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Examining the Interplay Among Indonesian EFL Students' Digital Literacy, Self-Regulated Learning, and Informal Digital Learning of English

Atin Kurniawati, Arief Eko Priyo Atmojo*, Nilam Febrina Swastika, Salma Ayu Lutfiana
Department of English Language Education, Universitas Islam Negeri Raden Mas Said Surakarta, Sukoharjo, Indonesia

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*Corresponding Author Email:
arief.atmojo93@staff.uinsaid.ac.id

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Abstract: In today's digital world, informal digital learning of English (IDLE) has revolutionized English as a foreign language (EFL) learning outside formal classrooms. While numerous studies have increasingly examined potential factors affecting IDLE, associations among digital literacy (DL), self-regulated learning (SRL), and IDLE have been underexamined. The present study seeks to uncover Indonesian EFL students' levels of DL, SRL, and IDLE, along with the hypothesized relationships among DL, SRL, and IDLE. Drawing on a quota sampling, 391 students responded to DL, SRL, and IDLE questionnaires after providing their informed consent and demographic information. The results demonstrate that Indonesian EFL students enjoy moderate levels of DL, SRL, and IDLE. The results also reveal that DL and SRL, respectively, possess significantly positive relationships with IDLE. Simultaneously, both DL and SRL significantly predict IDLE, explaining 56% of the total variance of IDLE. Ultimately, theoretical and practical implications, as well as future research directions, have been offered.

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INTRODUCTION

Informal digital learning of English (IDLE) has been gaining great attention in the recent decade as it offers flexible and joyful learning atmosphere with the support of online activities through various digital platforms and diverse authentic materials beyond in-class learning contexts (Y. Li, 2025; Barkati et al., 2025; Lee & Dressman, 2018). Conceptually, IDLE can be defined as self-driven English learning outside formal classrooms that relies on students' initiatives in using digital devices and online platforms without formal instruction or direct guidance from teachers (Zhang & Liu, 2024). It has enabled English as a foreign language (EFL) learners to learn English outside classrooms and set their own learning goals and pace with the affordance of technology (Lee, 2021). Positive impacts of IDLE have been documented in a plethora of studies around the globe (Soyoof et al., 2023; Barkati et al., 2025; Fauziah & Diana, 2023). Students' engagement in a various types of IDLE activities, both in receptive and productive language skills, has facilitated L2 communication among EFL learners (Lee & Sylvén, 2021; Lee & Lee, 2019; Lee, 2019; Lee & Drajati, 2019). Relying on frequency, devices, resources, and cognition, IDLE allows EFL learners to enjoy authentic L2 experiences in online settings that foster its advantages (Zhang & Liu, 2024; Rezai et al., 2024). Despite its growing popularity and positive impacts on EFL learning in various countries, there has been a dearth of research that examines the level of IDLE at an Indonesian Islamic university and its potential antecedents.

In this digital age, EFL students are required to embrace digital literacy (DL) as it plays a crucial role in IDLE. DL refers to an individual ability to utilize information and communication technology for navigating, assessing, creating, and sharing information that requires both technical and cognitive skills (Dashtestani & Hojatpanah, 2022). DL determines students' ability to use computers or mobile devices to

support their learning, and it significantly predicts university students' achievement positively (Chen, 2025). Furthermore, DL assists language learners in several ways, such as accessing and choosing learning materials that fit their needs and interest. It also helps learners to perceive the ease of use and usefulness of digital tools, which eventually contributes to their positive attitude while learning in digital settings (Li & Thien, 2025; Liu & Ma, 2024). Additionally, DL enables learners to creatively access, generate, and transform digital multimodal content to support their language learning, which enhances their understanding, retention, and engagement in informal digital learning (Wang et al., 2025). Extant literature has showcased the crucial roles of DL in fostering academic achievement and informal digital language learning in higher education, which bridges DL as a significant predictor of IDLE.

Pertinent studies have unveiled the connection between DL and IDLE in various contexts. In the Chinese EFL context, DL has been found useful and helpful in promoting undergraduate students' IDLE as the students hold positive and supportive attitudes toward DL in IDLE practices (Li, 2025). Moreover, DL has been discovered as the strongest predictor of EFL students' IDLE compared to L2 grit and self-efficacy that also significantly influence their IDLE (Barkati et al., 2025). This highlights the contribution of DL coupled with cognitive and personality variables as the predictors of IDLE. Additionally, DL serves as a foundational competence of IDLE that enables EFL learners to navigate, interpret, and participate effectively in online environments (Zhang & Liu, 2024). For example, EFL learners demonstrate their DL while interacting with native English speakers by making use of digital devices, considering digital conventions, and managing online interactions. In the current artificial intelligence-mediated IDLE (AI-IDLE), DL is reflected through learners' ability in generating and transforming content to facilitate EFL learning. This process requires the capacity to think creatively and critically about the language and proficiency in using digital platforms (Wang et al., 2025). Previous studies have expanded on how DL shapes EFL learners' IDLE and underscored its significance in influencing their IDLE.

Conceptualized as self-driven or autonomous learning through digital devices outside classrooms (Zhang & Liu, 2024), IDLE requires students to be able to manage their own learning process using several behavioral strategies, such as setting goals, dealing with learning tasks, managing time, and monitoring learning progress (Mahmud & German, 2021). These behavioral strategies represent self-regulated learning (SRL) as one of the potential predictors affecting students' IDLE. SRL refers to learners' strategies to manage their cognitive, emotional, and behavioral states to achieve personal learning objectives. It involves deliberate efforts to stay motivated, focused, and adaptive throughout the learning process (Zheng et al., 2016). Rezai and Goodarzi (2025) have revealed a significant, positive relationship between SRL and IDLE. It has been reported that SRL and IDLE promisingly foster EFL learning. Additionally, it has been uncovered that gamification in IDLE has effectively enhanced reading comprehension as it promotes goal-setting, help-seeking, and self-evaluation behaviors (Maimaiti & Hew, 2025). In today's era, IDLE can be mediated by generative AI (GenAI) that demonstrates paramount effects on English proficiency, underscoring its potentials to promote autonomous EFL learning. However, the efficacy of GenAI relies on how learners self-regulate their own learning processes (Guan et al., 2024). Students' SRL is, thus, crucial for enabling them to navigate and critically interpret the AI system, as well as to develop the awareness needed to shift from cognitively passive to active engagement (G. L. Liu et al., 2025). Extant literature and previous studies have spotlighted the significance and roles of SRL in shaping EFL learners' IDLE. The significant relationship between SRL and IDLE has also been unpacked.

Prior studies have highlighted the roles of DL and SRL in promoting learning. In online environments, both DL and SRL positively influence students' academic success by facilitating improved learning adaptation. DL facilitates learning adaptation in online settings, which promotes SRL and leads to higher academic achievement (Chen, 2025; Yang & Kim, 2014). Students with higher DL are more open to utilizing technology and tend to have better abilities to plan, execute, monitor, and evaluate their learning (Saregar et al., 2024). It has also been documented that stronger SRL helps students regulate their learning more effectively, including enhancing their DL (Anthonysamy et al., 2020). Specifically, both DL and SRL play significant roles in IDLE. Students' IDLE requires not only proficient DL but also strategic actions that represent their SRL to extend EFL learning beyond classrooms (G. L. Liu et al., 2025). While previous studies have confirmed the individual contributions of DL and SRL to IDLE, there has been a scarcity of research that examines the contributions of DL and SRL simultaneously in shaping EFL

learners' IDLE, particularly at an Indonesian Islamic university in which EFL learning outside classrooms should be encouraged.

Drawing on the limitations of pertinent studies, which mainly focused on DL and SRL as separate predictors of IDLE, the current study attempts to contribute to the body of literature by examining empirical relationships among DL, SRL, and IDLE in an underrepresented research setting, namely an Indonesian Islamic university. Therefore, the present study aims to seek answers of the following questions:

1) What are the levels of Indonesian EFL students' DL, SRL, and IDLE?
2) Is there any significant relationship between DL and IDLE?
3) Is there any significant relationship between SRL and IDLE?
4) Is there any simultaneous association among DL, SRL, and IDLE?

METHOD

Research Design

The study adopted a correlational research design under quantitative research method to scrutinize the interplay among DL, SRL, and IDLE. This research design is deemed appropriate as it helps identify both the direction and strength of the relationships among the three variables without manipulation (Cuttler et al., 2019). In particular, the study examined whether DL and SRL are associated with IDLE. Quantitative data were garnered using survey questionnaires on a 5-point Likert scale, and statistical analyses were subsequently performed to describe the data and examine the hypothesized relationships.

Research Setting and Participants

The study took place at a State Islamic University in Java, Indonesia, where there were 17,594 undergraduate students across five different faculties. Following the Slovin formula with a 5% margin of error, a sample of 391 undergraduate students was required to ensure the representative sample size of the student population (Tejada & Punzalan, 2012). Based on the number of students in each faculty, the participants were subsequently determined by a quota sampling to ensure proportional representation across the five faculties. This sampling technique was deployed to achieve balanced representation and variability across disciplines (Moser, 1952). Drawing on demographic information given during the survey, Table 1 summarizes the characteristics of the participants in the study.

Instruments

As instruments of the study, three previously validated questionnaires were adapted from past pertinent studies. These included digital literacy (Dashtestani & Hojatpanah, 2022), online self-regulated English learning (Zheng et al., 2016), and revisited informal digital learning of English (Zhang & Liu, 2024) questionnaires. To ensure clarity and relevance to the study context, adjustments with regard to linguistic and cultural aspects were made to the three questionnaires. These adapted questionnaires were then piloted to 33 non-sample students to examine item validity and questionnaire reliability. Drawing on the Pearson correlation between each item and total score, only items with acceptable correlation coefficients ($r > 0.344$) were retained (Boateng et al., 2018). Four invalid items were found and dropped from the DL questionnaire. Meanwhile, there were no invalid items on the other questionnaires. Based on the required Cronbach's alpha coefficients ($\alpha > 0.70$), all questionnaires were considered reliable (α of DL = 0.946; α of SRL = 0.920; α of IDLE = 0.935).

Data Collection

After the soundness of psychometric properties had been ensured, the instruments were distributed by faculty members to participants online and in person upon their preferences as shown in Table 1. Prior to participation, student participants were asked to provide their informed consent by considering the purposes, advantages, and ethical principles of the study, which covered anonymity, confidentiality, voluntariness, and absence of physical and psychological risks and penalty. This survey was carried out within one month in September 2025.

Table 1. Student Participants' Demographic Information

Category	Subcategory	Frequency	Percentage
Faculty	Islamic Economics and Business	95	24.3%
	Islamic Theology and Da'wah	80	20.5%
	Tarbiyah	77	19.7%
	Cultures and Languages	70	17.9%
	Sharia	69	17.6%
Gender	Male	95	24.3%
	Female	296	75.7%
Semester	Three	91	23.3%
	Five	225	57.5%
	Seven	72	18.4%
	Nine	3	0.8%
Self-perceived English Proficiency	Beginner	94	24.0%
	Elementary	183	46.8%
	Intermediate	94	24.0%
	Upper Intermediate	15	3.8%
	Advanced	3	0.8%
	Proficient	2	0.5%
Gadget Use	1–2 hours	15	3.8%
	3–4 hours	58	14.8%
	5–6 hours	146	37.3%
	7–8 hours	99	25.3%
	9–10 hours	38	9.7%
	11–12 hours	35	9.0%

Data Analysis

Following the survey, the data underwent quantitative analysis for both descriptive and inferential statistics through Jamovi version 2.6.13. Initially, data were screened to ensure completeness and avoid outliers. Subsequently, descriptive statistics were computed, resulting in mean, median, standard deviation, and range, eliciting the participants' levels of DL, SRL, and IDLE. Prior to inferential statistics computation, assumption tests, including normality, linearity, multicollinearity, and heteroskedasticity tests, were performed. As the classical assumption test results met the criteria, the Pearson correlation analysis could be run to examine bivariate relationships among the three variables. Ultimately, a multiple linear regression analysis was carried out to determine the degree to which DL and SRL predict IDLE (Tranmer et al., 2020). The complete sequence of research stages, from research design to the final statistical analysis, is presented in Figure 1.

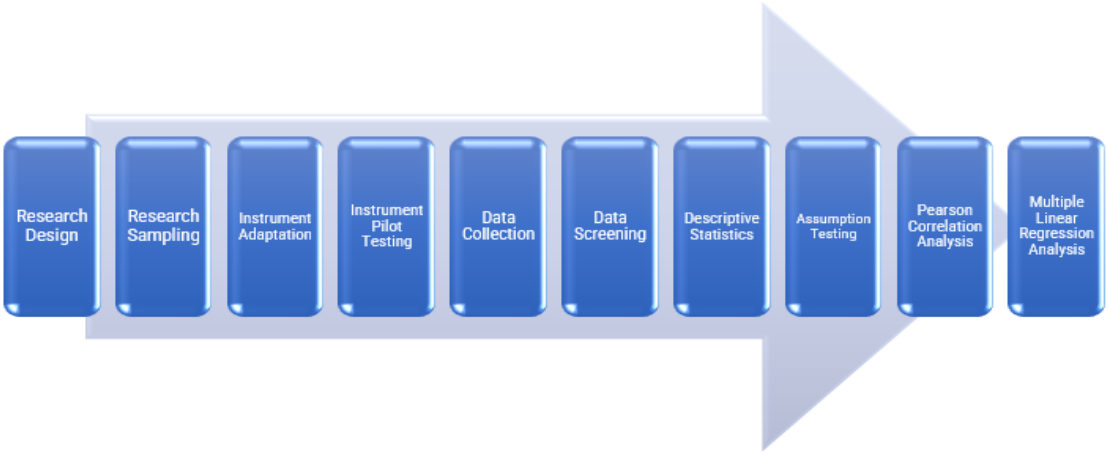

Figure 1. The Sequence of Research Stages

RESULTS

Descriptive Statistics

Prior to examining the interplay among DL, SRL, and IDLE, each of the study variables was analyzed through descriptive statistics, demonstrating its central tendency and dispersion, which were embedded in mean, median, standard deviation (SD), and range values. Table 2 shows the descriptive statistics results for each variable on a 5-point scale. Overall, the results exhibit that all three variables involved in the study occupy moderate levels (approximately 3 points). Measures demonstrate that DL has the highest mean (M = 3.32; SD = 0.506), directly followed by IDLE (M = 3.28; SD = 0.537) and SRL (M = 3.15; SD = 0.536) subsequently. For complete results of descriptive statistics, Table 2 is presented as follows.

Table 2. Descriptive Statistics

Variable	Mean	Median	Standard Deviation	Range
DL (X_1)	3.32	3.35	0.506	3.27
SRL (X_2)	3.15	3.10	0.536	3.67
IDLE (Y)	3.28	3.24	0.537	3.38

Based on Table 2, these results posit that DL is necessary but insufficient for IDLE efficacy. Theoretically, IDLE appears to be bounded by SRL. In addition, the moderate tendency of the three variables indicates a plateau effect, suggesting that unguided exposure to digital environments only yields functional ability, necessitating targeted interventions to achieve advanced mastery. As DL appears higher than SRL, classroom instructions should shift from technical training to metacognitive scaffolding and integrate SRL strategies. Moreover, EFL teachers can bridge IDLE with formal learning goals. This approach seeks to transform passive content consumption into active, goal-driven EFL learning through interconnected learning activities.

Pearson Correlation Analysis

Having accomplished descriptive statistics analysis for gaining general insights about the data, several assumption tests, including normality, linearity, heteroskedasticity, and multicollinearity tests, were run. Drawing on the Kolmogorov-Smirnov test, the p-value is 0.361 and higher than 0.05, indicating the data are in normal distribution. Subsequently, the Breusch-Pagan test was performed, and it resulted in a p-value of 0.20 that is higher than 0.05, implying heteroskedasticity does not occur on the data; thus, the data achieves homoskedasticity. Ultimately, the multicollinearity test generated a variance inflation factor (VIF) value of 1.21 that is lower than 10, exhibiting no strong correlation between DL and SRL as the independent variables.

To examine bivariate correlations among DL, SRL, and IDLE, the Pearson correlation test was employed, and the results are ultimately presented in Table 3. The results demonstrate that DL has a significantly positive association with IDLE ($r = 0.542$; $p < 0.001$), suggesting that DL and IDLE possess a one-way correlation with a moderate level of relationship. Furthermore, the results also exhibit that SRL owns a significantly positive relationship with IDLE ($r = 0.694$; $p < 0.001$), indicating that SRL and IDLE have a one-way correlation with a strong degree of association. These results suggest that higher levels of both DL and SRL lead to a greater degree of IDLE.

The observed correlations elucidate the distinct yet complementary roles of DL and SRL in shaping IDLE. The moderate association between DL and IDLE corroborates DL as a foundational threshold. DL reduces the cognitive load regarding tool usage, thereby facilitating entry into IDLE. Furthermore, the stronger correlation between SRL and IDLE suggests that mere DL is insufficient to elevate IDLE. This result indicates that SRL more predominantly drives IDLE. While DL offers access to the medium, SRL fosters the quality and sustainability of engagement. Pedagogically, this result necessitates a paradigm shift from techno-centric to learner-centric instructions. EFL teachers should provide scaffolded autonomy, guiding EFL learners to strategically navigate and leverage their IDLE.

Table 3. Correlation Matrix

		DL (X_1)	SRL (X_2)	IDLE (Y)
DL (X_1)	Pearson's r	—		
	df	—		
	p-value	—		
SRL (X_2)	Pearson's r	0.413	—	
	df	389	—	
	p-value	< 0.001	—	
IDLE (Y)	Pearson's r	0.542	0.694	—
	df	389	389	—
	p-value	< 0.001	< 0.001	—

Multiple Linear Regression Analysis

After examining bivariate correlations, a multiple linear regression test was run to determine the extent to which DL and SRL predict IDLE. As shown in Table 4, the regression model demonstrates significant results ($F (2, 388) = 247$; $p < .001$), suggesting that both DL and SRL simultaneously predict IDLE significantly. This model accounts for 56% of the total variance in IDLE ($R^2 = 0.560$, Adjusted $R^2 = 0.558$), with the remaining 44% influenced by other predictors not included in the study.

Table 4. Model Fit Measures

R	R^2	Adjusted R^2	F	df1	df2	p
0.749	0.560	0.558	247	2	388	< 0.001

As seen in Table 5, both DL and SRL have contributed significantly to the model. SRL emerges as the stronger predictor ($B = 0.568$; $t = 15.32$; $p < 0.001$) than DL ($B = 0.327$; $t = 8.34$; $p < 0.001$). These empirical results showcase that students with higher levels of DL and SRL tend to have a greater degree of IDLE. Between the two independent variables, SRL noticeably plays a more prominent role in predicting IDLE. If both independent variables value zero, however, IDLE can be predicted to be 0.405 since the constant appears as 0.405 ($t = 2.99$; $p = 0.003$). Therefore, the equation of IDLE (Y) can be postulated as follows.

$Y = 0.405 + 0.327*X_1 + 0.568*X_2$

Notes:

Y : IDLE
X_1 : DL
X_2 : SRL
0.405 : Constant

Table 5. Model Coefficients of IDLE

Variable	Estimate	SE	t	p
Intercept	0.405	0.1355	2.99	0.003
DL (X_1)	0.327	0.0392	8.34	< 0.001
SRL (X_2)	0.568	0.0370	15.32	< 0.001

The results in Table 5 indicate that IDLE is not solely a function of technological ability but rather an outcome of the interplay between DL and SRL. This implies that digital natives do not automatically become digital learners. As DL and SRL collectively account for 56% of the variance in IDLE, EFL teachers recognize that merely promoting DL is not enough. Future pedagogy needs to scaffold EFL learners regarding how to set goals, monitor progress, and curate content, which transforms EFL teachers' role from content providers to facilitators of autonomous learners.

DISCUSSION

Situated in a State Islamic University, the present study examines the Indonesian EFL students' levels of DL, SLR, and IDLE and the occurring interplay among the three variables. The results exhibit that the students enjoy moderate levels of DL, SRL, and IDLE. It aligns with a previous study indicating that Indonesian students' DL was not at the highest level (Wardhani et al., 2019), and Indonesian university students' SRL was also determined to be medium (Hindradjat et al., 2022; Mahmud & German, 2021). Several issues were reported to contribute to students' levels of SRL, including time management, learning space, and motivation (Lan et al., 2025; Yang & Kim, 2014). As for IDLE, the results echo past pertinent studies that unveiled the Indonesian EFL students' moderate level of IDLE (Lee & Drajati, 2019; Nugroho et al., 2023).

With regard to correlations, the results demonstrate a moderate, positive relationship between DL and IDLE. It implies that the students with higher levels of DL tend to have a greater degree of IDLE. This result is in line with earlier studies, emphasizing the pivotal roles of DL in assisting students to access, evaluate, and utilize digital resources for EFL learning outside formal classrooms (Barkati et al., 2025; Li, 2025). DL is crucial for navigating and effectively using online language learning resources (Chen, 2025). Additionally, the results also show a strong, positive relationship between SRL and IDLE. It suggests that the students who are better at setting learning goals, tracking learning progress, and adjusting learning strategies have a greater degree of IDLE (Rezai & Goodarzi, 2025). Reflecting on the strength of these relationships, it emphasizes the more prominent role of SRL in affecting the students' levels of IDLE. This result underscores the significant role of SRL in predicting IDLE. Moreover, the significant associations among DL, SRL, and IDLE suggest that EFL teachers should consciously embed DL and SRL strategies into classroom practices so as to prepare students for more autonomous engagement in IDLE beyond formal instructions (Lai et al., 2015; Ju Seong Lee, 2019).

As both DL and SRL predict IDLE, indicating that the students' DL and SRL are simultaneously associated with their IDLE, it reinforces the idea that students' IDLE not only depends on access to digital devices but also on their abilities to independently self-regulate their own learning (Yang & Kim, 2014). It underscores the contributions of DL and SRL in shaping learners' engagement in IDLE, as well as their success in EFL learning. Students' abilities to navigate, evaluate, and leverage digital resources incorporated with their capacity to plan and sustain learning behaviors have allowed them to transform digital exposure into meaningful and purposeful language practices (Lan et al., 2025; Y. Li, 2025). Additionally, it is noticeable that students' IDLE can also be influenced by other factors beyond the study, such as resources and cognition, authentic L2 experiences, frequency and devices, others' support (Rezai et al., 2024), learners' attitudes toward technology (An et al., 2024), cultural and contextual variables (Fauziah & Diana, 2023), and affective factors (Lee & Drajati, 2019).

From a policy perspective, these results suggest EFL curricula integrate DL and SRL as fundamental abilities instead of secondary skills. There must be alignment between formal provisions to learners and the way learners develop informally in the digital realm (Lai et al., 2015; Zimmerman, 2002). Moreover, teacher professional development programs should be designed to equip EFL teachers with effective pedagogy that incorporates SRL strategies and leverages IDLE outside formal instructions (J.S. Lee, 2019).

CONCLUSION

The evolving transformation of technology in digital devices and the internet has offered affordances for students to explore various English content and interact with diverse English users online. The present study examines the interplay among DL, SRL, and IDLE in the Indonesian higher education context. The results demonstrate that Indonesian EFL students have moderate levels in the three variables, comprising DL, SRL, and IDLE. The results further uncover that DL and IDLE have a significantly moderate, positive correlation, as well as SRL and IDLE possessing a significantly strong, positive correlation. Simultaneously, DL and SRL significantly predict IDLE with 56% of the total variance, while the remaining 44% are other predictors beyond the study. In summary, students with higher levels of DL and SRL tend to possess a greater degree of IDLE, opening up affordances for self-driven EFL learning beyond

formal settings. These results highlight the significance of DL and SRL in fostering informally autonomous EFL learning through digital devices and platforms.

Drawing on the results, it calls for innovative strategies to bolster the levels of DL, SRL, and IDLE among the Indonesian EFL students. The students must be equipped with high levels of DL and SRL to achieve a high degree of IDLE as an opportunity to autonomously learn English through digital devices outside classrooms. Indonesian universities should embrace DL and SRL development in their curricula. It can be embedded in courses especially dedicated to DL and SRL development or integrated into the existing courses with specific modules. Additionally, universities and academic communities should create learning environments conducive for informal self-driven EFL learning through digital devices by providing internet connection, informal learning space, and digital learning resources. As the current study merely offers quantitative analyses and results, future studies need to employ qualitative or mixed methods, offering more nuanced findings. In an attempt to leverage EFL students' DL and SRL levels, rigorous intervention studies are highly recommended. Studies on the associations between other potential predictors and IDLE itself are still worthy at various educational levels and settings.

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