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Cognitive Load in English as a Foreign Language Speaking Competency of Vocational High School Students

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Abstract
This study provides an overview of the level of students' cognitive load in learning English in vocational schools. A quantitative descriptive study uses a cross-sectional survey conducted to measure the level of cognitive load of students in learning English in vocational schools. The subjects are 69 respondents who are students from one of the private vocational schools in Denpasar City. A questionnaire with 9 Likert scales is used to measure Intrinsic Cognitive Load (ICL) and Extraneous Cognitive Load (ECL). Data are analysed with 5 category scales based on the ideal score of the instrument used. The results show that Intrinsic Cognitive Load (ICL) dominates English learning in vocational schools compared to Extraneous

Cognitive Load (ECL). The percentage of cognitive load level is dominated at a high level for Intrinsic Cognitive Load (ICL) and a medium level for Extraneous Cognitive Load (ECL). Because the results of this study explain the high cognitive load of Intrinsic Cognitive Load (ICL) level, it is recommended to balance the cognitive challenge in teaching materials so as not to burden students in learning English speaking in vocational schools. Future research should aim to examine the factors that influence these differences in cognitive load levels more comprehensively in a broader context to improve generalizability.

Keywords: English learning; extraneous cognitive load; intrinsic cognitive load; speaking competence; vocational students

Introduction

In the era of rapid globalization and evolving job markets, vocational high schools play a crucial role in equipping students with the necessary skills for the workforce. However, vocational school graduates in Indonesia face increasing challenges in securing employment due to technological advancements and socio-cultural shifts associated with Society 5.0. This situation underscores the urgent need to revitalize vocational education to enhance students' employability (Inderanata and Sukardi, 2023; Jaedun et al., 2024; Pambudi et. Al, 2020).

One critical aspect of vocational education that requires improvement is English language proficiency. English serves as a key competency for students, enabling them to compete in the global job market and adapt to workplace demands (Annisa et al., 2023; Anwas et al., 2025). As a compulsory subject in the national curriculum, English not only reflects students' international competencies but also contributes to raising educational standards. Furthermore, English teachers in vocational schools are expected to meet the qualifications outlined in the Indonesian National Qualification Framework, ensuring they possess relevant expertise that aligns with industry requirements (Zhang, 2024; Putri et al., 2023).

To enhance students' motivation and engagement in learning English, it is essential to implement activities and instructional strategies that encourage them to develop their speaking skills. Speaking competence is a fundamental aspect of language proficiency, as it directly impacts students' ability to communicate effectively in professional settings (Timpe-Laughlin et al., 2022). Despite its significance, speaking is often overlooked compared to other literacy skills. However, it is widely recognized as a primary indicator of language proficiency, both by educators and the general public (Baleghizadeh and Nasrollahi, 2014). Learners also acknowledge speaking as an essential skill in foreign language learning (Uztosun 2021). However, mastering speaking competence involves complex cognitive processes that impose varying levels of cognitive load on learners. Cognitive load theory states that excessive mental effort can hinder language acquisition in productive skills such as speaking (Shadiev et al., 2016). In vocational education, where students are expected to engage in real-world communication, understanding the cognitive load associated with speaking competence is essential. By examining these cognitive demands, educators can develop more effective instructional approaches to support students in overcoming language learning challenges.

English speaking difficulties remain a persistent issue across various educational contexts, with low participation, lack of confidence, and ineffective teaching strategies (Haka et al., 2021; Usman and Mahmud, 2024). Many students hesitate to engage in speaking activities due to shyness, fear of making mistakes, and psychological barriers, particularly among Asian learners, including Indonesians (Christina et al,. 2021; Sulindra et al., 2023). The situation is further exacerbated by students' cognitive attitudes, where their apprehension about pronunciation errors and discrepancies between spoken and written English discourages them from practicing(Kurniarizki and Prasetyarini 2023). In vocational schools, these challenges are compounded by low motivation, negative perceptions of English learning, and limited exposure to real communicative practice (Laila, 2023).

Additionally, ineffective instructional methods and a lack of engaging learning

environments hinder students' ability to develop oral proficiency. Given that speaking skills are essential for both academic and professional success, yet remain underdeveloped, targeted interventions are crucial. Strategies such as fostering interactive classrooms, reducing teacher-student power distance, and promoting social engagement in English learning have been suggested to enhance students' participation and confidence (Skarpaas, 2024; Terzioğlu and Kurt, 2022; Vo et al., 2018). Addressing these issues holistically through pedagogical improvements and motivational reinforcement is essential to overcoming the persistent barriers in English-speaking competency, particularly for vocational students who require these skills for their future careers.

Various problems in learning English as a foreign language may be caused by the high cognitive load experienced by students, which in turn lowers their motivation (Okuni and Widyanti, 2019). The research indicates that an increased cognitive load is associated with decreased learning performance in English as a foreign language acquisition (Chang et al., 2018). Cognitive load be it intrinsic or extraneous type significantly influences learning emotions and performance, as frustration can diminish working memory capacity (Hanham et al., 2023). In the vocational school, an increased cognitive load can induce stress and high-stress learner experienced cognitive overload and consequently decreased their performance. Whereas, low-stress learners felt moderate arousal and improved performance (Buchner et al., ,2021; Kim et al., 2022).

Given these challenges, the vocational school teacher should pay more attention to the increased cognitive load in english speaking competence learning. An interactive and well-designed teaching method and material lets the learner to engage in the learning process actively and stimulate leaners' working memory at the same time. Since working memory is an essential resource in learning speaking, cognitive load theory can be used to help learners use their information processing capacity effectively and enhance speaking skills in the EFL classroom . (Paas et al., 2003) To tackle issues related to low motivation and participation in English-speaking activities, educators can leverage cognitive load theory to design instructional methods that enable students to process complex language concepts more effectively.

Recent studies have explored innovative strategies to address cognitive load issues and enhance learning effectiveness (Edward et al., 2024). Research on cognitive load has generally examined the effects of different teaching methods, learning conditions, and academic tasks on students' cognitive load (Jiang and Kalyuga, 2022; Wu et al., 2022; Yang and Farley, 2019). For example, a study on English listening comprehension in senior high schools investigated how cognitive load varies by gender (Rahimi and Sayyadi, 2019). While these studies provide valuable insights into instructional efficiency, limited research has specifically examined the cognitive load associated with English-speaking proficiency, particularly in vocational high schools.

Speaking competence requires real-time language processing, fluency, pronunciation, and interaction skills, which may impose unique cognitive demands on learners. Understanding these cognitive demands is crucial for designing effective instructional strategies that enhance speaking proficiency in vocational education. To address this gap, this study aims to conduct an in-depth analysis of the cognitive load experienced by vocational high school students in English-speaking tasks. Specifically, it seeks to answer the following research question: What are the cognitive load levels of students in speaking proficiency at vocational high schools? The answers to the research questions are explained through quantitative data collected through a survey of English language learners in vocational schools. The theoretical contribution of this study lies in advancing cognitive load theory within the domain of language learning, particularly in speaking proficiency. The novelties of this study were (1) The study focuses on the cognitive load in the speaking competency of English as a foreign language subjects at the vocational school level and (2) Provides an overview of the level of cognitive load of students based on various backgrounds and pedagogical implications for teaching English at the vocational level.. Additionally, its findings have practical implications for teachers, curriculum design, and instructional strategies in vocational education, ultimately improving English language learning outcomes in this context.

Literature review

Cognitive load theory

Cognitive Load Theory (CLT) is a pivotal framework in cognitive psychology that examines the load imposed on working memory during the execution of cognitive tasks (Chen et al., 2016). This theory is grounded in the understanding of human cognitive architecture, particularly the limitations of working memory and its interaction with long-term memory (Sweller et al., 2011). Working memory is essential for reasoning, comprehension, and learning, yet its capacity and duration are notably finite, capable of holding approximately seven items for about 20 minutes unless reinforced (Miller, 1956; Peterson and Peterson, 1959).

Baddeley's multicomponent model further elucidates that working memory consists of four components: the phonological loop, the visuospatial sketchpad, the central executive, and the episodic buffer (Baddeley, 2010). This model highlights the significance of multimodal information processing, where cognitive load can be distributed across auditory and visual channels, thus potentially reducing the overall load (Baddeley, 2010) . However, the finite capacity of these channels underscores the importance of instructional designs that optimize cognitive load distribution to enhance learning outcomes (Sweller, 2005).

Cognitive load comprises three distinct types: intrinsic, extraneous, and germane. Intrinsic cognitive load arises from the inherent complexity of the material, characterized by element interactivity that is intrinsic to the content and not modifiable through instructional design (Paas et al., 2003). In contrast, extraneous cognitive load is influenced by instructional methods and can be minimized through effective design to avoid unnecessary demands on working memory (Sweller, 2005). Germane cognitive load, the desired type, involves the use of working memory resources to foster schema construction and automation, critical for long-term learning (Sweller et al., 1998).

Effective instructional strategies aim to reduce extraneous cognitive load while maximizing germane cognitive load, thereby enhancing the efficiency of learning. Research indicates that reducing unnecessary cognitive load enables working memory resources to be allocated to meaningful schema construction, a process pivotal for achieving expertise in complex tasks (Paas et al., 2003; Sweller, 2011).

Speaking competence in English in vocational high school

English language learning in vocational schools presents unique challenges and opportunities, especially when focusing on the development of speaking skills. Speaking is a critical competency for vocational students as it directly relates to their future professional interactions. However, mastering this skill often involves navigating cognitive demands that can hinder learning if not managed effectively.

Cognitive Load and Speaking Skills Vocational education often requires learners to process complex multimodal information, which can lead to cognitive overload, especially in speaking tasks that demand real-time processing. For example, students may need to simultaneously retrieve vocabulary, apply grammar rules, and articulate ideas fluently, which places a significant burden on their working memory (Zhang, 2024). Excessive cognitive load not only impairs performance but also diminishes motivation, as students struggle to manage the demands of speaking tasks effectively (Zhang, 2024). Implementing instructional strategies that align with Cognitive Load Theory (CLT) is therefore essential. These strategies include scaffolding techniques and the use of visual aids to reduce extraneous load and allocate more resources to germane cognitive processes.

Multimodal Approaches to Speaking Instruction Multimodal learning approaches, which involve engaging multiple sensory systems, have been shown to enhance speaking skills by addressing diverse learning styles. Techniques such as task-based activities, role-playing, and digital storytelling allow students to practice speaking in meaningful contexts (Al-Jarf, 2024). Additionally, the integration of VARK strategies—visual, aural, reading/writing, and kinesthetic—has proven effective in improving speaking proficiency and overall learner

engagement. While these approaches present challenges, such as the need for technological proficiency, they offer significant benefits when applied thoughtfully (Lee, 2019).

Curriculum Integration and Practical Applications Integrating English instruction with vocational training enhances students' speaking skills while fostering professional competencies. Practical applications, such as podcasting, radio broadcasting, and simulated workplace interactions, provide immersive experiences that align with communicative language teaching principles (Hamid et al., 2024). These activities help students develop not only linguistic proficiency but also soft skills, such as teamwork and adaptability, which are essential for their future careers (Li, 2024). Moreover, incorporating real-world tasks into the curriculum reinforces the relevance of English language learning, motivating students to engage more deeply.

Addressing Challenges in Speaking Instruction Despite the potential of multimodal and integrated approaches, challenges remain. Factors such as limited internet access, technological barriers, and the need for ongoing teacher training can hinder the implementation of these strategies (Pambudi and Kaliaskarova, 2023; Hamid et al., 2024). Additionally, fostering a positive belief system about the practical applications of English speaking skills can significantly enhance motivation and engagement. Ensuring that students recognize the value of English in their professional lives is critical to sustaining their interest and commitment to learning.

Research method

Research design

This study is a quantitative descriptive research involving survey activities to measure the level of cognitive load of students in learning English in vocational schools. Survey research is conducted with reference to the main characteristics of this research, namely (1) Data obtained from a group of subjects is intended to describe the characteristics of the population, (2) The main way of collecting data is through questions, and (3) Data or information is collected from samples, not from every member of the population. The survey design offers a tool to describe the research population and test the relationship between research variables. In this case, the main objective of survey research is to answer questions related to the variables under study(Creswell, 2023) . Therefore, the question to be answered in this study is how is the level of cognitive load of students in learning English at the vocational school level? To answer this question, a cross-sectional survey was conducted in collecting information from samples that have been taken from a predetermined population.

Research subjects

This study included students from one of the private vocational schools in Denpasar City. The sample in this study was determined by purposive sampling method. In this case, the researcher recruited the target group of respondents without using a probability or quota-based approach. There were a total of 69 learners involved. They came from two different majors, namely accounting and hospitality majors at the X grade level of SMK. The following is a description of the demographics of respondents in this study.

Table 1. Respondent demography

Variable		n
Age		
	15 y.o	33
	16 y.o	32
	17 y.o	4
Gender		
	Female	48

Male	21
Major	
Accounting	33
Hospitality	36
Final English Score	
81% - 100%	18
61% - 80%	51

Researchers chose this group by considering the curriculum that applies to the group, educators who teach with the same methods and teaching materials, as well as their learning achievements and learning experiences that together follow the additional English language training program. Based on the sampling method, this study seeks to examine in depth the level of cognitive load of students in learning English, especially on speaking material. In order to ensure the data collection process goes well, there are efforts made by researchers to ensure an ethical approach to the research conducted. Before the data were collected, the samples were explained and ensured to understand that they were volunteers who were willing to provide data without any elements that conflicted with research ethics.

Research instruments

The instrument used in this study was a non-test instrument in the form of a questionnaire with 9 Likert scales ranging from score 1 (totally disagree) to score 9 (totally agree). This was done because the utilization of a Likert scale with more than five response points in research can increase the reliability and validity of the instrument items used (Kusmaryono et al., 2022). The instrument in this study adapted from questionnaire that used to meassure cognitive load separately based on type such as instrinsic and ekstraneous cognitive load with 10 items question (Krieglstein, 2023). This questionnaire has been declared valid as a questionnaire that can be used to measure the cognitive load of students separately according to the three types of cognitive load. All of items question instrument have be valid as shown in table 3. In this study, cognitive load measured was limited to intrinsic and extraneus types. This is because the measurement and development of instruments to measure germain-type cognitive load is still controversial and theoretically still cannot be refined. The following is the instrument grid used.

Table 2. Instrument grid

Cognitive Load Aspect	Item
Intrinsic	1,2,3,4,5
Extraneous	6,7,8,9,10
Total	10

Based on the grid instrument, the maximum score that can be obtained in this study is 90 and the minimum score obtained is 10. This study also tested the content validity of the instrument again using internal consistency. Reliability refers to the consistency of scores or answers obtained or given by respondents (testees) from one measurement time and another time. This study uses rtable = 0.234 as a minimum standard reference to test the validity of the instrument items used. The reliability obtained on this research instrument is r = 0.71 with r> 0.7, indicating that the instrument has good reliability. The results of measuring the validity and reliability of the instruments used are as follows.

Table 3. Instrument validity

Item	R score	Criteria
ICL 1	0,56	Valid
ICL 2	0,46	Valid
ICL 3	0,60	Valid
ICL 4	0,58	Valid
ICL 5	0,58	Valid
ECL 1	0,67	Valid
ECL 2	0,54	Valid
ECL 3	0,69	Valid
ECL 4	0,55	Valid
ECL 5	0,62	Valid

Procedure of data collection

The data in this survey were collected at one specific point in time. The quantitative descriptive research stages carried out are as follows: (1) obtaining an approval letter from the college institution for conducting research, (2) obtaining approval from the school for conducting research, (3) preparing research instruments, (4) determining and collecting data from respondents, (5) analyzing data, and (6) reporting research results.

Data analysis

This research involved qualitative data analysis. The data from the questionnaire were analyzed quantitatively using descriptive statistics including the average score, standard deviation, and percentage score for each aspect of cognitive load. Empirical score criteria in this study are adjusted to the ideal maximum and minimum scores and the ideal standard deviation value to categorize with very low to very high levels. This analyzed used SPSS 25.0 for windows.

The instrument used in this study has an ideal mean $\overline{X}_i = 25$ an ideal standard deviation Sdi = 6,67 on the ICL and ECL aspects for a 9 gradation Likert scale instrument. Thus, the scoring criteria for the average score of ICL and ECL cognitive load are as follows.

Table 4. Cognitive load score's interpretation

Categorization	Criteria	Interpretation
$X > \overline{X}_i+1,8$ Sdi	$X > 37$	Very High
$\overline{X}_i+ 0,6$ Sdi $< X \leq \overline{X}_i+1,8$ Sdi	$29 < X \leq 37$	High
$\overline{X}_i- 0,6$ Sdi $< X \leq \overline{X}_i+0,6$ Sdi	$21 < X \leq 29$	Medium
$\overline{X}_i- 1,8$ Sdi $< X \leq \overline{X}_i-0,6$ Sdi	$13 < X \leq 21$	Low
$\overline{X}_i- 1,8$ Sdi $< X$	$X \leq 13$	Very Low

Ethical approval

This study adhered to ethical research guidelines. Ethical approval was obtained from the research ethics committee before data collection. Participants were informed about the purpose of the study, confidentiality of responses, and voluntary participation. Written informed consent was secured, ensuring that no personal identifying information was disclosed.

Results

The research questionnaires has been distributed for one week at one of the private vocational schools in Denpasar City, we found the level of cognitive load of grade X students. Based on each of the five statements to measure ICL and ECL, we found differences in the level

of cognitive load on students in general. The results of the overall cognitive load measurement can be seen in the following table. This table 5 shows the overall percentage comparison of intrinsic and extrinsic cognitive load. Intrinsic cognitive load was dominated by the very high (57%) and high (42%) categories, while the medium, very low, and low categories were almost absent. In contrast, extrinsic cognitive load was mostly at the moderate level (55%), followed by high (33%) and very high (7%), with a small percentage for the low category (4%) and none for the very low category. This suggests that participants experienced heavier intrinsic cognitive load compared to extrinsic cognitive load, which was mostly at a moderate level.

Table 5. Overall percentage

	Intrinsic Cognitive Load (%)	Ekstraneous Cognitive Load (%)
Very High	57%	7%
High	42%	33%
Medium	0%	55%
Low	1%	4%
Very Low	0%	0%

The total empirical score on Intrinsic Cognitive Load (ICL) is 2556 with a percentage of 82%. While the score on Extraneous Cognitive Load (ECL) with a score of 1962 with a percentage score of 63%. This shows that the cognitive load of learners in general is dominated by the learning content they learn as an intrinsic cognitive load compared to the delivery or delivery of the content as an extrinsic cognitive load in learning English. For more details, the following table 6 is a review of the cognitive load of learners based on the type of cognitive load and demographics of respondents in this study.

Table 6. Intrinsic and extraneous cognitive load overall score

	Intrinsic Cognitive Load					Ekstraneous Cognitive Load				
	1	2	3	4	5	6	7	8	9	10
Score	508	485	546	521	496	374	382	416	398	392
%	82	78	88	84	80	60	62	67	64	63
Means	7.36	7.0	7.91	7.55	7.18	5.42	5.53	6.02	5.76	5.68
Total	2556					1962				
Means	511					392				
Percentage	82%					63%				

The percentage of intrinsic cognitive load by major, gender, age, and exam score, with categories of very high, high, medium, low, and very low load. The majority of respondents experienced very high or high cognitive load, especially Accounting students (61%), males (57%), and those aged 16 years (69%). No respondents experienced moderate or very low load. In terms of exam scores, participants with scores of 81%-100% experienced more very high cognitive load (61%) than scores of 61%-80% (55%). Overall, very high cognitive load was more prevalent, especially in the 16-year-old age group, Accounting students, and those with high exam scores. This shows in table 7 below.

Table 7. Intrinsic cognitive load percentage

	Major		Gender		Age			Exam Score	
	Accounting	Hospitality	Male	Female	15	16	17	61%-80%	81-100%
Very High	61%	53%	57%	56%	48%	69%	25%	55%	61%

High	39%	44%	43%	42%	48%	31%	75%	43%	39%
Medium	0%	0%	0%	0%	0%	0%	0%	0%	0%
Low	0%	3%	0%	2%	3%	0%	0%	2%	0%
Very Low	0%	0%	0%	0%	0%	0%	0%	0%	0%

Tabel 8 below shows percentage of ekstraneous cognitive load by major, gender, age, and exam score, with categories of very high, high, medium, low, and very low level. The majority of respondents experienced moderate cognitive load, especially Hospitality students (58%), males (71%), and those aged 17 years (75%). Very high cognitive load had a small percentage across all categories, with a peak at 17 years of age (25%). Students with exam scores of 81%-100% tended to experience high cognitive load (56%), while those with scores of 61%-80% experienced more moderate ekstraneous cognitive load (61%). Overall, ekstraneous cognitive load was dominated by moderate level.

Table 8. Ekstraneous cognitive load percentage

	Major		Gender		Age			Exam Score	
	Accounting	Hospitality	Male	Female	15	16	17	61%-80%	81-100%
Very High	6%	8%	10%	6%	3%	9%	25%	10%	0%
High	39%	28%	14%	42%	42%	28%	0%	25%	56%
Medium	52%	58%	71%	48%	52%	56%	75%	61%	39%
Low	3%	6%	5%	2%	0%	6%	0%	2%	6%
Very Low	0%	0%	0%	2%	3%	0%	0%	2%	0%

Figure 1 illustrates the levels of Intrinsic Cognitive Load (ICL) and Extraneous Cognitive Load (ECL) in English speaking competency among Accounting and Hospitality students. The color-coded bars represent different levels of cognitive load, with ICL reflecting the mental effort required to produce spoken English, while ECL represents external factors such as instructional design, task complexity, and learning conditions.

The data shows that ICL is dominated by a very high level in both majors, indicating that students experience significant cognitive effort when speaking English in their respective fields. This suggests that vocational students must process industry-specific vocabulary, structure their responses correctly, and maintain fluency under pressure, making speaking a cognitively demanding task.

In contrast, ECL is primarily at a medium level, meaning that while the way English speaking activities are delivered does influence cognitive load, it does not overwhelm students. This indicates that teaching strategies and learning environments generally support speaking tasks, but there is still room for improvement in reducing unnecessary external burdens, such as unclear instructions or overly complex activities.

These findings emphasize that English speaking instruction in vocational settings should focus on reducing cognitive overload by integrating structured speaking exercises, role-play scenarios, and industry-specific communication practice. By doing so, educators can help students manage their cognitive load more effectively, leading to greater confidence and fluency in speaking English within Accounting and Hospitality contexts.

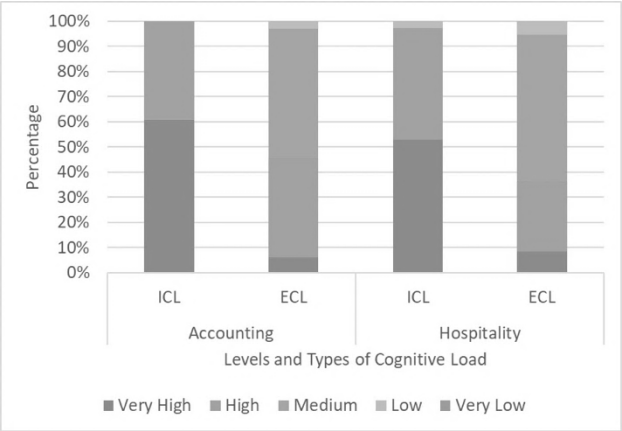

Figure 1. Cognitive load based on major

Figure 2 illustrates the distribution of Intrinsic Cognitive Load (ICL) and Extraneous Cognitive Load (ECL) in English speaking competency based on gender (male and female learners). The color-coded bars represent different levels of cognitive load, with ICL referring to the mental effort required to process and generate spoken language, while ECL pertains to external factors such as instructional delivery, task complexity, and learning environment.

The findings indicate that both male and female learners experience a very high level of ICL, suggesting that speaking in English requires significant cognitive effort. This reflects the challenge of organizing ideas, structuring sentences, and producing accurate pronunciation and fluency in real-time conversations. Since speaking is a productive skill that demands quick thinking and language retrieval, it naturally imposes a high intrinsic load.

In contrast, ECL is dominated by the medium level for both genders, meaning that while instructional methods and learning conditions influence speaking performance, they are not the primary source of cognitive burden. This suggests that educators provide relatively clear instructions and structured activities that support speaking practice without adding excessive external difficulty. However, the presence of low and very low ECL levels in some learners may indicate that certain students still face barriers related to instructional clarity, task design, or anxiety in speaking tasks.

These results emphasize the importance of scaffolding speaking activities to reduce cognitive overload while enhancing fluency and confidence in English communication. Educators should focus on structured speaking tasks, guided practice, and supportive feedback to help students manage their cognitive load effectively and improve their speaking competency in vocational settings.

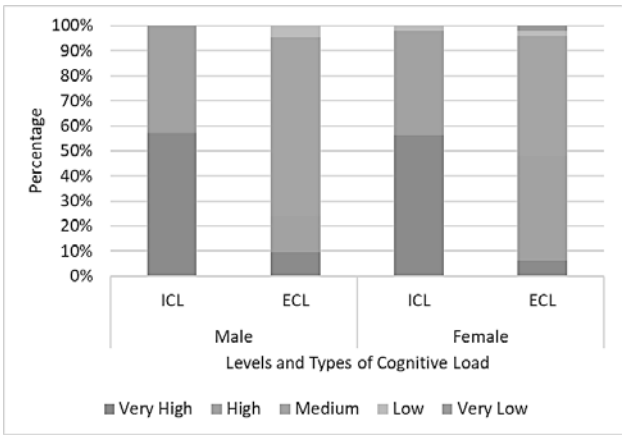

Figure 2. Cognitive load based on gender

Figure 3 presents the distribution of Intrinsic Cognitive Load (ICL) and Extraneous Cognitive Load (ECL) across different age groups of learners in English speaking tasks. The results indicate that at the age of 17, learners experience a high level of ICL, suggesting that speaking tasks remain cognitively demanding but manageable. Meanwhile, their ECL is at a medium level, which implies that external instructional factors do not significantly hinder their speaking performance. In contrast, at the age of 16, most learners report a very high level of ICL, highlighting the complexity of speaking tasks at this stage. Their ECL is also predominantly at a medium level, although a small proportion of them experience a low level, indicating that instructional design may help alleviate certain external burdens. On the other hand, at the age of 15, ICL is primarily at a high level, similar to that of the 17-year-old group, while ECL is dominated by a medium level, with a few learners reporting a very low level of ECL. This suggests that some students feel minimal external cognitive strain when engaging in speaking tasks.

Overall, these findings demonstrate that as learners grow older, their ability to manage cognitive load in speaking tasks improves, particularly in handling the intrinsic difficulties of the tasks. However, across all age groups, ECL remains relatively stable at a medium level, indicating that educational interventions may still be necessary to further reduce unnecessary cognitive strain in speaking activities.

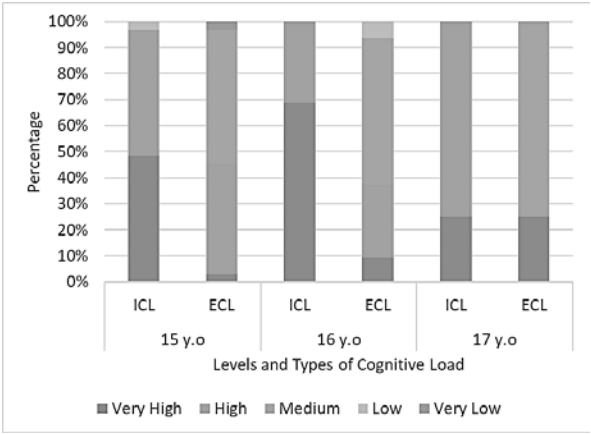

Figure 3. Cognitive load based on age

Figure 4 illustrates the distribution of Intrinsic Cognitive Load (ICL) and Extraneous Cognitive Load (ECL) among students categorized based on their final report card scores in English (61%-80% and 81%-100%). The vertical axis represents the percentage of students, while the horizontal axis differentiates between the two cognitive load types within each score category. The color-coded segments indicate varying levels of cognitive load, ranging from very high (blue) to very low (red). The results indicate that students with higher scores (81%-100%) tend to experience a greater intrinsic cognitive load, as reflected by the dominance of very high and high levels of ICL. This suggests that these students engage in more complex cognitive processes, likely due to their stronger foundational knowledge and ability to process language at a deeper level.

In contrast, students with scores in the range of 61%-80% also report experiencing ICL but with a more varied distribution, including low levels in some cases. Regarding ECL, both groups exhibit a noticeable presence of medium to high levels, indicating that external instructional factors such as teaching methods, task complexity, or environmental distractions remain influential. A few students with higher scores report lower levels of ECL, suggesting that they may have developed strategies to mitigate external cognitive burdens. These findings highlight the relationship between academic performance and cognitive load, where higher-achieving students engage more with intrinsic cognitive processes, yet external instructional factors continue to pose challenges across different performance levels.

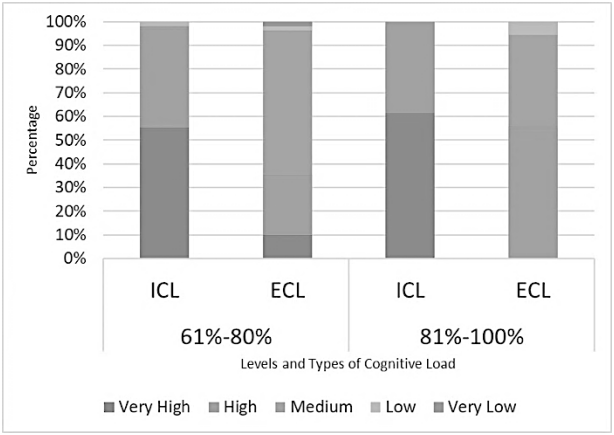

Figure 4. Cognitive load based on final report card score

Based on the findings the answer to the research question regarding the level of students' cognitive load in English language learning, particularly in speaking competence at vocational schools, is that the intrinsic cognitive load (ICL) is generally higher than the extraneous cognitive load (ECL). This pattern is also observed across different subject characteristics, including gender, major, age, and academic achievement. The results indicate that the content or complexity of learning materials in speaking competence for English as a foreign language contributes more significantly to the high cognitive load experienced by students compared to how educators deliver the material.

Discussion

English is one of the most difficult subjects for many students in Indonesia (Krisnayanti and Winarta, 2021). Although it has been taught since elementary school, many students still

experience difficulties in understanding and mastering English (Jannah et al., 2023). This difficulty can be caused by several factors, such as the lack of adequate English language skills, uninteresting teaching materials, and ineffective learning methods (Sintadewi et al., 2020) .

Lack of learning motivation is also one of the main causes of students' difficulties in understanding English materials (Mauliya et al., 2020). Uninteresting and non-interactive teaching materials make students feel bored and unmotivated to learn (Athiyyaturrahmah et al., 2023). In addition, the lack of adequate English language skills is also one of the obstacles in understanding English material (Naeem et al., 2023).

In addition, English also has many rules and exceptions that can make students feel confused (Damis et al., 2024). To overcome this difficulty, it is necessary to make improvements in teaching materials and learning methods (Ajaj, 2022). Teaching materials that are more interesting and relevant to daily life, as well as learning methods that are more interactive and fun, can help increase students' learning motivation and English language. Thus, it is hoped that students can more easily understand and master English, so as to improve academic achievement and future career opportunities.

The findings of this study reveal that cognitive load in vocational school students learning English is predominantly influenced by Intrinsic Cognitive Load (ICL), which is linked to the inherent complexity of the subject matter. This suggests that students struggle primarily with understanding fundamental English concepts, particularly in speaking tasks that require real-time processing of grammar, vocabulary, pronunciation, and fluency. Intrinsic Cognitive Load (ICL) is one component of cognitive load associated with the complexity and difficulty of the learning material itself (Sweller et al., 2011). Furthermore, this type of ICL cognitive load is often caused by several factors, including: learning materials that have complex concepts and are difficult to understand, learning materials that have a large amount of information and are difficult to organize, learning materials that have procedures that are difficult to follow, lack of prior knowledge, students do not have adequate prior knowledge about learning materials, and students do not have experience relevant to learning materials (Paas et al., 2003; Sweller et al., 2011). These factors can cause high ICL type cognitive load, thus affecting students' ability to understand and master learning materials. This is relevant to the study which show that the demands of global competition result in English becoming an important subject to learn (Neelambaram, 2004; Rao 2019).

However, despite the importance of speaking skills in vocational education, the teaching materials examined in this study did not sufficiently facilitate independent learning or real-life communication. The data show that many students experience very high ICL, suggesting that they struggle to relate the learning material to their personal and professional contexts. Furthermore, ineffective instructional methods and insufficient feedback contribute to the cognitive burden, making it difficult for students to develop speaking fluency. Similar patterns also observed in cognitive load distribution when analyzing English language acquisition in vocational settings (Patel and Alismail, 2024).

This study is limited to the subject and research method which makes it difficult to generalize the results found. In addition, this study also focused on the assessment of cognitive load for English learning materials taught in the classroom when the study took place, namely speaking materials. We also did not examine the Germane Cognitive Load (GCL) because the concept was considered unclear and difficult to operationalize. GCL was originally proposed as a component of cognitive load associated with effective and efficient learning. However, in practice, CGL is difficult to measure and identify (Sweller et al., 2011) . The concept of germane has also received much criticism from other research studies because it is considered inconsistent with the

overall Cognitive Load theory. They argue that CLG does not have a strong theoretical basis and cannot be explained logically in the context of Cognitive Load theory (Paas et al., 2003). The deepening of the factors that affect the cognitive load of students in learning English in vocational schools also cannot be explained optimally in this study. Therefore, future research is expected to be able to comprehensively examine the factors that affect the cognitive load of students in vocational schools in learning English or in other contexts with better generalization.

Finally, this study adds new information regarding language education, as reported elsewhere (Table 6).

Table 6. Previous studies on Language Education (Table by Author)

No	Title	Ref
1.	Combining chatbot and social media: Enhancing personal learning environment (PLE) in language learning.	Haristiani and Rifa'I (2020)
2.	Chatbot-based application development and implementation as an autonomous language learning medium	Haristiani and Rifa'I (2021)
3.	Empowering language models through advanced prompt engineering: A comprehensive bibliometric review	Fatawi et al. (2024)
4.	Chatbots as digital language tutors: revolutionizing education through AI	Luckyardi et al. (2024)
5.	Technology and hybrid multimedia for language learning and cross-cultural communication in higher education	Farida et al. (2024(
6.	Advancing language education in Indonesia: Integrating technology and innovations	Luckyardi et al. (2024)
7.	Introduction of Indonesian poem (pantun) as a creative effort of elementary school students in improving language skills in the Covid-19 pandemic era	Medani and Sakti (2022)
8.	Influence of parental involvement and school environment on pupils' academic performance in the English language	Saadu (2023)
9.	The effect of prowritingaid writing tool on the writing skills of English as a foreign language (EFL) students: A systematic literature review	Damayanti and Santosa (2024)
10.	Implementation of early intervention with family resourced to improve development of expressive language in children with cerebral palsy	Abidin et al. (2021)
11.	A computer-based approach to teaching foreign languages	Shaturaev and Khamitovna (2023)
12.	Impact of communicative language test assessments in enhancing learners' capacity	Jamiu (2023)
13.	Evaluation of assessment projects in English language education: A bibliometric review	Oya (2024)
14.	Bibliometric analysis using VOSviewer with Publish or Perish of CEFR-based comparison of English language teaching models for communication	Nadtayay and Wongsaphan (2025)
15.	Efforts to improve the vocabulary of Indonesian language for 1st-grade elementary students with hearing impairment for through the application of mnemonic	Kurniawati (2022)
16.	The weaknesses of the curriculum in the teaching of Arabic (a Muslim language) as a foreign language	Jamiu (2022)

17.	Linguistics and semantics difficulties in Arabic language among senior secondary schools in Ekiti, Nigeria	Jamiu (2023)
18.	ICT tools for teaching the Arabic language	Sanni (2023)
19.	How to improve student understanding in learning science by regulating strategy in language education? Definition, factors for enhancing students comprehension, and computational bibliometric review analysis	Suherman (2023)
20.	How language and technology can improve student learning quality in engineering? Definition, factors for enhancing students comprehension, and computational bibliometric analysis	Al Husaeni (2022)
21.	Strategies in language education to improve science student understanding during practicum in laboratory: Review and computational bibliometric analysis	Fauziah et al. (2021)
22.	How do english teachers prepare diagnostic assessment for students? insight from teachers' experiences in an Indonesian remote island	Masbara et al. (2024)
23.	Fostering self-directed learning through local wisdom project-based learning	Rosmayanti et al. (2024)
24.	Storytelling in higher education: Comparing expectancy-value in task-exposed and non-exposed English learners	Wang (2024)
25.	The importance of English language in tourism sector: A study in Socotra Island	Ahmed (2024)
26.	Role-play in language learning: A bibliometric analysis and its impact on Thailand secondary education	Kongsaenkham and Chano (2024)

Conclusion

The results of this study explain the level of Intrinsic and Extraneous type cognitive load in English subjects, especially in speaking material. The focus of this research is to answer the level of cognitive load of students in vocational schools in English subjects which are compulsory subjects for students at various levels of education. Based on the grouping of data, we showed that in general, ICL type cognitive load obtained a greater percentage than ECL type cognitive load in learning English in vocational schools. Moreover, motivating learning materials in speaking class, which are considered extraneous load from the perspective of cognitive load theory, should recognize that the motivational effects can be more effectively addressed if the persistence of students is acknowledged as a critical factor for achieving success in English learning. However, this study was limited to subjects in one vocational school in Denpasar City, future research is expected to be able to examine more deeply the factors that result in differences in the level of cognitive load on students.

Declaration of conflicting interest
The authors declare that there is no conflict of interest in this work.

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