Psycholinguistic Insight Into Digital Language Learning Ecosystems Through Cognitive Competence and Emotional Engagement

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DOI: 10.18355/XL.2026.19.01.05

Abstract
Digital technology has allowed educational institutions to change their operations. The digital transformation improved learners' skills and experience, learning outcomes, accessibility, quality learning resources, and information exchange. This study aims to investigate the effect of digital language learning ecosystems on achievement through cognitive competence and emotional engagement from a psycholinguistic perspective for university students in Indonesia. A survey-based quantitative investigation was conducted. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to examine the survey data of 802 university students. Findings show that EE (0.346) improves student achievement more than cognitive competence (0.310). DLLE exerts a substantial direct impact on CC (0.895) and EE (0.848). CC and EE directly influence SA, with EE (0.408) exhibiting a more pronounced effect than CC (0.347). DLLE directly influences SA (0.656), indicating that mediators (CC and EE), DLLE maintains a significant function in SA. Cognitive and emotional factors greatly affect students' learning success and achievement in Digital Language Learning Ecosystems. The progression of DLLE must continue to prioritize emotional elements to cultivate a more holistic and effective learning experience. This concludes that DLLE fosters a more engaging, participatory, and stimulating educational atmosphere, enabling students to have greater emotional investment in the learning process. This study can be implemented by designing Digital Language Learning Ecosystems that balance strengthening cognitive competencies and emotional engagement through adaptive learning, gamification, and digital interactions to improve student learning outcomes.
Key words: Achievement, cognitive competence, emotional engagement, DLLE, psycholinguistic insight

1. Introduction

The advancement of information and communication technology (ICT) has occurred since the beginning of the 21st century, and as a result, the world has undergone significant transformations and has become a globalized civilization. Several aspects of people's lives have been profoundly impacted as a result of this. In comparison to how individuals thought, learned, and communicated in the previous century, people now think, learn, and communicate entirely differently (Techakosit & Rukngam, 2023). Digital technology has brought about a huge change in the way we learn languages. In the past, language learning was generally limited to face-to-face classrooms with rigorously structured textbooks and study materials (Tammets et al., 2022). The emergence of digital platforms, including language learning applications, online courses, and technology-driven instructional tools, has rendered language acquisition significantly more accessible and adaptable (Imamyartha et al., 2023). Language learning applications like Duolingo, Babbel, and Memrise have made language acquisition readily accessible. Students can initiate or persist in their learning at any time and from any location, unbound by temporal or spatial constraints. This provides individuals, from novices to more proficient learners, the opportunity to learn at their own speed and skill level (Pinto-Llorente & Izquierdo-Alvarez, 2024).

Furthermore, online courses and technology-driven education facilitate access to a broader range of interactive learning resources (Harb & El Hajj, 2024). The incorporation of movies, interactive quizzes, discussion forums, and simulation-based exercises enhances the learning experience, rendering it more dynamic and engaging. This technology makes it easier to communicate directly with teachers or peers from all around the world, which helps you learn more about the language and culture you are studying (Kessler, 2018). Digital technology makes it easier to learn a language by removing traditional barriers, such as being in a certain place or having a busy schedule. Students can now choose the platform and method that works best for them, from video lessons that are visual and aural to text-based apps and fun game-based exercises (Pujolà & Appel, 2020). Digital technology enhances the accessibility and simplicity of language acquisition while offering a more tailored and globally interconnected experience. This alteration creates new options for all individuals, irrespective of their history or location, to acquire languages in a more pleasurable, flexible, and efficient manner.

The utilization of digital tools in language acquisition has numerous prospects for the adoption of more flexible and personalized methodologies. Technology enables the customization of the learning process to align with the requirements, capabilities, and preferences of individual students, so enhancing both efficacy and enjoyment (Yildirim et al., 2023). Adaptive learning methodologies employ technology to modify the difficulty of content according to the student's proficiency or advancement. When a learner swiftly comprehends specific content, a digital learning tool can offer a more challenging task. If a learner encounters difficulty with a concept, technology will offer supplementary activities or more comprehensive explanations (Luo et al., 2024). Consequently, learning becomes dynamic and specific, adapted to the unique circumstances and progression of each student. Furthermore, technology facilitates personalized learning by utilizing data gathered from student interactions with the application or learning platform. Zhao, (2024) says that a language learning tool can keep track of words that are not learned, common mistakes, and areas that need improvement and then suggest appropriate materials or activities. It helps students focus and understand what they are learning, which makes them want to work on skills they find important or hard. This makes learning more focused and meaningful, which encourages students to work on skills that they find important or difficult.

Even if digital tools have many benefits, they can sometimes make it harder to think clearly and feel emotionally involved. From a cognitive perspective, over dependence on technology for learning can increase cognitive load when the content is very complex or difficult to access (Y. Yang et al., 2021). This may result in pupils experiencing confusion in comprehending knowledge or diminished memory retention. If technological interactions are poorly constructed, students may become overwhelmed by too much information to comprehend concurrently. From an emotional standpoint, while technology might enhance engagement via gamification or challenge-based learning, there exists a risk that students may experience loneliness or isolation in the absence of direct social interaction. Emotional engagement may be undermined if students experience frustration due to technical challenges or perceive a deficiency in emotional support, resulting in diminished desire and interest in learning (Venn et al., 2023). While technology offers a more flexible and personalized learning approach, it is crucial to comprehend its potential to either facilitate or impede students' cognitive and emotional dimensions. In technology-driven educational design, it is essential to maintain a balance between challenge and emotional support to foster an optimal environment for the growth of students' language proficiency (Liu et al., 2022).

2. Literature Review

2.1 Digital Learning Ecosystems

The term "ecosystem" was borrowed from biology to depict the interactions and connections among humans, activities, environment, and resources in education. The term has been widely employed in the field to describe the learning environments and interactions among people, practices, technology, and data flows (Tammets et al., 2022; Anvari et al., 2024). The idea of a digital ecosystem is extensive and comprehensive, encompassing all facets of engineering, technology, and experiences necessary for its optimal operation. The establishment of a digital ecosystem and a comprehensive shift to digital education will yield both advantageous and detrimental consequences for the development of human capital (Belessova et al., 2023).

Extensive studies and research on the application of ICT and digital technology in education from primary to higher levels have been undertaken since 1980. Educators incorporate digital technology into their instruction to enhance their teaching and to accurately evaluate students' understanding (Tuamsuk et al., 2023). Information and Communication Technology (ICT) is employed to enhance communication between educators and learners, as well as among peers, thereby creating a Digital Learning Ecosystem (DLE) (Techakosit & Rukngam, 2023).

2.2 Cognitive Competence (CC)

Students must receive support in cultivating robust social, emotional, and cognitive competencies. Students require a broad array of cognitive, social, and emotional skills to obtain favorable outcomes in education and life overall (Hachem et al., 2022). Cognitive Competence (CC) denotes an individual's ability to acquire, process, and utilize knowledge and cognitive skills across diverse contexts (Mingaleva & Vukovic, 2020). Cognitive competency is characterized by critical and creative thinking skills that enhance successful problem-solving, decision-making, and learning, contributing to positive youth development. Critical thinking, problem-solving, decision-making, and metacognitive skills encompassed by CC facilitate lifelong learning (Sun & Hui, 2012). Cognitive competency evolves via social interactions and learning experiences facilitated by contextual scaffolding, including teachers, classmates, or educational technology. In the realm of education, CC is frequently linked to the cultivation of higher-order cognitive processes encompassing analysis, synthesis, and evaluation.

In education, CC serves as a metric for learning achievement, particularly in technology-driven and digital learning environments (Miklánková, 2019). Methods such as flipped classrooms, gamification, and blended learning have demonstrated enhancementss in cognitive engagement and student learning outcomes. Moreover, the application of artificial intelligence in adaptive learning enhances the personalization of education and the development of critical competencies.

2.3 Emotional Engagement (EE)

Emotional Engagement (EE) denotes an individual's emotional investment in an activity, particularly within the realm of learning. Engagement in education encompasses an emotional reaction characterized by interest, excitement, motivation, and sentiments regarding the learning process (Liu et al., 2022). Emotional engagement in learning is shaped by academic emotions, including enjoyment, pride, worry, and boredom, which can impact motivation and learning results. EE is associated with the Self-Determination Theory and underscores the significance of pleasant emotions in fostering autonomy, competence, and connectivity in the learning process (Zhu et al., 2021).

In education, experiential engagement (EE) is a crucial element in enhancing student learning outcomes and retention rates. Research indicates that children exhibiting

great emotional involvement are generally more motivated and achieve superior academic performance (Yang, 2022). In technology-driven education, EE contributes to enhancing the efficacy of digital and online learning. In artificial intelligence-driven education, tailored and emotionally responsive learning experiences can enhance student engagement and improve learning results (Imamyartha et al., 2023). Addressing classroom emotions has become essential for students' emotional development and academic success. It is anticipated that effective educators possess elevated emotional competencies (Yang, 2022). Teachers should evaluate the best EQ sub-variables for foreign language acquisition to benefit students emotionally. This will highlight the importance of emotional and cognitive intelligence (Taheri et al., 2019).

2.4 Students' Achievement

Students' achievement denotes learning results assessed by multiple success indicators, including exam scores, academic skills, and conceptual comprehension (Taheri et al., 2019). In the realm of education, academic achievement serves as an indicator of the efficacy of the learning system and the effectiveness of the employed teaching methodologies. The advancement of technology significantly impacts achievement through digital-based learning methodologies (Zhang & Bray, 2020). Innovative methods enable students to freely access materials before in-person sessions, allowing class time to concentrate on discussion and problem-solving. Moreover, the application of learning analytics facilitates a comprehensive evaluation of the elements affecting student academic performance (Hachem et al., 2022). By analyzing learning data, educators can adjust teaching methods to be more flexible and aligned with the needs of individual students. In the digital age, this makes learning more personalized, efficient, and data-driven, which improves academic success.

2.5 Psycholinguistics insights

The psycholinguistic method is founded on psycholinguistics, integrating psychology and linguistics. It is referred to as a hybrid field. Psycholinguistics investigates the connections between language and cognition. It examines the processes by which individuals acquire their native and other languages, as well as the cognitive mechanisms employed for language production, comprehension, and retention (DemiRezen, 2004). First, teachers need to figure out the most important individual sources of performance variation in their classroom. Second, they need to come up with ways to effectively reduce the psychological or cognitive factors that slow down their students' learning rate and trajectory (Karbakhsh & Ahmadi Safa, 2020).

A lot of studies have talked about how important technology is for learning languages, but not many have looked specifically at how digital learning ecosystems (DLEs) affect student achievement through cognitive and affective processes. Most studies only look at how technology can help students improve their general language skills. They do not look into how it affects their thinking, how well they understand, or how emotionally involved they are in learning. This study aims to fill in that gap by looking into how DLEs can improve students' academic performance through pathways of cognitive competence and emotional involvement.

This study aims to investigate the effect of digital language learning ecosystems on achievement through cognitive competence and emotional engagement from a psycholinguistic insight for university students in Indonesia. The research hypothesis is as follows:

H1: The effect of digital learning ecosystems (DLE) on cognitive competence (CC)
H2: The effect of digital learning ecosystems (DLE) on emotional engagement (EE)
H3: The effect of cognitive competence (CC) on students' achievement (AC)
H4: The effect of emotional engagement (EE) on students' achievement (AC)

H5: The effect of digital learning ecosystems (DLE) on students' achievement through cognitive competence (CC)
H6: The effect of digital learning ecosystems (DLE) on students' achievement through emotional engagement (EE)

3. Research Method

3.1 Research Design

A survey-based quantitative investigation was conducted. The helpful aspects assisted the survey during the investigation. Several key features that improved research results were identified. These criteria included high representation, affordable, easy data collection, statistical significance, little researcher subjectivity, and reliable study results (Leavy, 2017).

Survey data was analyzed using PLS-SEM (Hair et al., 2021), which stands for structural equation Modelling, is considered the next step in the progression of multivariate analysis within the subject of study. Academics and researchers generally favour this methodology for analyzing information obtained through surveys. When adapting this PLS-SEM method, using PLS-SEM apps is highly suitable because it will deliver more precise results (Mustafa et al., 2020; Collier, 2020).

It is unknown to what extent this method is employed to investigate the association between individual variables in a given setting. However, this study used PLS-SEM by focusing on contexts that have not been adequately investigated, such as specific education sectors, particular geographic regions, or new intervention factors, which is one way to bridge this vacuum in knowledge. PLS-SEM applications are not being discussed enough, which is a problem. The fact that PLS-SEM applications produce more accurate findings is mentioned in this study; nevertheless, the technological advancements made in developing these applications are not investigated. The efficiency of new apps or technical changes in facilitating data analysis might be analyzed to explore this gap further.

3.2 Participants

The participants in this study were students from Universitas Negeri Makassar, IAIN Ambon, and Universitas Pattimura representing 802 Indonesian language education students. Indonesian students are given access to professional development opportunities tailored to meet their specific requirements and opportunities to customize their curriculum. The demographic information of the participants, broken down by gender, age, and most recent level of schooling, is presented below. The demographic data of participants were between the ages of 17 and 24 years old until the final semester.

Table 1. Demographic Data

Demographic	n	Percentage

Institution	Universitas Negeri Makassar (UNM)	
Gender		
Male	104	(26%)
Female	296	(74%)
Institution	Institut Agama Islam Negeri (IAIN) Ambon	
Gender		
Male	65	(40.88%)
Female	94	(59.12%)
Institution	Universitas Pattimura	
Gender		
Male	85	(34.98%)
Female	158	(65.02%)
Age		
17-19	146	18.2%
20-22	351	43.8%
23-25	305	38.0%
Total	**802**	

The answers came from three different universities, which are Makassar State University, State Islamic Institute (IAIN) Ambon, and Pattimura University. These universities were selected based on their respective institutions. There was a total of 400 students attending UNM Makassar, which was the source of the majority of the respondents. In the meantime, Pattimura University had 243 respondents, and IAIN Ambon provided 159 respondents to the survey. Within every institution, the proportion of female respondents was significantly higher than that of male respondents. Among those who participated in the survey at UNM Makassar, 74% were female, while 26% were male. For example, the percentage of girls at IAIN Ambon reached 59.12%, while the percentage of males was 40.88%. The percentage of female respondents at Pattimura University was 65.02%, while the percentage of male respondents was 34.98%. There was a total of 548 female respondents in this study, which accounts for 68.33 percent of the total, while there were 254 male respondents comprising 31.67% of the total. The bulk of responders, or 351 individuals, were between the ages of 20 and 22 years old. This represents 43.8% of the total population. Following closely after 305 respondents (38%) was the age group ranging from 23 to 25 years old, while the youngest respondents, who were between the ages of 17 and 19, were 146 individuals (18.2%). This study included a total of 802 participants, the majority of them were found to be between the ages of 20 and 22 years old. The majority of the participants were female. The features of the people who participated in the research are going to be further investigated in studies that are relevant to the ecosystem of digital language learning, and this data provides an overview of such qualities. The sampling technique used is random sampling, so the results of the study can be considered quite representative.

3.3 Validity and Reliability Test

The validity and reliability test in this investigation is designed to confirm that the research instrument that is being utilized is capable of accurately and consistently measuring the construct that is being investigated.

Table 2. Validity and Reliability Test

The loading factor creates the basis for the validity analysis. By examining item dependability (a validity indicator), the loading factor value is used to ascertain convergent validity.

Table 2. The output of outer loading

Constructs	CC	DLLE	EE	SA
CC1	0.754			
CC2	0.733			
CC3	0.710			
CC4	0.780			
CC5	0.732			
CC6	0.785			
CC7	0.722			
DLLE1		0.756		
DLLE2		0.733		
DLLE3		0.767		
DLLE4		0.779		
DLLE5		0.816		
DLLE6		0.770		
DLLE7		0.782		
EE1			0.716	
EE2			0.727	
EE3			0.741	
EE4			0.737	
EE5			0.726	
EE6			0.768	
EE7			0.735	
EE8			0.646	
SA1				0.727
SA2				0.761
SA3				0.807
SA4				0.786
SA5				0.773
SA6				0.771

CC (Cognitive Competence) consists of 7 indicators (CC1 - CC7) with loading values ranging from 0.710 to 0.785. DLLE (Digital Language Learning Ecosystem) has 7 indicators (DLLE1 - DLLE7) with loading levels between 0.733 and 0.816. Emotional Engagement (EE) has eight indicators (EE1 - EE8) with loading values between 0.646 and 0.768. Student Achievement (SA) has six indicators (SA1 - SA6) with loading values between 0.727 and 0.807. All constructs show relatively high outer loadings, so they can be assumed to have good

convergent validity. A statistic known as the loading factor illustrates the correlation between the scores of a question item (indicator) and the construct indicators when measuring the construct (latent variable). A loading factor greater than 0.7 is considered valid.

The outer model can be evaluated by assessing construct reliability, as shown by composite reliability scores. The recommended value had ranged from .70 to .90 (Hair et al., 2011), is shown in Table 3.

Table 3. The Construct Reliability and Validity

Constructs	Composite Reliability	Average Variance Extracted (AVE)
CC	0.897	0.556
DLLE	0.912	0.596
EE	0.899	0.526
SA	0.898	0.595

The analysis of the Composite Reliability (CR) and Average Variance Extracted (AVE) test results indicates that the study instrument possesses strong reliability and validity. Composite Reliability assesses the internal consistency of the indicators of a concept. A CR value of 0.70 or higher signifies that the construct exhibits strong reliability. Since all AVE values exceed 0.50, the indicators within each concept can account for a substantial variance, hence satisfying the criteria for convergent validity in this model. According to the Composite Reliability (CR) and Average Variance Extracted (AVE) values, all constructs in this investigation demonstrate robust reliability and satisfactory convergent validity. This signifies that the employed measurement methodology is dependable for assessing the examined variables.

3.4 Procedure of research

Three primary stage makeup this study technique. Preparation is the initial stage, which has just begun. Researchers recognized issues or occurrences in the field at this point. Furthermore, researchers carried out literature reviews from a variety of sources, including books and research journals, among other sources. The researchers also submitted a letter of application to the institution's leadership where the study was conducted to request permission to conduct research. This was done to grant authorization. Research instruments, specifically questionnaires, were then prepared by the researchers. The gathering of information was a two-stage process.

During this research project phase, the researchers handed out questionnaires to the participants, who had initially provided their informed consent to participate in the study. The questionnaires were developed through 34 statements on digital learning ecosystems on achievement through cognitive competence and emotional engagement from a psycholinguistic insight for university students in Indonesia. Earlier than the distribution of the questionnaire, the researcher provided an explanation of the objectives of this study as well as the potential advantages that the participants would encounter. Because it was a self-evaluation, the researcher emphasized the need for participants to be truthful when filling out this questionnaire. Participants are responsible for providing themselves with an evaluation. The researcher utilized a one-shot experiment approach, data gathering, because of the limited time and resources available. This method did not involve testing the instrument beforehand. After putting the data through testing using PLS-SEM, the third stage is the data analysis.

3.5 Instrument of the research

A closed questionnaire was employed to investigate the effect of digital learning ecosystems on achievement through cognitive competence and emotional engagement from a psycholinguistic insight for university students in Indonesia. The research instrument in this study is a questionnaire developed to assess the four primary constructs examined, specifically digital learning ecosystems (DLE), students' achievement, cognitive competence (CC), and emotional engagement (EE) based on a psycholinguistics perspective. The instrument items such as Cognitive Competence in Digital Learning: I can understand the material presented through the digital platform without difficulty, I can follow the learning flow provided by the digital platform independently, interactive exercises on the digital platform help improve my ability to understand the language, I can complete tasks on the digital platform without requiring additional guidance, The digital learning system facilitates me to connect new knowledge with previous knowledge, I can analyze my mistakes based on the feedback provided by the platform, I feel that spaced repetition on the digital platform helps me master the material effectively. Emotional Engagement in Digital Learning: I feel happy when using the digital platform to learn a language, I feel satisfied when completing tasks or exercises on the digital platform, I feel confident in using the digital platform to improve my language skills, I feel proud when achieving learning targets given by the digital platform, I feel anxious when I cannot complete tasks or exercises on the digital platform on time, I feel inspired to try new things in language learning after using the digital platform, I feel rewarded when receiving positive feedback from the system or instructor on the digital platform, and I feel emotionally connected to the learning community on the digital platform (e.g., discussion forums or study groups). Digital Language Learning Ecosystem: Learning materials available on digital platforms suit my needs in learning a language, I can access and utilize language learning applications or platforms independently, I can find relevant language learning resources via the internet, I can evaluate the quality and credibility of language learning resources that I find online, I feel that my digital literacy helps me learn a language more effectively and efficiently, I can utilize software or applications designed to improve my language skills, I feel that my digital literacy helps me learn a language more effectively and efficiently. Achievement: I have achieved my language learning target that I set using the digital platform, I can understand the language material better thanks to the interactive features in the digital platform, Feedback from the digital platform helps me achieve higher learning targets, I feel that the combination of my cognitive competence and emotional engagement has a positive impact on my language learning outcomes, I achieve better scores in language tests or exercises after learning through the digital ecosystem, and The increase in my emotional engagement during the digital learning process contributes to the achievement of my learning targets.

This research often uses a Likert scale (e.g., 1 = Strongly Disagree to 5 = Strongly Agree) for each questionnaire item. Procedures for Validation and Reliability Construct validity, encompassing convergent and discriminant validity, is evaluated to confirm that each question accurately measures the target construct. Reliability is assessed by Cronbach's Alpha or Composite Reliability to verify the internal consistency of each construct. This tool is intended to collect data for analysis via Partial Least Squares Structural Equation Modelling (PLS-SEM), hence facilitating the statistical evaluation of variable relationships (Hair et al., 2013).

3.6 Data Collection Process

PLS-SEM is an exceptionally valuable framework since it provides a multitude of advantages to its users. In the first place, it simplifies the process of doing exploratory and confirmatory research by including self-reflection, Modelling expertise, and

theoretical foundations (Hair et al., 2012). When the approach that has been provided is put into practice within the confines of the philosophy of discovery or confirmation, it is said to be practical. It is helpful in a variety of research methodologies, including experimental or survey research, cross-sectional or longitudinal studies, and approaches including measurement or hypothesis testing. This is an extra advantage that it offers. Additionally, this strategy can be utilized in a broad variety of institutional or cultural settings, as well as among a group of people from different backgrounds (Bagozzi, & Yi, 2012).

There are often several steps involved in the process of conducting a structural equation Modelling (SEM) analysis. These stages include the design of the model, the collection of data, estimating, evaluation, and the possibility of further model change. In most cases, one of the software packages that was developed specifically for PLS-SEM is utilized to carry out a significant number of PLS-SEM assessments. It is important to note that PLS-SEM is a representative of one of the businesses that are being considered. When it comes to estimating parameters, the PLS-SEM program can generate bootstrapped standard error estimates in addition to confidence intervals. If there is a lack of data, SEM PLS offers an extra method to generate a maximum probability estimate that takes into account all of the information that is currently available (Lei, &Wu, 2007). To do confirmatory factor analyses (CFA) on the scales and structural equation Modelling (SEM) to examine the interrelationships among the components that make up the proposed model, the PLS-SEM software package was utilized.

The PLS-SEM software initially employed confirmatory factor analysis to assess the measurement model. The model delineated several distinct variables. The variables encompassed digital learning ecosystems (DLE), students' achievement, cognitive competence (CC), and emotional engagement (EE) based on a psycholinguistics perspective. The measurement model test validated the independence of the given elements as distinct constructs and assessed their correlation. For evaluation, structural equation Modelling (SEM) research utilizing partial least squares (PLS) was performed on the theoretical model. The PLS-SEM analysis included instructors' ages as endogenous variables. This was done to lessen the sample's large age gap (Byrne, 2010).

The model was evaluated using CFI, IFI, TLI, RMSEA, and chi-square test statistics. CFI, IFI, and TLI indices above 0.90 are good, and values above 0.95 suggest an excellent data match. Analyzing data begins with confirming the instrument's authenticity and reliability. Regression analysis requires the usual assumption test. Four analytical processes are incorporated in this step: normalcy, multicollinearity, heteroscedasticity, and linearity. Third, the simultaneous f-test and multiple linear regression analysis were used to evaluate the hypothesis (Collier, 2020).

4. Results

4.1 Data analysis

The exogenous model consists of the Digital Language Learning Ecosystem (DLLE). The intervening models are Cognitive Competence (CC) and Emotional Engagement (EE). The construction of the Students' Achievement (SA) has become an endogenous model. The figure below shows the inner model design which is presented with smart PLS 3 software:

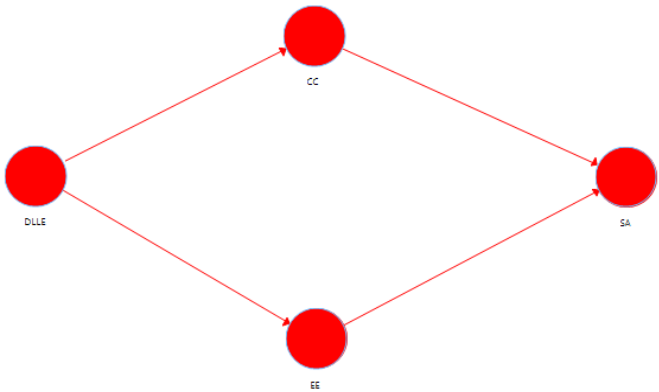

Figure 1. Inner model design

Outer model design

The outer model displays reflexivity in the indicators of the DLLE, CC, EE and SA. Latent variables (constructs). The construction of the indicators is shown through the measurement model's arrow. The outer model design created with smartPLS version 3 software is displayed in the graphic below.

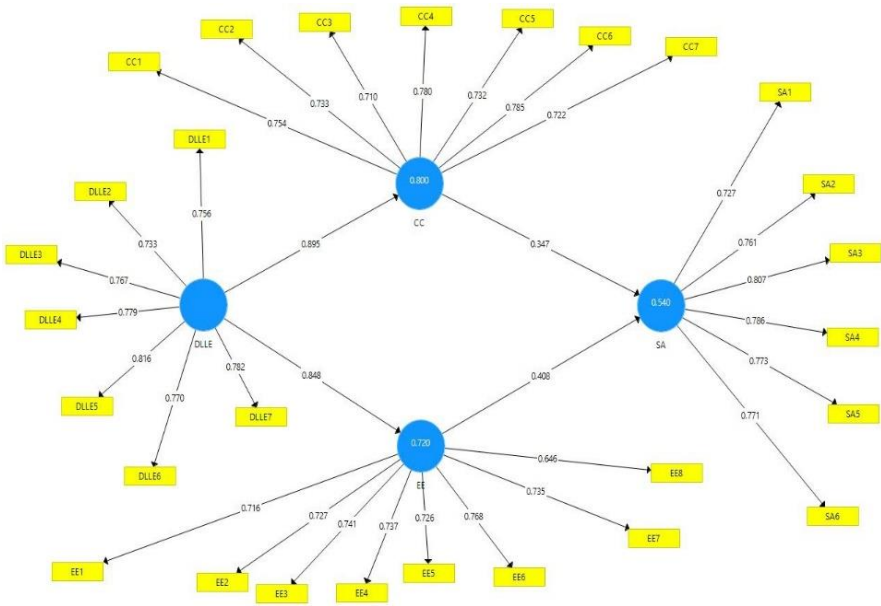

Figure 2. Outer model design

Figure 2 displays that there are four latent variables describing the correlation with the indicators. These constructs produce convergent validity, which is proven by having a correlation of over 0.60 from each indicator.

4.2 Structural Model Evaluation

Loading Factor

Discriminant validity

To evaluate discriminant validity, compare the square root of the Average Variance Extracted for each concept to its latent variable correlation. When the average variance extracted (AVE) root value for each construct exceeds the hidden variable correlation, the model has sufficient discriminant validity. The Fornell-Larcker Criterion table illustrates the connection between the correlation of latent variables as established by the PLS (Partial Least Squares) Algorithm and the root of AVE (Average Variance Extracted) in the table below:

Table 4. The Output of Fornell-locker Criterion

Constructs	CC	DLLE	EE	SA
CC	0.896			
DLLE	0.895	0.848		
EE	0.745	0.772	0.725	
SA	0.712	0.750	0.719	0.771

Discriminant validity has been met because the square root value of AVE is greater than the correlation between constructs. Digital learning ecosystem (DLLE) has a strong influence on cognitive competence (CC) and emotional engagement (EE). Emotional engagement (EE) has a fairly strong relationship with learning achievement (SA), confirming that emotions play an important role in learning success.

Table 5. R-square

Constructs	R-Square
CC	0.800
EE	0.720
SA	0.540

DLLE significantly impacts CC (R^2 = 0.800) and EE (R^2 = 0.720). Students' Achievement (SA) exhibits a moderately strong correlation with CC and EE (R^2 = 0.540), suggesting that cognitive competence and emotional engagement are critical elements in students' self-assessment processes. This model demonstrates reliability in elucidating the connections among digital-based language learning, cognitive competence, emotional engagement, and SA.

The next step in testing the hypotheses was path coefficient results. The significant value between variables, t-statistics, and p-values were used to decide whether a hypothesis test should be accepted or rejected

Table 6. Specific Indirect Effect (Mean, STDEV, T-Values)

Construct	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics (|O/STDEV|)	P-Values
DLLE -> CC -> SA	0.310	0.315	0.078	3.972	0.000
DLLE -> EE -> SA	0.346	0.344	0.069	4.997	0.000

Both pathways DLLE → CC → SA and DLLE → EE → SA have substantial indirect effects. The impact of EE (0.346) surpasses that of CC (0.310), suggesting that emotional engagement significantly enhances students' achievement more than cognitive competence. These findings affirm that in Digital Language Learning Ecosystems, both cognitive and emotional dimensions significantly contribute to students' learning success and students' achievement (SA).

Table 7. Direct Effect (Mean, STDEV, T-Values)

Construct	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P-Values
CC -> SA	0.347	0.351	0.085	4.092	0.000
DLLE -> CC	0.895	0.896	0.012	72.494	0.000
DLLE -> EE	0.848	0.850	0.011	80.746	0.000
DLLE -> SA	0.656	0.659	0.024	26.950	0.000
EE -> SA	0.408	0.405	0.081	5.048	0.000

DLLE has a significant direct influence on CC (0.895) and EE (0.848). CC and EE exert a direct influence on SA, with EE (0.408) demonstrating a more significant effect than CC (0.347). DLLE exerts a direct influence on SA (0.656), signifying that, alongside mediators (CC and EE), DLLE continues to play a substantial role in SA.

5. Discussions

5.1 The effect of DLLE on CC

Digital Language Learning Ecosystems (DLLE) significantly impact cognitive competence (CC). This indicates that about 90% of the enhancements in cognitive competence can be attributed to the utilization of DLLE, affirming that digital technology in language acquisition plays a vital role in fostering the cognitive dimensions of learners. DLLE encompasses several digital platforms, including language learning software, virtual learning environments, AI-driven tutors, and interactive content that facilitate more adaptable and personalized learning experiences. This technology enables students to access materials at any time and anywhere, receive automatic feedback, and engage in challenge-based activities that enhance critical thinking and problem-solving abilities (Hung et al., 2012).

Furthermore, digital ecosystems facilitate the incorporation of evidence-based pedagogical approaches, including adaptive learning, game-based learning, and collaborative online learning, which directly enhance conceptual comprehension and fortify long-term retention (Belessova et al., 2023). Interactivity in DLLE fosters individual investigation and the use of diverse learning resources, hence enhancing students' metacognition and their capacity to organize learning processes effectively. Consequently, the application of DLLE enhances the language learning process and

markedly elevates students' cognitive abilities. This suggests that the integration of digital technology in language education might effectively enhance students' cognitive processes, hence enhancing comprehension, information processing (Tammets et al., 2022), and decision-making within the realm of language acquisition.

5.2 The effect of DLLE on EE

There is a considerable impact that digital language learning ecosystems (DLLE) have on cognitive ability of students. This suggests that approximately 84.8% of the variance in students' emotional engagement may be attributed to the utilization of DLLE, affirming that digital technology in language education significantly enhances the affective dimensions of learners. DLLE fosters a more engaging, participatory, and stimulating educational atmosphere, enabling students to have greater emotional investment in the learning process. Elements like as gamification, immediate feedback, content customization, and social engagement via online communities enhance the enjoyment and immersion of the learning process. These factors enhance student motivation for active participation, increase learning satisfaction, and bolster confidence in language skill development.

Moreover, DLLE facilitates a self-regulated learning paradigm, enabling students to dictate the speed, methodologies, and resources of their learning following their preferences and requirements. This enhances feelings of autonomy and intrinsic engagement, fostering motivation, a sense of accomplishment, and persistence in language acquisition. The interactivity in DLLE fosters a more social and collaborative learning environment through discussion forums, AI-driven simulations, and project-based activities that enable students to engage with peers or instructors digitally. This social dimension contributes to fostering a deeper emotional connection to the learning process, alleviating anxiety associated with language acquisition, and enhancing a sense of belonging within the learning community. Consequently, DLLE enhances both the cognitive dimension of language acquisition and markedly affects students' emotional involvement. The integration of digital technology in the language learning environment has demonstrated the ability to enhance enjoyment, motivation, and students' emotional resilience when confronting problems in acquiring a foreign language.

5.3 The Effect of CC on Students' Achievement

Cognitive competence (CC) exerts a direct and substantial influence on Students' Achievement (SA). This study indicates that 34.7% of the variance in students' academic performance may be attributed to their cognitive competence, suggesting that greater cognitive competence correlates with improved learning outcomes. Cognitive competency encompasses critical thinking abilities, problem-solving skills, conceptual comprehension, and memory, all of which significantly contribute to students' academic achievement. Enhancing cognitive competence via diverse adaptive and technology-driven learning methodologies enables students to formulate more effective learning strategies, augment their comprehension of the material, and refine their cognitive processes in executing academic tasks (Dubovi, 2022).

Furthermore, elevated cognitive competency enables students to have greater autonomy in overseeing their learning process, including establishing learning objectives, selecting appropriate strategies, and assessing their progress (Zhu et al., 2021). Consequently, students are better equipped to confront academic problems, capable of executing tasks with more efficiency, and more readily attain the established learning objectives. This finding suggests that enhancing cognitive competence using a technology-driven approach may effectively improve students' academic performance. Consequently, digital learning designs must persist in incorporating components that foster critical thinking, analytical abilities, and

problem-solving skills to enhance learning outcomes and elevate students' overall academic achievement (Artino & Jones, 2012).

5.4 The effect of EE on Students' Achievement

Emotional Engagement (EE) exerts a positive and significant influence on Students' Achievement (SA). This finding reveals that 40.8% of the diversity in students' academic performance may be attributed to their emotional engagement, affirming that increased emotional involvement in the learning process correlates with improved academic outcomes. Emotional engagement encompasses intrinsic drive, a desire for learning, and favorable emotions during interactions with educational resources and the learning environment. The elements such as gamification, immediate feedback, content customization, and social interaction significantly contribute to augmenting students' emotional involvement. When students are motivated and find enjoyment in learning, they are more likely to concentrate, exert greater effort, and demonstrate perseverance in fulfilling their academic responsibilities (Pentaraki & Burkholder, 2017).

Moreover, heightened emotional engagement diminishes academic worry and enhances students' self-confidence. For instance, when students are at ease in an interactive and supportive digital learning environment, they are more inclined to engage actively, take initiative in their studies, and persist in overcoming problems related to comprehension of the topic. This enhances self-regulated learning, enabling students to manage their learning processes more efficiently, so positively influencing their academic performance (Hartikainen et al., 2021).

This research substantiates that emotional engagement is a vital component in facilitating students' academic achievement, particularly in technology-enhanced learning environments. Findings underscore the relevance of emotional engagement, particularly for individuals at risk of ambiguous educational ambitions and those least likely to continue in education following post-compulsory schooling (Gutman & Schoon, 2018). Consequently, the design and execution of language learning must undergo continual enhancements to foster students' emotional dimensions, including interactive components, supportive learning communities, and engaging, pleasurable educational methodologies. This strategy can enhance students' academic progress while fostering a more positive and meaningful learning environment (Hartikainen et al., 2021).

5.5 The effect of DLLE on Students' Achievement through CC

Digital Language Learning Ecosystems (DLLE) enhance students' academic achievement by fortifying cognitive competence (CC). Research indicates that DLLE enhances cognitive development by offering a more adaptive, interactive, and technology-driven learning environment. This ecosystem provides students with diverse digital resources, including AI-driven learning, gamification, automated feedback, and interactive content aimed at improving conceptual comprehension, critical thinking, and problem-solving abilities. The profound influence of DLLE on academic performance via cognitive skills is seen in the manner technology facilitates more autonomous and organized learning approaches. Enhanced cognitive abilities enable students to regulate their learning, comprehend information, and employ efficient thinking processes in academic endeavors. Educational achievement was found to have a constructive and statistically significant relationship with cognitive competence (Hachem et al., 2022).

Empirical studies indicate that the enhancements of cognitive competencies enabled by DLLE strongly correlates with improved academic performance since individuals possessing superior analytical thinking and problem-solving abilities typically attain higher success in language acquisition. Educators incorporate digital technology into

their instructions to enhance their teaching methods and to accurately evaluate student learning (Imamyartha et al., 2023). Information and Communication Technology (ICT) is utilized to enhance communication between educators and learners, as well as among peers, thereby creating a Digital Learning Ecosystem (DLE) (Techakosit & Rukngam, 2023).

5.6 The effect of DLLE on Students' Achievement through EE

Digital Language Learning Ecosystems (DLLE) possess substantial potential to enhance students' Cognitive Competence (CC), hence considerably impacting Students' Achievement (SA). DLLE offers a cohesive digital learning ecosystem, wherein diverse technical instruments, including educational software, online platforms, and artificial intelligence, collaborate to deliver a tailored and adaptable learning experience. This enables students to enhance their cognitive abilities, including critical thinking, problem-solving, and metacognition, within a more interactive and interesting language learning environment. Enhanced Cognitive Competence (CC) enables students to digest material more efficiently, engage in self-assessment, and implement more successful learning practices (Miklánková, 2019). The augmentation of cognitive competence contributes to enhancing Students' Achievement since individuals with superior cognitive abilities are more adept at resolving academic challenges, mastering content, and elevating their overall educational performance. In this instance, DLLE enhances students' linguistic abilities while simultaneously fostering cognitive capabilities essential for academic success, hence directly influencing their academic performance.

Furthermore, what makes this study unique is how Digital Language Learning Ecosystems (DLLE) integrate cognitive and emotional aspects of language learning, giving students a more complete and holistic experience. Most studies in the past concentrated on one component, cognitive or emotional. Both characteristics are interconnected and can reinforce each other, especially in technology-based learning, according to this study. In addition to improving students' cognitive skills like critical thinking and problem-solving, DLLE, which includes learning apps, AI-based tutors, and gamification, boosts their emotional engagement in learning. Technology makes learning more engaging and emotive, which boosts motivation, contentment, and self-confidence (Wei, 2022).

An important mediator between cognitive competence (CC) and student accomplishment is emotional engagement. Higher emotional engagement helps students take on difficulties, learn deeper, and be more active. Students who feel emotionally linked are more likely to learn more, overcome fear, and succeed academically (Liu et al., 2022). DLLE improves academic skills and produces a more comprehensive learning experience by synergistically integrating cognitive and emotional elements, making this study innovative. Technology-based learning can provide a more inclusive, immersive, and individualized environment for students, where thinking skills and emotional engagement improve academic performance (Tawafak et al., 2023).

Digital Language Learning Ecosystems (DLLE) are integrated digital frameworks intended to facilitate language acquisition using diverse online tools and technology. These ecosystems encompass language learning programs (Salazar & Maldonado, 2020), online platforms, virtual learning environments, AI-driven tutors, and interactive content that facilitate adaptive and personalized learning experiences. This concept aligns with the trend of educational digitalization, wherein technology is essential for enhancing accessibility, engagement, and self-regulated learning. It utilizes modern technology to provide a more adaptable, cooperative, and data-informed methodology for language acquisition (Souza et al., 2021). Furthermore, these ecosystems facilitate the enhancements of language abilities for learners through varied and enriching educational experiences. DLLE transforms language learning

from a typical classroom setting into a dynamic, technology-driven experience, enabling learners to engage with the target language across diverse digital environments.

This study may have concentrated on a particular category of learning technology in DLLE and may not have encompassed the entire range of digital tools accessible. Various learning platforms and technologies can significantly influence CC and EE differently, and the findings derived from the technology employed in this study may not be entirely relevant to other platforms or technological instruments. This study may have been predominantly cross-sectional or reliant on measurements taken at a singular moment in time. Consequently, the extent to which the influence of DLLE on CC and EE is maintained over the long run is uncertain. Assessing the long-term impact on student accomplishment would enhance comprehension of the results' sustainability. Recognizing and comprehending these constraints is crucial for enhancing the quality and dependability of the research findings and guiding future investigations that can address the study's constrained parts.

6. Conclusions

This study demonstrates that Digital Language Learning Ecosystems (DLLE) significantly influence students' cognitive competence (CC) and emotional engagement (EE), hence enhancing students' achievement (SA). The use of DLLE offers a more adaptable and individualized learning experience, enabling students to access resources at any time, obtain automated feedback, and participate in challenge-based activities that foster critical thinking and problem-solving abilities. Moreover, elements like gamification, content personalization, and social interaction via online communities enhance students' motivation and self-assurance, hence augmenting their emotional involvement in the learning experience. Cognitive competency and emotional involvement serve as mediators that affect students' academic achievement. The enhancements of students' emotional engagement, instigated by DLLE components, directly influences their academic performance improvement. These findings affirm that DLLE enhances both the cognitive and emotional characteristics of students, both of which significantly influence academic performance. Consequently, the advancement of DLLE must persist in emphasizing emotional components to foster a more comprehensive and efficacious learning experience.

Future research is recommended to explore the role of other psychological variables—such as intrinsic motivation, self-regulation, and digital literacy—and to test the effectiveness of DLLE across different learning contexts, educational levels, and technology designs.

Bibliographic references

Anvari, R., Moradi, F., & Shirvani, A. (2024). Digital Learning Ecosystem at Educational Institutions: A 4-University Perspective. Professional Studies: Theory and Practice, 28(1), 100–110. https://doi.org/10.56131/pstp.2024.28.1.275

Artino, A. R., & Jones, K. D. (2012). Exploring the Complex Relations Between Achievement Emotions and Self-Regulated Learning Behaviors in Online Learning. The Internet and Higher Education, 15(3), 170-175. https://doi.org/10.1016/j.iheduc.2012.01.006

Bagozzi, R. P., & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. Journal of the Academy ofMarketing Science, 40(1), 8e34. https://doi.org/10.1111/j.1745-3992.2007.00099.x

Belessova, D., Ibashova, A., Bosova, L., & Shaimerdenova, G. (2023). Digital Learning Ecosystem: Current State, Prospects, and Hurdles. Open Education Studies, 5(1), 20220179. https://doi.org/10.1515/edu-2022-0179

Byrne, B. M. (2010). Structural Equation Modelling with AMOS: Basic Concepts,

Applications, and Programming Second Edition. New York, USA: Routledge Taylor & Francis Group.
Collier, J. (2020). Applied structural equation Modelling using AMOS: Basic to advanced techniques. Routledge.
DemiRezen, M. (2004). Relations between psycholinguistic approach and foreign language learning and teaching. Ondokuz Mayis University Journal of Education Faculty, 17(1), 33-44.
Dubovi, I. (2022). Cognitive and Emotional Engagement While Learning with Vr: The Perspective of Multimodal Methodology. Computers & Education, 183, 104495. https://doi.org/10.1016/j.compedu.2022.104495
Gutman, L. M., & Schoon, I. (2018). Emotional engagement, educational aspirations, and their association during secondary school. Journal of Adolescence, 67(1), 109-119. https://doi.org/10.1016/j.adolescence.2018.05.014
Hachem, M., Gorgun, G., Chu, M.-W., & Bulut, O. (2022). Social and Emotional Variables as Predictors of Students' Perceived Cognitive Competence and Academic Performance. Canadian Journal of School Psychology, 37(4), 362-384. https://doi.org/10.1177/08295735221118474
Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). Partial Least Squares Structural Equation Modelling (PLS-SEM) Using R: A Workbook. Springer International Publishing. https://doi.org/10.1007/978-3-030-80519-7
Hair, J. F., Ringle, C. M., & Sarstedt, M. (2012). Partial Least Squares: The Better Approach to Structural Equation Modelling? Long Range Planning, 45(5-6), 312-319. https://doi.org/10.1016/j.lrp.2012.09.011
Hair, J. F., Ringle, C. M., & Sarstedt, M. (2013). Partial Least Squares Structural Equation Modelling: Rigorous Applications, Better Results and Higher Acceptance. Long Range Planning, 46(1-2), 1-12. https://doi.org/10.1016/j.lrp.2013.01.001
Hair, J.F., Ringle, C.M. and Sarstedt, M. (2011). PLS-SEM: indeed a silver bullet. Journal of Marketing Theory and Practice, 19(2), 139-151.
Harb, H., & El Hajj, M. (2024). Integrating Eclecticism and Technology in Language Teaching: The Case of Lusail University in Qatar. XLinguae, 17(4), 3-19. https://doi.org/10.18355/XL.2024.17.04.01
Hartikainen, J., Poikkeus, A.-M., Haapala, E. A., Sääkslahti, A., & Finni, T. (2021). Associations of Classroom Design and Classroom-Based Physical Activity with Behavioral and Emotional Engagement among Primary School Students. Sustainability, 13(14), 8116. https://doi.org/10.3390/su13148116
Hung, C.-M., Hwang, G.-J., & Huang, I. (2012). A Project-Based Digital Storytelling Approach for Improving Students' Learning Motivation, Problem-Solving Competence and Learning Achievement. Educational Technology & Society, 15(4). https://eric.ed.gov/?id=EJ992969&utm_source=chatgpt.com
Imamyartha, D., Widiati, U., & Anugerahwati, M. (2023). The Nexus Between Emotional Intelligence, Learning Engagement, Motivation, and Achievement in Team-Based Mobile Language Learning. The JALT CALL Journal, 19(2), 269-298. https://doi.org/10.29140/jaltcall.v19n2.1083
Karbakhsh, R., & Ahmadi Safa, M. (2020). Basic Psychological Needs Satisfaction, Goal Orientation, Willingness to Communicate, Self-efficacy, and Learning Strategy Use as Predictors of Second Language Achievement: A Structural Equation Modelling Approach. Journal of Psycholinguistic Research, 49(5), 803-822. https://doi.org/10.1007/s10936-020-09714-7
Kessler, G. (2018). Technology and the future of language teaching. Foreign Language Annals, 51(1), 205-218. https://doi.org/10.1111/flan.12318
Leavy, P. (2017). Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches.
Lei, P. W., &Wu, Q. (2007). Introduction to structural equation Modelling: Issues and

practical considerations. Educational Measurement: Issues and Practice, 26(3), 33e43.
Liu, S., Liu, S., Liu, Z., Peng, X., & Yang, Z. (2022). Automated Detection of Emotional and Cognitive Engagement in MOOCS Discussions to Predict Learning Achievement. Computers & Education, 181, 104461. https://doi.org/10.1016/j.compedu.2022.104461
Luo, S., King, R. B., Wang, F., & Leung, S. O. (2024). English digital reading achievement for East Asian students: Identifying the key predictors using a machine learning approach. Asia Pacific Journal of Education, 1-17. https://doi.org/10.1080/02188791.2024.2398120
Miklánková, L. (2019). Cognitive Competence of a Child in Primary School Age in the Context of Gross Motor Skills. IJAEDU- International E-Journal of Advances in Education, V(14), 200-206. https://doi.org/10.18768/ijaedu.593487
Mingaleva, Z., & Vukovic, N. (2020). Development of Engineering Students Competencies Based on Cognitive Technologies in Conditions of Industry 4.0. International Journal of Cognitive Research in Science Engineering and Education, 8(Special issue), 93-101. https://doi.org/10.23947/2334-8496-2020-8-SI-93-101
Mustafa, M. Z. Bin, Nordin, M. N. Bin, & Abdul Razzaq, A. R. Bin. (2020). Structural equation modelling using AMOS: Confirmatory factor analysis for taskload of special education integration program teachers. Universal Journal of Educational Research, 8(1), 127-133. https://doi.org/10.13189/ujer.2020.080115
Pentaraki, A., & Burkholder, G. J. (2017). Emerging Evidence Regarding the Roles of Emotional, Behavioural, and Cognitive Aspects of Student Engagement in the Online Classroom. European Journal of Open, Distance and E-Learning, 20(1), 1-21. https://doi.org/10.1515/eurodl-2017-0001
Pinto-Llorente, A. M., & Izquierdo-Álvarez, V. (2024). Digital Learning Ecosystem to Enhance Formative Assessment in Second Language Acquisition in Higher Education. Sustainability, 16(11), 4687. https://doi.org/10.3390/su16114687
Pujolà, J.-T., & Appel, C. (2020). Gamification for Technology-Enhanced Language Teaching and Learning: In M. Kruk & M. Peterson (Eds.), Advances in Educational Technologies and Instructional Design (pp. 93-111). IGI Global. https://doi.org/10.4018/978-1-7998-2591-3.ch005
Rojas Salazar, L. J., & Maldonado G, L. F. (2020). Autonomous Learning of English as a Foreign Language in a Culturally Integrated B-Learning Ecosystem. Revista Boletín Redipe, 9(7), 182-202. https://doi.org/10.36260/rbr.v9i7.1030
Souza, R. D., Parveen, R., Chupradit, S., Velasco, L. G., Tabuena, A. C., Pentang, J. T., & Ventayen, R. J. M. (2021). Language Teachers' Pedagogical Orientations in Integrating Technology in the Online Classroom: Its Effect on Students Motivation and Engagement. Turkish Journal of Computer and Mathematics Education, 12. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3844678
Sun, R. C. F., & Hui, E. K. P. (2012). Cognitive Competence as a Positive Youth Development Construct: A Conceptual Review. The Scientific World Journal, 2012, 1-7. https://doi.org/10.1100/2012/210953
Taheri, H., Sadighi, F., Bagheri, M. S., Bavali, M., & Khajavi, Y. (2019). EFL learners' L2 achievement and its relationship with cognitive intelligence, emotional intelligence, learning styles, and language learning strategies. Cogent Education, 6(1), 1655882. https://doi.org/10.1080/2331186X.2019.1655882
Tammets, K., Khulbe, M., Sillat, L. H., & Ley, T. (2022). A Digital Learning Ecosystem to Scaffold Teachers' Learning. IEEE Transactions on Learning Technologies, 15(5), 620-633. https://doi.org/10.1109/TLT.2022.3198739
Tawafak, R. M., Al-Obaydi, L. H., Klimova, B., & Pikhart, M. (2023). Technology integration of using digital gameplay for enhancing EFL college students' behavior intention. Contemporary Educational Technology, 15(4), ep452. https://doi.org/10.30935/cedtech/13454

Techakosit, S., & Rukngam, T. (2023). Constructionist Approach Instructional Model in the Digital Learning Ecosystem to Promote Self-Directed Learning Skills. International Journal of Emerging Technologies in Learning (iJET), 18(10), 123-135. https://doi.org/10.3991/ijet.v18i10.35431
Tuamsuk, K., Nguyen, L. T., Kanjug, I., Lowatcharin, G., Manakul, T., Poonpon, K., Sarakorn, W., Somabut, A., Srisawasdi, N., & Traiyarach, S. (2023). Key success factors for transforming classrooms into learning communities in digital learning ecosystem at secondary schools in Thailand. Contemporary Educational Technology, 15(2), ep408. https://doi.org/10.30935/cedtech/12920
Venn, E., Park, J., Andersen, L. P., & Hejmadi, M. (2023). How do learning technologies impact on undergraduates' emotional and cognitive engagement with their learning? Teaching in Higher Education, 28(4), 822-839. https://doi.org/10.1080/13562517.2020.1863349
Wei, Y. (2022). Toward Technology-Based Education and English as a Foreign Language Motivation: A Review of Literature. Frontiers in Psychology, 13, 870540. https://doi.org/10.3389/fpsyg.2022.870540
Yang, N. (2022). An Investigation Into the Interplay Between Chinese EFL Teachers' Emotional Intelligence, Ambiguity Tolerance, and Work Engagement. Frontiers in Psychology, 13, 929933. https://doi.org/10.3389/fpsyg.2022.929933
Yang, Y., Yuan, Y., Tan, H., Wang, Y., & Li, G. (2021). The Linkages Between Chinese Children's Both Cognitive Engagement and Emotional Engagement and Behavioral Engagement: Mediating Effect of Perceptions of Classroom Interactions in Math. Psychology in the Schools, 58(10), 2017-2030. https://doi.org/10.1002/pits.22571
Yildirim, M., KesiK, C., & CiĞerci, F. M. (2023). The effect of digital literacy levels and e-learning attitudes on screen reading self-efficacy: A structural equation modelling. Journal of Educational Technology and Online Learning, 6(3), 625-646. https://doi.org/10.31681/jetol.1253186
Zhang, W., & Bray, M. (2020). Comparative Research on Shadow Education: Achievements, Challenges, and the Agenda Ahead. European Journal of Education, 55(3), 322-341. https://doi.org/10.1111/ejed.12413
Zhao, J. (2024). Ecosystem Construction of International Chinese Language Education Meta-Universe in the Internet Era. Applied Mathematics and Nonlinear Sciences, 9(1), 20240563. https://doi.org/10.2478/amns-2024-0563
Zhu, G., Raman, P., Xing, W., & Slotta, J. (2021). Curriculum design for social, cognitive and emotional engagement in Knowledge Building. International Journal of Educational Technology in Higher Education, 18(1), 37. https://doi.org/10.1186/s41239-021-00276-9

Words: 8666
Characters: 64 076 (36 standard pages)

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