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Intrinsic, Extraneous, and Germane Cognitive Load in Arabic Learning: A Descriptive Study Based on John Sweller's Theory

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ABSTRACT

Background: Learning Arabic is often considered difficult by students because it involves various language elements that must be understood simultaneously. From the perspective of John Sweller's Cognitive Load Theory, this condition is associated with the high demands of information processing in working memory, which can generate cognitive load. The study of cognitive load in learning Arabic is important for understanding students' learning processes.

Purpose: To describe students' cognitive load during learning Arabic on the topic of al-mihnah in class X E at MAN Sumenep.

Method: This study employed a descriptive quantitative, using all tenth-grade students of MAN Sumenep as the population, with 36 students from class X E selected as the research sample. The research instruments consisted of students' worksheets (LKS) to measure intrinsic cognitive load and questionnaires to assess extraneous cognitive load and germane cognitive load. The questionnaire instruments were developed by adapting the multi-item indicators of Cognitive Load Theory proposed by Leppink and Klepsch and were constructed based on the factors and effects of cognitive load in the learning process. The instruments were translated and adjusted to the context of Arabic language learning and were subsequently tested for validity and reliability prior to data collection. The data were analyzed using descriptive statistical techniques to identify and categorize the levels of intrinsic, extraneous, and germane cognitive load experienced by students during Arabic learning.

Results and Discussion: The study found that all three components of cognitive load were in the medium category. Intrinsic cognitive load had a mean score of 72.62, indicating that students were fairly capable of understanding the material and completing the worksheet tasks. Extraneous cognitive load had a mean score of 59.79, indicating that the instructional design sufficiently supported the learning process, although some unnecessary cognitive load remained. And germane cognitive load obtained a mean score of 71.13, indicating that students were fairly active in constructing and strengthening knowledge schemas.

Conclusions and Implications: Students generally understand the material and constructed knowledge effectively, although the cognitive demands still require further optimization. These findings imply that Arabic language instruction should be designed in accordance with Cognitive Load Theory principles, with structured material

presentation, appropriate media use, and clear instructions to reduce extraneous cognitive load and optimize students' working memory capacity.

***Keywords*:** *Arabic Learning; Cognitive Load Theory; Students' Cognitive Load.*

ABSTRAK

Latar Belakang: Belajar bahasa Arab sering dianggap sulit oleh siswa karena melibatkan berbagai unsur bahasa yang harus dipahami secara bersamaan. Dalam perspektif Cognitive Load Theory John Sweller, kondisi tersebut berkaitan dengan tingginya tuntutan pemrosesan informasi dalam memori kerja yang dapat menimbulkan beban kognitif. Kajian mengenai beban kognitif dalam belajar bahasa Arab menjadi penting untuk memahami proses belajar siswa.

Tujuan: Untuk mendeskripsikan tingkat beban kognitif siswa dalam belajar bahasa Arab materi al-mihnah di kelas X E MAN Sumenep

Metode: Penelitian ini menggunakan pendekatan kuantitatif deskriptif dengan populasi seluruh siswa kelas X MAN Sumenep dan sampel penelitian sebanyak 36 siswa kelas X E. Instrumen penelitian terdiri atas lembar kerja siswa (LKS) untuk mengukur beban kognitif intrinsik serta angket untuk mengukur beban kognitif ekstrinsik dan beban kognitif germane. Instrumen angket disusun dengan mengadaptasi indikator multi-item Cognitive Load Theory yang dikembangkan oleh Leppink dan Klepsch, serta mengacu pada faktor-faktor dan efek beban kognitif dalam proses pembelajaran. Instrumen diterjemahkan dan disesuaikan dengan konteks pembelajaran bahasa Arab, kemudian diuji validitas dan reliabilitasnya sebelum digunakan pada sampel penelitian. Data dianalisis menggunakan analisis statistik deskriptif untuk mengetahui dan mengategorikan tingkat beban kognitif intrinsik, ekstrinsik, dan konstruktif yang dialami siswa dalam belajar bahasa Arab.

Hasil dan Pembahasan: Hasil penelitian menunjukkan bahwa ketiga komponen beban kognitif berada pada kategori sedang. Intrinsic cognitive load memperoleh rata-rata sebesar 72,62, yang menunjukkan bahwa siswa cukup mampu memahami materi dalam menyelesaikan tugas pada LKS. Extraneous cognitive load memperoleh rata-rata sebesar 59,79, yang menunjukkan bahwa desain pembelajaran cukup mendukung proses belajar meskipun masih terdapat beban kognitif yang tidak diperlukan. Sementara itu, germane cognitive load memperoleh rata-rata sebesar 71,13, yang menunjukkan bahwa siswa cukup aktif dalam membangun dan memperkuat skema pengetahuan.

Kesimpulan dan Implikasi: Siswa secara umum mampu memahami materi dan membangun pengetahuan dengan cukup baik, meskipun tuntutan kognitif masih perlu dioptimalkan. Temuan ini mengimplikasikan bahwa pembelajaran bahasa Arab perlu dirancang sesuai prinsip Cognitive Load Theory melalui penyajian materi yang terstruktur, penggunaan media yang tepat, dan instruksi yang jelas untuk mengurangi beban kognitif ekstrinsik serta mengoptimalkan kapasitas memori kerja siswa.

Kata Kunci: *Beban Kognitif Siswa; Belajar Bahasa Arab; Teori Beban kognitif*

INTRODUCTION

Arabic language learning requires a high level of cognitive processing, as students are expected to simultaneously manage multiple linguistic components within working memory, including grammatical structures, vocabulary, as well as listening, speaking, reading, and writing skills.[1] In this process, learners are not only required to comprehend meaning but also to integrate various linguistic elements at the same time, thereby creating substantial demands on information processing during learning activities. This condition is influenced by the inherent characteristics of the Arabic language, which is marked by a relatively high degree of linguistic complexity, such as

its grammatical system (naḥw), morphology (ṣarf),[2] sentence structures, and extensive vocabulary. In addition, Arabic possesses distinctive linguistic systems, including phonological, semantic, syntactic, and orthographic systems that are not commonly found in many other languages.[3] This complexity requires students to process linguistic information in a deep and integrated manner, highlighting the importance of appropriate instructional strategies to ensure optimal comprehension of the material.

Arabic also has unique characteristics that are not found in many other languages, making its level of difficulty more pronounced. This difficulty is further intensified by the fact that Arabic is a foreign language for the majority of learners in Indonesia. In addition, the significant linguistic differences between Arabic and Indonesian reduce the level of similarity and relevance between the two languages.[4] This condition may lead to cognitive load, as students are required to understand relatively complex Arabic material while simultaneously mastering other equally demanding subjects. Such complexity often becomes an obstacle for some students.

In this context, Cognitive Load Theory (CLT) is highly relevant as it explains how the limited capacity of working memory influences students' processes of receiving, processing, and understanding information[5] According to Sweller, cognitive load refers to the amount of mental resources required by working memory when learning new material or completing a task. One of the central concepts in CLT is element interactivity, which refers to the degree of interrelation among information elements that must be processed simultaneously in working memory. The higher the level of element interactivity, the greater the cognitive load experienced by learners.[6] In Arabic language learning, the interconnection between grammar (naḥw), morphology (ṣarf), vocabulary, and sentence structure requires students to process multiple linguistic components simultaneously, which may increase cognitive load. Therefore, CLT emphasizes the importance of instructional design that aligns with the limitations of working memory to ensure more effective learning.[7]

One educational institution that reflects these challenges is Madrasah Aliyah Negeri Sumenep, particularly Class X E, which demonstrates relatively complex learning characteristics. These characteristics are reflected in the diversity of general and religious subjects, students' involvement in various intensive extracurricular activities, and the fact that some students reside in dormitories with demanding study schedules. Class X E of MAN Sumenep and the al-miḥnah material are relevant for this study because they represent learning conditions in which the three types of cognitive load may emerge simultaneously. Variations in students' prior knowledge of Arabic indicate differences in knowledge levels that may influence intrinsic cognitive load, particularly when students learn materials involving interconnected linguistic elements. Meanwhile, classroom learning processes, including teaching methods, instructions, and the presentation of learning materials, may generate extraneous cognitive load originating from factors external to the material itself. On the other hand, the al-miḥnah material, which requires the integrated comprehension of vocabulary, sentence structures, and semantic relationships among sentences, provides opportunities for the emergence of germane cognitive load through the reinforcement of Arabic language knowledge schemas.

Research on Cognitive Load Theory has been widely conducted across various learning contexts with diverse focuses, approaches, and findings. In general, these studies indicate that cognitive load is an important factor influencing learning effectiveness, particularly when learners are confronted with materials characterized by a high level of complexity. Nevertheless, existing studies still demonstrate variations in research focus. Some studies discuss cognitive load theory primarily from a conceptual perspective, whereas others emphasize the application of cognitive load theory only in specific aspects or learning skills without examining the overall dimensions of cognitive load in an integrated manner.

Research in the context of Arabic language learning, such as the study conducted by Ahmad Syagif employed a conceptual approach at the elementary education level without empirical measurement, and therefore did not produce quantitative findings regarding the level of cognitive load.[8] In contrast, Salwa Hassan Muhamed applied a quantitative experimental approach at the university level with a focus on writing skills based on Arabic poetic prosody; however, the findings were limited to a single skill domain and did not examine the three types of cognitive load in an integrated manner.[9] Meanwhile, Alkhawaldeh and Khasawneh employed a quantitative design in a general educational context and found that cognitive load influenced learning outcomes, although the study did not specifically consider linguistic complexity.[10] Similarly, Eka Lesmana Sari et al. investigated application-based learning strategies in the context of science education and found that such strategies could reduce cognitive load, yet the study did not focus on language characteristics as the primary source of cognitive burden.[11] Overall, the differences among these studies can be seen in terms of focus, methods, samples, and findings; however, none of them comprehensively integrated the three types of cognitive load (intrinsic, extraneous, and germane) within the context of Arabic language learning, which is characterized by high linguistic complexity.

Based on previous studies, Cognitive Load Theory has been widely applied in various learning contexts to improve learning effectiveness. However, research on cognitive load in Arabic language learning remains relatively limited. Most previous studies have focused on the application or effects of cognitive load theory on learning outcomes rather than on the simultaneous descriptive mapping of intrinsic cognitive load (ICL), extraneous cognitive load (ECL), and germane cognitive load (GCL). In addition, studies examining these three components of cognitive load in al-miḥnah material, which is characterized by a high level of element interactivity, using validated cognitive load theory instruments, are still very limited. Therefore, this study aims to address this gap through a descriptive mapping of ICL, ECL, and GCL in the learning of al-miḥnah material among tenth-grade students at Madrasah Aliyah Negeri Sumenep. The findings of this study are expected to provide a more comprehensive understanding of students' cognitive processes and to serve as a basis for the development of more effective Arabic language learning strategies.

LITERATURE REVIEW

Cognitive Load

Cognitive Load Theory is a theory in psychology that explains how mental processes and human behavior occur during learning. This theory addresses the relationship between psychological concepts in the brain, such as attention and memory, and observable learning outcomes.[6] Cognitive load refers to the amount of mental effort required by working memory to process information or learning materials within a certain period of time.[12] The core assumption of this theory emphasizes that human cognitive capacity has certain limitations. These limitations are primarily found in working memory, which is actively engaged when individuals are involved in mental activities such as learning.

Cognitive Load Theory was first introduced in the 1980s by John Sweller, an emeritus professor and psychologist at the University of New South Wales, Australia. Sweller explained that this theory relates to the level of difficulty in learning and problem-solving processes, which is influenced by the limited capacity of working memory in processing new information. These limitations make it difficult for individuals to handle too much information simultaneously. When learners are exposed to excessive information, they may experience difficulties in processing it during learning.[5] The concept of cognitive load refers to the amount of mental effort exerted by working memory when processing information at a given time. This load is primarily determined by the number of elements that require learners' simultaneous attention and focus. Activity in working memory increases when an individual receives new information. If the amount of

incoming information exceeds the capacity of working memory, the process of understanding and processing information becomes difficult.

According to Sweller in Cognitive Load Theory, cognitive load is composed of three main types: Intrinsic Cognitive Load (ICL), Extraneous Cognitive Load (ECL), and Germane Cognitive Load (GCL). Intrinsic cognitive load refers to the mental effort required for learners to process information, which is influenced by the level of complexity and the inherent characteristics of the learning material. Extraneous cognitive load, on the other hand, arises from poorly designed instructional materials or ineffective presentation of information. Germane cognitive load refers to the mental effort devoted to constructing, organizing, and automating knowledge schemas during the learning process.[6]

Although the concept of germane cognitive load remains a subject of debate in the recent development of Cognitive Load Theory, this study continues to employ the three-component model of cognitive load consisting of intrinsic, extraneous, and germane cognitive load. The use of this model is based on the cognitive load instruments developed by Leppink and Klepsch,[13], [14] which still measure these three components separately. In this study, germane cognitive load is operationalized as the mental effort exerted by students in allocating cognitive resources to construct and strengthen Arabic language knowledge schemas through the processes of information processing and integration during learning activities.

Learning Arabic

Learning is a conscious activity carried out by an individual with a specific purpose. This activity emphasizes the active involvement of individuals in mental processes that can lead to changes within themselves.[15] According to Oemar Hamalik, learning is viewed as a process and effort that involves activities, rather than merely an outcome or final goal. Learning is not only about memorization but also involves experiences that result in behavioral changes, not simply the acquisition of skills through practice.[16] Sardiman adds that learning is always characterized by changes in behavior or performance that occur through various activities such as reading, observing, listening, imitating, and other related activities.[17]

Arabic according to Al-Ghalayini, is defined as a set of sentences used by Arabs to express their thoughts and feelings.[18] In learning Arabic, there are four main skills that must be mastered (listening, reading, speaking, and writing). These four skills cannot be separated from the mastery of grammar (qawaʿid), which serves as the linguistic foundation for understanding sentence structure, along with knowledge of sarf (morphology), which studies word changes and forms. In addition, mastery of vocabulary and the ability to recognize and use the complex Arabic script are also fundamental and essential aspects that cannot be separated from learners' efforts to comprehensively master the Arabic language.

Asrori explains that the essence of learning Arabic is to fulfill the need for social communication.[19] Thus, learning Arabic can be defined as a conscious and structured process undertaken by individuals to master language skills (listening, reading, speaking, and writing) as well as linguistic rules such as grammar, morphology, and phonology, with the primary goal of enabling effective communication and understanding Arabic texts, both classical and modern.

METHOD

Research Design

This study employed a quantitative approach with a descriptive research design. A quantitative descriptive method is a research method used to describe or portray phenomena, both natural and human-made, presented in the form of measurements, quantities, or frequencies.[20] This study adopts a descriptive quantitative approach aimed at providing an objective overview of students' levels of intrinsic, extraneous, and germane cognitive load in learning Arabic, particularly

on the al-miḥnah material. This approach emphasizes the collection of numerical data, which are then analyzed statistically to produce a clear, objective, and measurable description of the phenomena under investigation.

Population and Sample

The population of this study consisted of all tenth-grade students at Madrasah Aliyah Negeri Sumenep, totaling 440 students. The sample comprised 36 students from Class X E who were selected using purposive sampling techniques. The selection of Class X E was based on the consideration that the class demonstrated diverse levels of Arabic language proficiency and participated in Arabic language instruction with the same learning material, making it relevant to the objectives of the study. The selection of Class X E was carried out using a purposive sampling technique because the class exhibits variation in students' prior Arabic language proficiency and studies the al-miḥnah material, which is considered suitable for eliciting intrinsic, extraneous, and germane cognitive load in line with the objectives of this study. The inclusion criteria in this study were students who actively participated in Arabic language learning and were present during the data collection process. The demographic profile of the sample indicated that the students were between 15 and 16 years old and came from heterogeneous educational backgrounds.

Instruments

The research instruments consisted of student worksheets and questionnaires. The worksheets were used to measure intrinsic cognitive load based on students' ability to complete tasks representing the complexity of the learning material. Meanwhile, the questionnaires were used to measure extraneous cognitive load through students' perceptions of instructional design and to assess germane cognitive load through students' mental effort in constructing and strengthening knowledge schemas. The questionnaire data employed a four-point Likert scale consisting of (1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree). The questionnaire instruments were developed by adapting the multi-item Cognitive Load Theory indicators proposed by Leppink and Klepsch,[13], [14] while also referring to various factors and effects of cognitive load in the learning process.

The extraneous cognitive load instrument related to instructional aspects was adapted from Leppink and Klepsch and further strengthened by incorporating several effects within Cognitive Load Theory, including the worked example effect, split-attention effect, modality effect, and redundancy effect. Meanwhile, the germane cognitive load instrument adopted the aspects of schema construction and elaboration from Leppink, as well as the indicators of self-explanation and deep processing from Klepsch. In addition, the instrument was further developed by incorporating a reflection aspect as part of strengthening the schema-construction process during learning. The instruments were translated into Indonesian and adjusted to the context of Arabic language learning. The adaptation process involved modifications in language and content to ensure suitability with the characteristics of the material and the students. Subsequently, the instruments were validated through expert judgment conducted by an Arabic language learning specialist prior to statistical validity and reliability testing.

Table 1. Components, Aspects, and Indicators of Cognitive Load Instruments

Component	Aspect	Number of Items	Example Item	Scale	Interpretation
Intrinsic Cognitive Load	Prior knowledge, element interactivity,	70 items (3 worksheets)	"Correct the verbs in the following sentences using	A score of 1 was assigned for correct answers and	Higher scores indicate a higher level of students' ability to

	and material difficulty		the appropriate vocabulary"	0 for incorrect answers: speaking skill and writing skill tasks were assessed using rubrics	process the complexity of the material
Extraneous Cognitive Load	Instruction, worked example, split attention, modality, redundancy	20 items	"The teacher's instructions during the learning of al-miḥnah material were unclear and made me confused"	4-point Likert scale	Higher scores indicate a higher level of unnecessary mental load
Germane Cognitive Load	Schema construction, self-explanation, information organization, elaboration, reflection	20 items	"I paid attention to the relationship between fiʿil, fāʿil, and mafʿūl in order to understand the function of each element in profession-related sentences"	4-point Likert scale	Higher scores indicate greater constructive mental effort exerted by students

Procedures

The research was conducted in several stages. In the first stage, students were given worksheets (LKS) in each meeting of the al-miḥnah learning sessions to measure intrinsic cognitive load. The worksheets were administered across three meetings, resulting in three sets of LKS tailored to the material covered in each session. In the fourth meeting, students were given questionnaires to measure extraneous cognitive load and germane cognitive load. After all data were collected, the data were processed and analyzed based on the scores obtained for each cognitive load component.

Data Analysis

The research data were analyzed using descriptive quantitative statistics to describe the levels of students' intrinsic, extraneous, and germane cognitive load in Arabic language learning. The data were obtained through student worksheets and questionnaires, which were subsequently scored according to the assessment guidelines of each instrument. Intrinsic cognitive load was measured using three worksheets administered during each learning session on the al-miḥnah material. Objective items were assessed using a dichotomous scoring system, in which correct answers received a score of 1 and incorrect answers received a score of 0, whereas maharah kalam and maharah kitabah tasks were evaluated using assessment rubrics. Meanwhile, extraneous cognitive load and germane cognitive load were measured using questionnaires based on a 1–4 Likert scale.

Data from each instrument were first scored according to the scoring guidelines, and then converted into a 100-point scale so that all components of cognitive load had a comparable score range before being analyzed descriptively.

The obtained scores were then converted into a 100-point scale using the following formula:

$$Score = \frac{Obtained\ Score}{Maximume\ Score}\ x\ 100$$

Subsequently, the mean score, standard deviation, minimum score, and maximum score were calculated to describe the levels of intrinsic, extraneous, and germane cognitive load. Category intervals were determined based on the calculation of the ideal mean (Mi) and ideal standard deviation (SDi) to classify cognitive load levels into low, moderate, and high categories. The mean scores of the intrinsic, extraneous, and germane cognitive load components were classified based on the criteria proposed by Azwar.[21] The same analytical procedures were applied consistently to intrinsic, extraneous, and germane cognitive load.

Table 2. Categorization Levels of Students' Average Cognitive Load Scores

Score Interval	Category
X≤ (Mean – 1,5 SD)	Very Low
(Mean – 1,5 SD) < X ≤ (Mean – 0,5 SD)	Low
(Mean – 0,5 SD) < X ≤ (Mean + 0,5 SD)	Medium
(Mean + 0,5 SD) < X ≤ (Mean + 1,5 SD)	High
X≥ (Mean + 1,5 SD)	Very High

Validity-Reliability

The validity and reliability of the student worksheet and cognitive load questionnaire instruments were assessed using IBM SPSS Statistics 25 through Pearson Product-Moment correlation and Cronbach's Alpha analyses. The instrument try-out was conducted on 30 and 31 students outside the main research sample. Item validity was determined by comparing the calculated correlation coefficient (r-count) with the r-table value at a significance level of 0.05. Items with r-count greater than the r-table value were considered valid, whereas those with lower values were excluded. As presented in Table 3, the student worksheet for Meeting 1 initially consisted of 34 items, of which 30 were valid and 4 were invalid (r-table = 0.361). The worksheet for Meeting 2 initially consisted of 28 items, with 20 valid and 8 invalid items (r-table = 0.355). The worksheet for Meeting 3 initially consisted of 40 items, with 30 valid and 10 invalid items (r-table = 0.361). The Extraneous Cognitive Load (ECL) questionnaire initially consisted of 28 items, of which 20 were valid and 8 were invalid (r-table = 0.361), while the Germane Cognitive Load (GCL) questionnaire initially consisted of 25 items, with 20 valid and 5 invalid items (r-table = 0.361). Although several items were removed, all intrinsic, extraneous, and germane cognitive load indicators remained adequately represented; therefore, the construct coverage was not affected. Reliability was assessed using Cronbach's Alpha. The coefficients ranged from 0.682 to 0.950, indicating acceptable to excellent internal consistency. Based on the criterion of Cronbach's Alpha > 0.60, all research instruments were considered reliable and appropriate for use in the main study.

Table 3. Item Validity Analysis of Research Instruments

Instrument	Try-Out Sample	Initial Items	Valid Items	Invalid Items	r-table	Decision
Worksheet Meeting 1	30 students	34	30	4	0,361	Valid

Worksheet Meeting 2	31 students	28	20	8	0,355	Valid
Worksheet Meeting 3	30 students	40	30	10	0,361	Valid
ECL Questionnaire	30 students	28	20	8	0,361	Valid
GCL Questionnaire	30 students	25	20	5	0,361	Valid

Ethics

The study obtained permission from the head of MAN Sumenep and the Arabic language teacher. All student data were used solely for research purposes and were kept confidential. Respondents' identities were anonymized during the data analysis and reporting process and ensuring that participation was voluntary.

RESULT AND DISCUSSION

A. Level of Intrinsic Cognitive Load

The instrument used to measure the level of intrinsic cognitive load in this study was a student worksheet. The worksheets were developed based on the predetermined learning objectives and Learning Objective Flow (ATP), as well as the forms and types of questions contained in the Arabic teaching module used by the teacher during instruction. Therefore, the tasks provided remained aligned with the learning materials studied by the students. This study employed three worksheets administered to students at the end of each learning session. The purpose of administering the worksheets was to determine students' level of understanding of the material that had been learned. The questions in the worksheets were designed with levels of complexity that corresponded to the characteristics of intrinsic cognitive load, namely the cognitive load that naturally arises from the learning material itself. The level of this load is determined by the complexity of the material and the number of interconnected elements within it.

The following presents the data on the results of students' intrinsic cognitive load levels:

Table 4. Data on the results of students' intrinsic cognitive load levels

No	Aspects of Intrinsic Cognitive Load	Mean Score
1.	Prior knowledge	82.63
2.	Element interactivity	69.25
3.	Material difficulty	65.97
	Overall mean of intrinsic cognitive load	**72.62**
	Category	**Medium**

Based on the data obtained from the students' completion of the worksheets designed to represent the complexity of the al-mihnah material, the mean score of intrinsic cognitive load was 72.62, which falls into the medium category. In terms of the aspects of intrinsic cognitive load, the prior knowledge aspect obtained the highest mean score of 82.63, followed by element interactivity with a mean score of 69.25, while the material difficulty aspect obtained the lowest mean score of 65.97. These findings indicate that the intrinsic cognitive load of class X E students in learning Arabic on the al-mihnah material was at a medium level.

The level of intrinsic cognitive load, which falls into the medium category, indicates that

students still need to exert cognitive effort to understand the interrelationships among the elements of the material; however, these demands remain within their cognitive capacity. In this study, the level of intrinsic cognitive load was measured through students' performance on the worksheets (LKS), in which their ability to complete the tasks reflected the extent to which the complexity of the material could be processed. This finding is consistent with Cognitive Load Theory, which states that cognitive load can be measured through task performance or test performance, as learning performance is related to the use of learners' working memory capacity. According to Sweller, intrinsic cognitive load is a type of cognitive load that naturally arises from the characteristics of the learning material itself and is determined by the level of complexity and the interrelatedness of the elements that must be processed simultaneously in working memory.[6] Thus, the medium category found in this study indicates that although the material contains relatively complex interrelated elements, students were still able to process and integrate the information effectively, enabling the comprehension process to take place successfully in completing the worksheet tasks.

This is reflected in the prior knowledge factor, which obtained the highest mean score of 82.63. This finding indicates that students possessed relatively good prior knowledge of the learning material, particularly in vocabulary mastery, understanding of meanings, and their functional use. Prior knowledge stored in long-term memory enabled students to complete the worksheet tasks with answers that were mostly correct and consistent with the answer key. This condition was evident in worksheet activities involving vocabulary recognition, meaning interpretation, and meaning identification through audio and images, which helped students relate new information to their existing knowledge more easily. This finding is consistent with Latifah who stated that information stored in long-term memory is more easily retrieved.[22] In addition, Sweller explained that intrinsic cognitive load is influenced by learners' abilities and prior knowledge, causing the complexity of the material to be perceived differently by each student.[23] The better the students' prior knowledge, the easier it is for them to process and integrate new information into their existing knowledge structures.

In the material difficulty aspect, the lowest mean score of 65.97 was obtained, indicating that this aspect was the most challenging compared to the other aspects of intrinsic cognitive load. This difficulty arose from the multiple language skills involved in the worksheets, such as speaking, writing, and reading through text translation activities, requiring students to integrate various language elements simultaneously, including sentence structures, vocabulary, grammatical rules, and conceptual understanding. In addition, students were required to analyze meanings, apply nahw and sharf rules, and develop coherent ideas in speaking and writing activities. During this process, students had to process various language elements simultaneously at a higher level of complexity. This condition increased the burden on working memory because multiple components had to be processed concurrently. These findings indicate that students experienced greater difficulty due to the complexity and interrelatedness of the material elements. This result is consistent with Banner's view that complex tasks can increase students' cognitive load.[24] Furthermore, Afidah also emphasized that material complexity is the main factor contributing to the emergence of intrinsic cognitive load, as it is closely related to information processing in working memory and the construction of cognitive schemata.[25] Therefore, intrinsic cognitive load is strongly influenced by the level of material complexity and the interrelationships among the elements that must be processed simultaneously.

In the aspect of element interactivity, a mean score of 69.25 was obtained, which falls into the medium category, indicating that the interrelationships among the elements in the worksheets were moderately complex but not excessively high. Therefore, students needed to process and integrate several pieces of information simultaneously in their working memory; however, this level of complexity remained within their cognitive capacity and did not significantly hinder their

understanding of the material. This condition was reflected in worksheet activities integrating listening and reading skills, requiring students to listen to audio, read texts, understand vocabulary and sentence structures, and answer questions simultaneously. Consequently, students had to process multiple pieces of information at the same time in their working memory, resulting in greater cognitive effort.

In Cognitive Load Theory, element interactivity refers to the degree of interrelatedness among pieces of information that must be processed simultaneously in working memory in order to achieve meaningful understanding.[26] The higher the element interactivity, the greater the cognitive demands required. Chen, Paas, and Sweller explained that this is determined by the structure of information and the knowledge stored in long-term memory.[27] Lin and Lin stated that intrinsic cognitive load arises from interrelated elements that must be processed simultaneously,[28] while Kalyuga emphasized that it is determined by the interaction among essential informational elements in understanding the material.[29]

These findings are consistent with Sari, who found an average intrinsic cognitive load score of 81.25 in environmental pollution material using the Prezi application, indicating that students were able to understand the material and complete the learning tasks effectively.[11] Similar findings were also reported by Nasution and Fadilah, who obtained an average intrinsic cognitive load score of 66.09 in cell biology material, suggesting that students possessed adequate ability to comprehend the material and complete the assigned tasks.[30] These findings are consistent with the present study, in which Class X E students at Madrasah Aliyah Negeri Sumenep achieved worksheet scores indicating good ability in understanding the al-miḥnah material and completing the assigned tasks. The similarity of these findings suggests that, despite differences in subject matter, the complexity of the material remained within the students' cognitive processing capacity, enabling them to process information and complete learning tasks effectively. This interpretation is further supported by Amin, who stated that vocabulary mastery, Arabic grammatical structures (naḥw–ṣarf), and reading habits are complementary components in developing Arabic language comprehension.[31] This indicates that understanding al-miḥnah material requires the simultaneous integration of various linguistic elements. Therefore, students' ability to master these elements likely contributed to their success in completing the learning tasks.

B. Level of Extraneous Cognitive Load

The instrument used to measure the level of extraneous cognitive load in this study was a student perception questionnaire. This questionnaire aimed to identify the level of mental effort exerted by students during the learning process, particularly the effort influenced by external factors. This mental effort reflects the additional cognitive burden caused by ineffective presentation of the material, unclear instructions, or the use of learning media that do not adequately support the learning process.

The following presents the data on the results of students' extraneous cognitive load levels:

Table 5. Data on the results of students' extraneous cognitive load levels

No	Aspects of Extraneous Cognitive Load	Mean Score
1.	Instructions	57.95
2.	Worked example	57.22
3.	Split attention	60.41
4.	Modality	59.48
5.	Redundancy	63.88
	Overall average of extraneous cognitive load	**59.79**
	Category	**Medium**

Based on the data from the student perception questionnaire regarding extraneous cognitive load related to instructional design, the mean score obtained was 59.79, which falls into the medium category. Among its aspects, the redundancy effect had the highest mean score of 63.88, followed by split attention at 60.41 and modality at 59.48, all of which were categorized as moderate. Meanwhile, instructional guidance and worked example obtained the lowest mean scores, namely 57.98 and 57.22, respectively. Thus, it can be concluded that the extraneous cognitive load experienced by class X E students in learning the al-mihnah material was in the medium category, indicating that there were still elements of instructional design that contributed additional cognitive load, although not at a high level.

The medium level of extraneous cognitive load indicates the presence of unnecessary cognitive burden resulting from instructional design, although it has not reached a high level. This is reflected in the redundancy aspect, which obtained the highest mean score of 63.88, indicating that unnecessary repetition of information can hinder understanding and increase the load on working memory with irrelevant information, thereby increasing extraneous cognitive load. Sweller, in Cognitive Load Theory, explained that excessive or repetitive presentation of information increases extraneous cognitive load and reduces learning efficiency.[5] Therefore, presenting the same information in multiple forms should be avoided if it does not provide additional instructional value, as reducing redundancy can help direct working memory resources toward processing essential information and promoting deeper understanding.

In the aspect of instructional strategies, worked example obtained the lowest mean score of 57.22, followed by instructional clarity at 57.98, indicating that the use of examples and instructions by the teacher in teaching the al-mihnah material was relatively effective, although it could still be further optimized. Cognitive Load Theory explains that worked examples reduce extraneous cognitive load by presenting problem-solving steps systematically, thereby facilitating understanding and the construction of cognitive schemata. Renkl demonstrated that learning through worked examples is more effective than direct problem solving.[32] Sweller also argued that this approach reduces working memory load compared to discovery learning,[5] while Habes emphasized the importance of instructional strategies in improving students' understanding. Regarding instructional clarity, Leppink explained that clear instructions help reduce extraneous cognitive load because unclear instructions increase students' mental effort. Conversely, clear and well-structured instructions facilitate comprehension.[13] Zheng further stated that good teacher clarity enhances students' understanding, motivation, and engagement in the learning process.[33]

In terms of material presentation, the split attention aspect obtained a mean score of 60.41, while the modality effect obtained a mean score of 59.48, both falling into the medium category. This indicates the presence of extraneous cognitive load resulting from the way the material and instructions were presented, although not at a high level. This reflects that the lack of optimal integration in information presentation and the less effective use of instructional media still affected students' concentration and understanding. Sweller, in Cognitive Load Theory, explained the principle of the modality effect, which suggests that presenting information through the integration of multiple modalities, such as visual and verbal modes, can increase the effectiveness of information processing and reduce unnecessary cognitive load, as comprehension becomes more efficient through parallel processing.[5] Conversely, poorly integrated information presentation can lead to the split attention effect, in which students are required to divide their attention across multiple sources of information, thereby increasing mental effort, overloading working memory, and raising extraneous cognitive load.[34] This finding is consistent with Sari's view that instructional media support learning by simplifying information presentation and enhancing interaction and attention between teachers and students.[35]

These findings are consistent with Nasution and Fadhilah, who found an average extraneous

cognitive load score of 77.91 on cell biology material and categorized it as medium. [30] Similar findings were also reported by Sari, who obtained an average extraneous cognitive load score of 65.2 in environmental pollution material using the Prezi application.[11] The similarity of these findings indicates that, across various learning contexts, extraneous cognitive load tends to remain within the moderate category when instructional design still contains elements that do not fully support the comprehension process, such as unsystematic material presentation, unclear instructions, or the use of instructional media that does not entirely facilitate students' information processing. Therefore, the moderate level of extraneous cognitive load identified in this study suggests that the learning process has generally supported students' learning; however, several aspects of material presentation and instructional guidance still require optimization in order to reduce unnecessary cognitive load and enable students to utilize their working memory capacity more effectively.

C. Level of Germane Cognitive Load

The instrument used to measure germane cognitive load in this study was a student perception questionnaire. This instrument focused on how students utilized their cognitive effort to understand the material, construct cognitive schemata, and integrate new information with prior knowledge. Therefore, the questionnaire items were designed to capture constructive cognitive activities, such as connecting concepts, recognizing patterns, and deepening understanding of the learning material. Accordingly, this questionnaire was expected to comprehensively measure the constructive mental effort exerted by students.

The following presents the data on the results of students' germane cognitive load levels:

Table 6. Data on the results of students' germane cognitive load levels

No	Aspects of Germane Cognitive Load	Mean Score
1.	Cognitive structure	74.13
2.	Deep processing	74.13
3.	Elaboration	69.27
4.	Reflection	70.55
5.	Information strategies	67.58
	Overall average of germane cognitive load	**71.13**
	Category	**Medium**

Based on the data from the student perception questionnaire regarding germane cognitive load, the average germane cognitive load score was 71.13, which falls into the medium category. Among the aspects of germane cognitive load, the aspects of cognitive structure (schema acquisition) and deep processing obtained the highest mean score of 74.13. Furthermore, the reflection aspect obtained a mean score of 70.55, while the elaboration aspect obtained a mean score of 69.27, both of which were categorized as moderate. Meanwhile, the information strategies aspect obtained the lowest mean score of 67.58. Therefore, it can be concluded that the level of germane cognitive load among class X E students in learning Arabic on the al-mihnah material was in the medium category.

The medium level of germane cognitive load indicates that students' mental effort in constructing understanding had begun to develop, although it had not yet reached an optimal level. This is reflected in the cognitive structure (schema acquisition) and deep processing aspects, which obtained the highest mean score of 74.13, indicating that students engaged in active cognitive processes such as self-explanation and deep processing, which are considered essential elements in Germane Cognitive Load Theory for constructing cognitive schemata that support learning.[14] In other words, some students had already been involved in efforts to understand and process information meaningfully. Germane cognitive load is understood as the type of cognitive load that

arises from conscious engagement in cognitive processes that support learning. These processes include the ability to ask relevant questions, provide self-explanations of the material, monitor understanding and performance metacognitively, and follow up on the results of such monitoring through appropriate learning activities.[36]

However, the information strategies aspect obtained the lowest mean score of 67.58, indicating that students' ability to organize and integrate information systematically was still limited. Schnotz and Galy argued that information organization is an essential process in constructing cognitive schemata because it helps connect elements of knowledge into meaningful units. The relatively low score in this aspect indicates that the process of schema construction had not yet reached an optimal level. As explained by Schnotz, Kurschner, and Galy, germane cognitive load is not directly related to task performance, but rather to other cognitive processes such as the conscious use of learning strategies.[37], [38] These processes are influenced by the availability of cognitive resources and the learners' level of motivation. If germane cognitive load is associated with motivation-driven processes, it can be assumed that students' motivational levels were relatively similar across different learning conditions. Therefore, the less prominent differences in this aspect may indicate that students' engagement in organizing information was still relatively low, causing the information strategies aspect to fall into a lower category.

In the reflection aspect, a mean score of 70.55 was obtained, while the elaboration aspect obtained a mean score of 69.27, both of which fell into the medium category. This condition indicates that students were not yet fully accustomed to using deep learning strategies, such as developing examples, restating the material in their own words, and evaluating their level of understanding. Galy and Klepsch emphasized that elaboration and reflection are active strategies that support the construction of cognitive schemata, and weaknesses in these aspects may limit deeper understanding. These findings are also consistent with Paas's view that germane cognitive load is constructive in nature and should be enhanced through instructional strategies that encourage active cognitive engagement, such as self-explanation, elaboration, and retrieval practice.[39] One example is the elaborative interrogation strategy, which helps students build connections among concepts and thereby strengthens long-term information retention. Germane cognitive load is understood as the cognitive load that arises from conscious engagement in cognitive processes that support learning, such as asking questions, providing self-explanations, and monitoring as well as evaluating understanding.[37] Therefore, it appears that students' engagement in deep thinking processes was not yet fully balanced, as certain aspects such as understanding and analysis had developed, while aspects of organization, elaboration, and reflection still required further enhancement.

These findings are consistent with Nasution and Fadilah, who found that the average germane cognitive load score was 68.52, which fell into the moderate category, indicating that students had begun to construct cognitive schemata, although the process had not yet reached an optimal level.[30] Similarly, Sari reported an average germane cognitive load score of 63, suggesting that students' mental effort in organizing and integrating knowledge was still below the expected level of mastery.[11] A similar pattern was observed in the present study, where students demonstrated mental effort to understand concepts, analyze sentence structures, and connect new information with their prior knowledge during the learning of al-miḥnah. However, these cognitive activities had not been fully reflected in information organization, elaboration, and reflection, indicating that schema construction was still developing. The similarity of these findings suggests that, although students had begun to allocate cognitive resources for meaningful learning, the learning activities had not yet fully facilitated deeper cognitive processing. Therefore, greater opportunities for students to engage in comprehension, analysis, information organization, elaboration, and reflection are needed to strengthen germane cognitive load, promote more effective schema construction, thereby leading to more profound understanding.

CONCLUSION AND IMPLICATIONS

This study aimed to describe the levels of intrinsic cognitive load (ICL), extraneous cognitive load (ECL), and germane cognitive load (GCL) among Class X E students at Madrasah Aliyah Negeri Sumenep in Arabic language learning on the al-miḥnah material. The findings revealed that all three components of cognitive load were within the moderate category. These findings indicate that students were able to understand material characterized by relatively high linguistic complexity in accordance with the capacity of their working memory. However, the learning process still demonstrated the presence of cognitive load originating from instructional design, while students' mental effort in constructing and developing Arabic language knowledge schemas also requires further enhancement to achieve more optimal learning outcomes.

These findings imply that Arabic language teachers need to design instruction in accordance with the principles of Cognitive Load Theory through the gradual and systematic presentation of learning materials, the appropriate use of instructional media, clear instructional guidance, and the provision of activities that encourage elaboration, information organization, and reflection in order to strengthen students' schema construction processes. This study has several limitations, as it involved only one class in a single madrasah and focused exclusively on al-miḥnah material; therefore, the findings cannot yet be generalized to broader contexts of Arabic language learning. Accordingly, future studies are recommended to involve larger samples, examine different Arabic language materials, develop and validate Cognitive Load Theory instruments that are more specific to Arabic language learning, and conduct experimental studies focusing on efforts to reduce extraneous cognitive load and enhance germane cognitive load through more effective instructional strategies.

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