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Investigating the Relationship between the Use of Reading Assistant Software and Reading Comprehension Skills: A Case among Thai EFL University Students

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ABSTRACT

This study examined the relationships between reading assistant (RA) software usage, reading comprehension ability, and post-TOEIC reading scores among Thai EFL university students. Seventy-six students from a private international university in central Thailand participated. Data were collected from students' pre- and post-TOEIC reading scores and their RA software usage over twelve weeks. Pearson's r was used to analyze the connections between various variables: weekly duration spent on RA software, count of chosen reading passages, reading level identified by the RA software, fluency and accuracy levels per minute, percentage-based reading comprehension score, and pre- and post-TOEIC reading scores. The findings revealed some correlations among variables such as time invested in RA software, reading level, fluency and accuracy rates per minute, and reading comprehension scores. However, there was no significant correlation between the frequency of RA software use and students' post-TOEIC reading scores. This suggests that using RA software may not directly impact learners' reading comprehension skills. The study implies that while certain language learning tools may be beneficial, they might not substantially enhance language proficiency as measured by standardized tests like the TOEIC reading comprehension skills. Some implications for improving EFL students' reading comprehension skills through RA software are briefly discussed.

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INTRODUCTION

Reading is one of the essential skills for all learners studying English (Pardede, 2022). Understanding what has been read helps learners achieve better comprehension of the content they have learned. Moreover, better reading comprehension skills can predict the academic success of learners and contribute positively to students' academic performance (Fitri & Zainil, 2018). Reading comprehension is not only the ability to read words and pronounce them correctly, but it refers to the ability to understand the thoughts and ideas of the written words (Nation & Cocksey, 2009; Rochman, 2017). In the realm of reading comprehension, it includes the capacity to understand and define each word individually and synthesize the information to form a deeper understanding of the concepts presented in the discussions or readings (Sidek & Rahim, 2015; Novita, 2016; Caraig & Quimbo, 2022). In addition, reading comprehension entails the act of deriving meaning from written text, a process influenced by cognitive and social elements (Torgesen & Hudson, 2006; Joulide et al., 2020; Kusumarasdyati, 2023). Reading comprehension involves two essential components: word coding, which involves decoding the symbols on a page, and language comprehension, which entails understanding the meaning conveyed by the words and sentences (Caraig & Quimbo, 2022; Nephawe, 2023). With this notion, it is crucial to implement effective strategies to improve students' reading comprehension (Chamba & Ramirez-Avila, 2021). Varied reading techniques among learners of English as a Foreign Language (EFL) signify a critical aspect of language acquisition (Ayu, 2021; Tanjung et al., 2022). Students equipped with a diverse range of techniques are better equipped to comprehend texts, leading to greater success in reading (Barzegar & Fazilatfar, 2019; Habók et al., 2019; Rosalina & Nasrullah, 2020).

To aid in understanding the reading process, reading theorists have devised models of reading. There are three primary reading models: 1) bottom-up, 2) top-down, and 3) interactive. The study's findings of Nadea et al. (2021) revealed that students employing bottom-up reading strategies endeavor to grasp word meanings through contextual cues. These strategies, identified in the study, include reading challenging sections aloud, rereading difficult passages, and tracing the text line with a pen or finger. The second set of strategies employed by students involves top-down reading strategies. Students utilizing these strategies rely on prior experiences and connect background knowledge to the information presented in the text as they read (Smith et al., 2021). Smith et al. (2021) further identified that students resorted to scanning when tasked with locating specific information. They also underline sections that they found important while reading English texts (Nadea et al., 2021). In the interactive model, comprehension arises from the interaction between the text and reader. This model focuses on both the role of language and the readers' background knowledge (Oranpattanachai, 2023).

Over the decades, various methods and teaching techniques have been introduced and utilized to enhance reading comprehension in the classroom. These include the use of reciprocal teaching techniques (Gruenbaum, 2012), enhancing students' reading comprehension through critical reading (Fitri & Zainil, 2018), and giving pre-reading tasks for class reading activities (Alghonaim, 2020). Recognizing the necessity of reading skills in modern education, technology has been developed and designed to contribute to language learning. Reading programs are designed to improve students' fluency, accurate

pronunciation, vocabulary breadth, and reading comprehension skills. Several reading programs with similar functions have been implemented worldwide (Capodieci et al., 2020). For instance, Lalio (see Hembise et al., 2021) assists with pronunciation and detects pronunciation errors; the LALA program is designed to enhance vocabulary (Engel de Abreu et al., 2020); and Reading Assistant Plus focuses on building vocabulary, comprehension, and fluency (Beattie, 2010).

In Thailand, reading programs are not widely implemented in educational settings. Instead, various teaching methods are used to improve reading comprehension, such as critical thinking processes (Rungsawang & Pookcharoen, 2022), web-based instruction and the KWL-Plus method (Vaisean & Phusawisot, 2020), reading English newspapers (Arwuttawin, & Porkaew, 2018), extensive reading strategy (Sek et al., 2021), and blended e-learning (Wongwuttiwat et al., 2020). Consequently, studies on reading program software are limited (Arunsirot, 2020; Kitjaroonchai & Maywald, 2024).

At the university where the researchers work, the Reading Assistant (RA) software is used to enhance students' reading fluency and comprehension. This software identifies inserted speeches and provides instant corrective feedback to individuals as they participate in oral reading, enabling self-correction of pronunciation errors (Bhatt et al., 2020). Recent research findings (Faisol et al., 2021; Kilag et al., 2024; Kitjaroonchai & Maywald, 2024; Li, 2020) have indicated that incorporating the RA software into second language (L2) classrooms results in enhancements in learners' vocabulary acquisition, reading fluency, comprehension, and language prosody. The adaptability of the RA software, customizing instruction based on individual needs and progress, results in personalized learning experiences, enhancing the effectiveness and engagement of the intervention (Adams, 2013). In line with the language development of young learners, the program steers them through reading passages with the guidance of a skilled speaker. Operating akin to a parent reading to a child, the RA software supervises and corrects mispronunciations in real-time during comprehension assessments that assist learners in increasing their reading fluency (Keller et al., 2018; Mahdi & Al Khateeb, 2019).

Although the RA software integrates speech recognition technology to provide real-time feedback on pronunciation and oral reading skills, there is a gap in research regarding its influence on TOEIC reading test—a vital measure of language proficiency among Thai EFL students at the university level. The primary focus of the TOEIC reading test is to evaluate the reading proficiency of individuals in English for both professional and daily communication purposes (Busa & Chung, 2024; Sittisuwan & Sitthitikul, 2019). Like various educational higher institutions, the university where the researchers serve has incorporated the TOEIC reading test to assess students' language proficiency for meeting graduation requirements. Since TOEIC plays a significant role in employability of the university graduates, senior graduating students at the university are mandated to undergo the TOEIC test as a prerequisite for graduation. To enhance TOEIC test performance, the language teachers need to come up with training programs addressing specific weaknesses, conduct regular practice tests, integrate preparation into the curriculum (Busa & Chung, 2024; Im & Cheng, 2019; Sittisuwan & Sitthitikul, 2019), and foster a supportive learning environment by maintaining open communication channels with language teachers and promote peer

collaboration for collective learning (Hsieh, 2023; Maliwan, 2018, 2020). These strategies could build test-taking skills and motivate students toward achieving a better TOEIC score.

Given the availability of the RA software at the university where the researchers work, and the limited studies on its impact on TOEIC reading comprehension skills, the researchers are motivated to explore the potential effects of the RA software usage on students' TOEIC reading comprehension ability. Taking this as the foundation, this study aims to investigate the potential relationships between the use of RA software, reading comprehension, and post-TOEIC scores among a sample of Thai EFL university students. With this as a research premise, this study aims to address the following research question: Are there any correlations between the use of reading assistant (RA) software, reading comprehension abilities, and post-TOEIC exam scores among Thai EFL students?

METHOD

Participants and setting

At the beginning of the project, eighty-four first and second-year Thai EFL students volunteered to participate in the study. They were asked to voluntarily sign an informed consent form during the first week of the semester. In the second week, participants were required to take a pre-TOEIC reading test before using the RA software. From weeks 3 to 12, students were instructed to use the RA software for a minimum of 150 minutes per week. In the 13th week, they took the post-TOEIC reading test. Participants who did not complete the pre-test or meet the RA software usage requirement were excluded from the dataset. After this exclusion, seventy-six students met all the requirements and their data were used for the study.

Research Instruments

Pre- and post-TOEIC reading test

A reading section from Barron's TOEIC practice exams (Lougheed, 2018) was employed as both the pre- and post-TOEIC test in this study. The TOEIC test comprised three parts: incomplete sentences (30 questions), text completion (16 questions), and reading comprehension (54 questions), totaling 100 points. Students took the pre-TOEIC reading test in the second week of the research phase, with 75 minutes allocated for its completion. Similarly, the post-TOEIC reading test was administered under the same conditions in the 13th week of the research phase.

RA program

The RA program serves as an online guided reading tool. It detects spoken words and offers immediate corrective feedback during oral reading, allowing users to self-correct pronunciation errors. The software is capable of recording users' data, including minutes used per week and overall usage. Additionally, it can analyze each user's reading level, average words correct per minute, and reading comprehension scores as a percentage during reading tasks. In this study, the RA software served as the intervention. Participants were encouraged to log in and practice oral reading for at least 150 minutes per week, at their convenience, over a twelve-week period. Table 1 provides an example of how the RA software records users' data.

Table 1. *Example of RA software recording users' data*

Students	Actual minutes used per week	Selections per Week	Reading Level	Fluency level per minute	Words correct per minute	Reading Comprehension (%)
1	152.5	1.9	3.4	97	76	56.0
2	193.6	5.5	4.5	104	86	47.0
3	183.2	0.7	1.8	86	56	45.0
4	222.9	7.4	2.4	108	75	52.0
5	270.8	5.5	7.7	135	118	85.0
6	123.1	3.5	2.4	87	65	41.0
7	151.2	4.1	6.0	129	95	67.0
8	248.0	5.2	6.8	124	108	65.0
9	171.9	1.5	2.5	89	70	40.0
10	172.6	5.6	3.2	105	85	64.0
11	229.1	5.7	4.7	103	87	52.0
12	190.5	4.2	6.0	130	112	73.0
13	522.8	9.8	3.7	109	84	54.0
14	840.4	5.6	7.3	135	111	77.0
15	204.5	3.3	4.7	147	118	74.0
16	150.7	2.3	4.4	125	116	73.0
17	403.2	6.4	6.1	123	114	71.0
18	142.6	1.5	4.1	118	107	65.0
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76	182.2	4.3	4.6	105	93	60.0

Data analysis procedures

A paired-samples t-test was conducted to analyze the pre- and post-TOEIC reading scores to determine if there was a statistically significant difference between them. Additionally, the Pearson correlation coefficient was used to investigate the relationships among various variables, including minutes spent on the RA software per week, number of reading passages selected per week, reading comprehension level detected by the RA software, fluency level per minute, accuracy level per minute, reading comprehension score in percentage, and pre- and post-TOEIC reading scores.

Ethical Consideration

Adhering to ethical principles is crucial to protect both the researchers and the research participants. Formal ethical approval was obtained from the University Research, Ranking, and Development Committee (RRDC), reference number RRDC 2023-89. All the participants in the study gave informed consent after a thorough explanation of the consent form,

ensuring they fully understood their participation in the project before signing and engaging in the study.

FINDINGS

The results of a paired samples t-test, which compares participants' pre- and post-TOEIC reading scores are presented in Table 2.

Table 2. *A paired samples t-test illustrating participants' pre- and post-TOEIC reading score*

TOEIC Reading Scores	Mean	N	SD	MD	*t*	df	*p*
Pre-test score	31.18	76	9.85	4.37	-6.48	75.00	0.00
Post-test score	35.55	76	10.18				

*Note. *p < .001 (2-tailed)*

The results in Table 2 demonstrate that participants' reading comprehension showed a significant increase in their post-TOEIC reading scores (t (75) = -6.48, p < .001) after participating in the intervention. The mean difference (MD) was 4.37, indicating that participants obtained significantly higher average scores in the post-TOEIC reading test. From the standard deviation (SD), it can be inferred that the post-TOEIC reading scores were slightly more heterogeneous than the pre-TOEIC reading scores, although the difference is minimal. The present study sought to examine the correlations between the use of RA software, reading comprehension ability, and post-TOEIC reading scores among Thai EFL students to respond to the research question. The results of this investigation are presented in Table 3.

Table 3. *Correlations among various variables related to the use of RA software*

	Descriptive Statistics			Correlations							
Variables	N	M	SD	MU	SPW	RL	FLPM	ACPM	RC	Pre-TOEIC	Post-TOEIC
MU	76	242.6	120.6	1	.621**	.356**	.269*	.254*	.234*	.252*	0.069
SPW	76	5.69	3.03		1	0.076	.579**	.532**	.345**	0.200	0.042
RL	76	4.34	1.42			1	0.119	-0.115	.405**	.552**	.529**
FLPM	76	98.84	24.18				1	.983**	.300**	0.075	0.041
ACPM	76	59.05	14.64					1	.266*	0.016	-0.001
RC	76	63.28	12.23						1	.542**	.471**
Pre-TOEIC	76	31.18	9.85							1	.828**
Post-TOEIC	76	35.55	10.18								1

Note. ** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

MU = Minutes of use; SPW = Selection per week; RL = Reading level; FLPM = Fluency level per minute; ACPM = Accuracy level per minute; RC = reading comprehension; Pre-TOEIC = Pre-TOEIC reading scores Post-TOEIC = Post-TOEIC reading scores

The analysis in Table 3 indicated significant relationships between several pairs of variables. Minutes of use (MU) exhibited a strong positive correlation with selections per week (SPW) [r (76) = 0.621, p < 0.01] and a moderate positive correlation with reading level (RL) [r (76) = 0.356, p < 0.01], as well as weak positive correlations with fluency level per minute (FLPM) [r (76) = 0.269, p < 0.05], accuracy level per minute (ACPM) [r (76) = 0.254, p < 0.05], reading comprehension (RC) [r (76) = 0.234, p < 0.05], and pre-TOEIC reading scores [r (76) = 0.252, p < 0.05].

Table 4. *Summary of simple linear regression model of predictors on post-TOEIC exam score*

Predictor	R^2	R^2 Adjusted	F	*B*	SE	B
M1 Reading Level	0.280	0.270	28.409	0.529	0.710	3.785
M2 Reading Comprehension	0.222	0.211	21.115	0.471	0.085	0.392
M3 Pre-TOEIC	0.686	0.682	161.965	0.828	0.856	0.856

Note. N=76. We investigated the influence of reading level, reading comprehension, and pre-TOEIC scores on post-TOEIC scores. In Model 1, we included reading level as a predictor; in Model 2, reading comprehension was included as a predictor; and in Model 3, pre-TOEIC score was included as a predictor.

* $p < .05$

Selections per week (SPW) demonstrated a moderate positive correlation with fluency level per minute (FLPM) [r (76) = 0.579, p < 0.01], accuracy level per minute (ACPM) [r (76) = 0.532, p < 0.01], and reading comprehension (RC) [r (76) = 0.345, p < 0.01]. Reading level (RL) exhibited a moderate positive correlation with reading comprehension (RC) [r (76) = 0.405, p < 0.01], Pre-TOEIC reading scores (Pre-TOEIC) [r (76) = 0.552, p < 0.01], and post-TOEIC reading scores (Post-TOEIC) [r (76) = 0.529, p < 0.01]. A simple linear regression was conducted to predict learners' post-TOEIC scores based on their reading level (refer to Table 4). The analysis revealed a significant regression equation [F (1, 73) = 28.409, p < .001], and the adjusted R-squared value was found to be .270. This suggests that reading level accounted for 27% of the variability in learners' post-TOEIC reading scores.

The analysis revealed a very strong positive correlation between FLPM and ACPM [r (76) = 0.983, p < 0.01]. This indicates a robust relationship, suggesting that as fluency levels increase, accuracy levels also tend to rise significantly. In other words, individuals who demonstrate higher fluency in their reading also tend to exhibit greater accuracy in their reading. Additionally, the analysis shows a moderate positive correlation between FLPM and RC [r (76) = 0.300, p < 0.01]. This implies that as fluency levels per minute increase, there is a corresponding increase in reading comprehension, though the relationship is not

strong. Therefore, while fluency plays a role in enhancing reading comprehension, other factors may also contribute to overall comprehension ability.

The analysis indicates a moderate positive correlation between RC and both pre-TOEIC reading scores [r (76) = 0.542, p < 0.01] and post-TOEIC reading scores [r (76) = 0.471, p < 0.01]. This suggests that students with higher pre-TOEIC reading scores generally demonstrate better reading comprehension ability. Similarly, those who perform well on the post-TOEIC reading test also tend to exhibit higher levels of reading comprehension. Based on Table 4, the analysis revealed a notable regression equation [F (1, 73) = 21.115, p < .001], with an adjusted R-squared value of .211. This indicates that reading comprehension explained 21% of the variability in learners' post-TOEIC reading scores.

Furthermore, pre-TOEIC reading scores showed a very strong positive correlation with post-TOEIC reading score [r (76) = 0.828, p < 0.01]. This suggests that there is a significant relationship between students' performance on the pre-TOEIC test and their subsequent performance on the post-TOEIC test. In other words, students who achieve higher scores on the pre-TOEIC test are more likely to perform well on the post-TOEIC test. As shown in Table 4, the analysis revealed a significant regression equation [F (1, 73) = 161.965, p < .001], along with an adjusted R-squared value of .682. This suggests that pre-TOEIC reading scores explained 68% of the variability in learners' post-TOEIC reading scores.

From the analysis we found significant correlations among various variables related to language proficiency and academic performance. Specifically, the results indicate that MU correlate positively with SPW and RL, suggesting that increased usage of language learning materials and higher reading proficiency are associated. Additionally, correlations between SPW and FLPM, ACPM, and RC indicate that students who engage more frequently with language materials tend to demonstrate better fluency, accuracy, and comprehension skills. Moreover, the moderate positive correlation between RL and RC suggests that students with higher reading levels also exhibit enhanced reading comprehension ability. Notably, the very strong positive correlation between pre-TOEIC and post-TOEIC reading scores underscores the predictive validity of pre-TOEIC reading scores in determining students' language proficiency and readiness of the post-TOEIC test. Overall, these findings highlight the importance of consistent language practice and the predictive value of pre-TOEIC reading scores in assessing language proficiency development over time. However, it is worth noting that reading assistant software (RA) does not exhibit any significant correlation with students' post-TOEIC reading scores as indicated by MU and post-TOEIC, suggesting that the use of such software may not directly impact their language proficiency outcomes. This finding implies that while certain language learning strategies and resources may be beneficial, others may not contribute directly and significantly to overall language proficiency development as measured by standardized tests like the TOEIC.

DISCUSSION

Based on the findings, it was observed that increased utilization of the RA likely exposes users to a wider array of reading materials, encompassing texts of varying difficulty levels. While it is well-established that exposure to diverse reading materials can enhance reading

proficiency, our study provides empirical evidence supporting this claim within the context of Thai EFL university students. This expanded exposure enables learners to interact with a range of topics, genres, and writing styles, potentially enhancing their overall reading proficiency (Keller et al., 2018). Our findings align with Capodieci et al. (2020), who found that students committed to training programs utilizing reading software experience positive effects on reading comprehension.

Additionally, repetitive engagement with texts can lead to improvements in reading fluency, comprehension, and vocabulary acquisition over time (Chamba & Ramirez-Avila, 2021; Kitjaroonchai & Maywald, 2024). As individuals engage with more selections per week, they are likely to develop stronger reading skills, leading to higher reading proficiency levels. This might be due to the RA offering customized learning experiences designed to suit the specific needs and skills of each user. With features like adjustable difficulty levels, tailored feedback, and progress monitoring, individuals receive assistance and direction that matches their reading abilities. This individualized approach can effectively develop and enhance reading skills, leading to increased levels of reading proficiency (Adams, 2013; Faisol et al., 2021).

The analysis indicates a strong positive relationship between FLPM and ACPM, demonstrating that as fluency increases, accuracy also rises substantially. This relationship can be attributed to better text comprehension, enhanced reading automaticity, and improved language processing skills. Our findings underscore the importance of considering both fluency and accuracy in assessing reading proficiency, as they are closely intertwined and mutually reinforcing aspects of reading. This is consistent with Barzegar & Fazilatfar (2019), Kilag et al. (2024), Sidek & Rahim (2015), and Smith et al. (2021), who posited that reading fluency involves the ability to read quickly and smoothly, depending on proficient decoding abilities. When readers possess good decoding skills, they can read words accurately, leading to higher reading accuracy (Nation & Cocksey, 2009; Novita, 2016; Torgesen & Hudson, 2006).

The moderate positive correlation between pre-TOEIC reading scores and reading comprehension suggests that individuals with higher pre-test scores tend to exhibit better reading comprehension skills. This finding is significant as it highlights the importance of a strong foundation in English language skills for improved performance on standardized tests. Additionally, the strong positive correlation between pre- and post-TOEIC reading comprehension scores indicates that higher pre-test scores are predictive of better performance on the TOEIC reading comprehension test. The correlation between pre- and post-TOEIC reading scores can be attributed to several factors. Firstly, students who excel in the pre-test likely possess a strong foundation in English language skills, contributing to their improved performance on the post-test. Furthermore, the pre-test serves as a diagnostic tool, identifying areas of weakness that students can address before the post-test (Tanjung et al., 2022). Moreover, higher pre-test scores may enhance students' confidence and motivation, leading to more focused preparation and ultimately better outcomes on the post-test. This finding aligns with studies by Busa and Chung (2024) and Maliwan (2018, 2020), which reported that self-motivation and self-directed learning positively impact students' TOEIC scores. Overall, the strong positive correlation between

pre- and post-TOEIC reading scores highlights the predictive validity of the pre-test and its effectiveness in assessing students' language proficiency levels.

CONCLUSION AND IMPLICATIONS

The research findings suggest that frequent use of the RA exposes users to a diverse range of reading materials, potentially enhancing their reading proficiency through practice with various topics and genres. Increased interaction with the software is positively correlated with improvements in reading fluency, comprehension, and vocabulary, as repetitive engagement promotes skill development. Additionally, the RA's customized features adapt the learning experience to individual needs, further improving reading proficiency. The study also underscores a strong positive relationship between reading fluency and accuracy, indicating that proficiency in decoding enhances both speed and precision, which are crucial for effective comprehension. Moreover, a significant correlation was observed between pre-TOEIC scores and reading comprehension skills, with higher pre-test scores predicting better outcomes on the TOEIC reading test. This indicates that a solid foundation in English not only boosts performance but also increases learners' confidence, which is vital for exam preparation. Overall, the study highlights the importance of integrated reading practices and personalized learning approaches in boosting the overall language proficiency of EFL learners.

This study has revealed that integrating the RA can enhance the reading comprehension skills of Thai EFL students. Several key implications emerge from these findings, including:

(1) Integration of RA into the curriculum: The findings indicate that using RA exposes EFL students to a broader range of reading materials, thereby enhancing their reading proficiency. It is advisable for educational programs to consider incorporating such software into their reading curricula. This integration would facilitate varied and frequent exposure to English texts, ultimately fostering improvements in reading fluency and comprehension.

(2) Personalized learning approaches: The positive outcomes associated with RA's customizable features highlight the benefits of personalized learning environments. The reading courses could adopt technologies that adapt to individual learner's needs, helping them to progress at their own pace and according to their specific capabilities.

(3) Focus on fluency and accuracy: The significant positive correlation between reading fluency and accuracy underscores the importance of educational strategies that concurrently foster both aspects. It is recommended that the program of study incorporates teaching practices aimed at enhancing decoding skills, which are pivotal for improving both reading speed and accuracy, thereby facilitating enhanced comprehension.

(4) Enhancing test preparation with diagnostic tools: The correlation between pre- and post-TOEIC reading scores underscores the utility of diagnostic assessments. These tools help in identifying areas of weakness early, allowing for targeted interventions that can boost students' performance in subsequent assessments.

(5) Regular practice and engagement: The curriculum should emphasize the importance of students regularly interacting with a variety of reading materials via the RA,

as this can facilitate continuous improvement in language abilities. By incorporating consistent practice as a fundamental element of language education, the program can utilize technology to offer continuous feedback and support, enhancing the learning experience.

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