented reality for learning English. It signifies the motivational and contextual benefits of self-efficacy while acknowledging the nuanced role of attitude in affecting various aspects of self-regulated learning. The research issues addressed in this study were around understanding the linkages between self-efficacy, attitude, and self-regulated learning in learning English with augmented reality. The hypotheses testings were used to answer the research questions. First, five hypotheses were accepted specifically self-efficacy positively influencing the dimension of self-regulated learning (cognition, motivation, behaviour, dan context).

This aligns with the previous study indicating that English language self-efficacy was linked to technology-based self-regulated learning strategies (An et al., 2021). Learner self-efficacy may be increased by boosting learners' dynamic attitudes, online engagement, self-assessment, academic knowledge, and positive affectivity (Goeltz & Cuevas, 2021; Winarno et al., 2022). The present study echoes that self-efficacy positively contributes to self-regulated learning (cognition, motivation, behaviour and context) in terms of motivational regulatory tactics, goal setting, evaluation of learning, and social strategies. The cognitive component as a result of using augmented reality explains how self-efficacy beliefs alter an individual's cognitive processes and cognitive strategies used during self-regulated learning, as well as how self-regulated learning attitude affects cognitive engagement and information acquisition.

It can also increase motivation when learners have consciousness of their skills to navigate and interpret AR-enhanced information, they are more inclined to engage with it (Muhammad et al., 2023; Su et al., 2022). It is also corroborated by previous studies that demonstrated that using AR technology had a considerable favourable influence on learners' motivation levels toward educational materials in the classroom since it worked as an interactive and amusing tool, transforming a dull learning environment into an engaging and effective one (Jamrus & Razali, 2019; Ustun et al., 2022). Also, the adoption of augmented reality (AR) technology tends to spark students' curiosity, leading to increased willingness to engage in the learning process (Su et al., 2022; Vagg et al., 2020). Self-efficacy also affects behaviour in respective explanatory behaviour. In the context of utilizing AR to learn English, self-efficacy might encourage experimental behaviour. Learners with strong self-efficacy are more likely to explore various AR features, functionalities, and applications. They can investigate diverse resources, participate in autonomous learning, and actively seek out chances to broaden their knowledge and abilities in AR-enhanced reading (Alsowat, 2016; Djamdjuri et al., 2014). Self-efficacy can also have an impact on learning contexts by increasing learning confidence, autonomy, active engagement, perseverance, collaborative learning, and heightened motivation (Ustun et al., 2022; Zhang, 2022). Cultivating and reinforcing self-efficacy attitudes can result in a supportive and empowering learning environment in which learners are inspired to investigate AR technology, actively participate in learning activities, and attain their language learning objectives.

Second, this study examined the mediating effect between variables and indicated that self-efficacy had no influence on cognition and behaviour mediated by attitude while self-efficacy has a substantial influence on

motivation mediated by attitude and on context mediated by attitude. It is in accordance with a study that revealed students' learning motivation explains the relationships between students' perceptions of technological settings and their attitudes toward technology-based self-directed learning (Pan, 2020). Learning motivation can be a mediator for self-efficacy in technology-based learning environments. Another study also revealed that when students read an AR book, they experienced reduced cognitive load, higher motivation, and a more favourable attitude regarding the experiences (Cheng, 2017).

Third, the study also probed the relationship between attitude and self-regulated learning. The findings revealed that attitude has no significant influence on cognition and behavior while attitude satisfaction has a statistically significant influence on motivation and context. The study accepted Hypothesis 10 and Hypothesis 12 but rejected Hypothesis 9 and Hypothesis 11. Attitude is a complex construct with cognitive, emotional, and behavioural components. In the complicated process of self-regulated learning, it is difficult to distinguish the precise effect of attitude on cognition and behaviour. Because attitude may interact with other factors and be mediated by numerous cognitive and motivational processes, determining its direct influence on cognition and behaviour is challenging. Attitude influences motivation, goal planning, self-efficacy, the learning context, perseverance, resilience, and social relationships, all of which are important in self-regulated learning. Positive attitudes toward the learning task increase motivation, provide a supportive learning environment, and allow the effective application of self-regulation mechanisms, resulting in enhanced learning outcomes (Lai & Chang, 2021; Sirakaya & Cakmak, 2018).

Educators, decision-makers, and researchers must comprehend the complex relationships between self-efficacy and attitude toward self-directed learning. Interventions and techniques may be created to improve self-directed learning experiences and generate favourable attitudes about autonomous learning efforts by acknowledging the reciprocal effect of these dimensions. Although this research provides valuable insights into the relationship between self-efficacy and attitudes toward self-regulated learning, it is important to acknowledge some limitations. First, the applicability of study findings may be limited in the wider context, given their origin from the particular group of participants and settings. Moreover, this study mainly concentrates on the conceptual exploration of the relationship between self-efficacy and attitudes, omitting in-depth investigations into potential moderating factors that may shape this relationship. Future implementation can examine the moderating complexities with other relevant variables in other language skills and subject areas.

The implications of the study can contribute valuable insights into factors in self-regulated learning for language educators and researchers who are passionately intrigued by enhancing language learning through technology and self-regulated learning strategies. This study also contributes to the understanding of EFL undergraduate students in ESP class in augmented reality using conditions for learning English reading skills. Above all, the findings of the study add knowledge to the existing literature on the proliferation of augmented reality for learning English that addresses the relationship between self-efficacy and attitude to self-directed learning (cognition, motivation, behaviour and context).

4. CONCLUSION

This study provides a comprehensive analysis of the relationships between self-efficacy, attitude, and self-regulated learning within the context of augmented reality-enhanced reading for EFL learners. It highlights the significant impact of self-efficacy on self-regulated learning and emphasizes the mediating role of attitude in this relationship. These findings have implications for pedagogical instruction and suggest the potential for enhancing EFL learning through augmented reality technology by focusing on self-efficacy, attitude, and self-regulated learning processes. Theoretically, the study bestows perspectives that extend the relationship between variables that self-efficacy has a positive significant impact on all dimensions of self-regulated learning while attitude has no positive significant impact on all dimensions limited only to motivation and context. The study also examines the specific indirect effects on the mediation influence of exogenous factors such as self-efficacy and attitude, as well as endogenous characteristics such as self-regulated learning namely cognition, motivation, behaviour, and context.

5. ACKNOWLEDGEMENTS

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