
Instructional Design of E-Modules and E-Courses for AI Literacy: Enhancing Conceptual, Critical, and Ethical Understanding

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Abstract

The rapid development of artificial intelligence (AI) in higher education has created an urgent need to strengthen students' AI literacy, particularly in understanding foundational concepts, critically evaluating AI outputs, and applying ethical considerations. This study aims to analyze students' AI literacy skills and to develop e-modules and e-courses designed to enhance their conceptual, critical, and practical competencies. A design-based research approach was employed, involving needs analysis through interviews, instructional design development, expert validation, and implementation testing with student users. Data were collected through qualitative interviews, expert review sheets, and user response questionnaires, and were analyzed using systematic reduction, interpretation, and triangulation techniques. The findings reveal that students predominantly possess functional rather than conceptual or ethical AI literacy. They frequently rely on AI tools without adequate prompt construction, verification strategies, or awareness of potential algorithmic bias. The developed e-module and e-course received high validation scores, demonstrating strong content quality, effective structure, and high levels of interactivity, particularly in the video-based e-course. User responses further indicate that digital learning materials significantly improved students' understanding of AI fundamentals and responsible use. This study emphasizes the importance of higher education institutions incorporating AI literacy into their curricula through structured digital learning resources and explicit ethical guidelines for AI-assisted academic work. Limitations include the small interview sample, restricted institutional context, and absence of longitudinal effectiveness testing. Future research should involve larger participant groups and long-term evaluation to strengthen the generalizability and sustainability of the model.

Keywords: *Development Research, E-course, E-module, Literacy AI, Students*

A. Introduction

The phenomenon of artificial intelligence (AI) has grown rapidly and is being increasingly applied in various aspects of life, including the academic world. AI literacy skills are becoming increasingly important for students, as the academic world and industry are now relying more heavily on this technology (Ali & Rani, 2024). The challenge faced by students in improving their AI literacy is the lack of easily accessible learning resources that are appropriate for their level of understanding. Much of the available AI material remains technical and challenging for students to comprehend. The gap between needs and technological skills can disrupt the learning process (Ulum & Arifin, 2024).

Students use ChatGPT as an academic tool without a thorough understanding of how artificial intelligence (AI) works, including how the model is trained, the data sources used, and

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the potential biases it may contain. The limitations of AI, such as a lack of deep contextual understanding and a tendency to produce information that is not always accurate, are often overlooked by users who lack adequate digital literacy (Bender et al., 2021). This ignorance can lead to over-reliance, where students tend to accept AI answers without critical thinking or further verification of the information provided (Weidinger et al., 2022). Furthermore, the use of AI without proper understanding can contribute to the spread of misinformation, which risks creating misunderstandings in academia and society at large (Onayinka et al., 2024). Mahmudah (2024) successfully educated teachers on recognizing the working principles of AI.

In the use of artificial intelligence such as ChatGPT, many users create prompts that are too broad or ambiguous, causing the system to generate answers that are general, lacking in depth, and not always suited to the specific needs of users (Liu et al., 2023). Unfocused prompts make it difficult for ChatGPT to tailor its responses to the desired context, resulting in information that is less relevant or too general (Brown et al., 2020). Users are advised to create more detailed and specific prompts, including relevant keywords and clear boundaries, so that the system can generate more accurate and in-depth responses (Zhang et al., 2022). Additionally, strategies such as prompt iteration, which involves asking follow-up questions based on previous responses, can enhance the quality of the information obtained (Liu et al., 2023). By understanding how to construct effective prompts, users can maximize the benefits of AI in various fields, including education, research, and data analysis (Mujica-Sequera, 2025). Literacy skills are crucial in the digital age and should be taught in both academic and professional contexts (Wei et al., 2022).

Based on observations, students who use ChatGPT often unconsciously compose prompts with words that steer the answers toward a certain perspective, either in the form of implicit assumptions or suggestive questions. Users should use neutral and open language when composing prompts so that the model can generate more balanced and diverse answers with multiple perspectives (Onayinka et al., 2024). One strategy that can be employed is to ask exploratory questions and include requests to compare different perspectives, thereby minimizing bias in the results provided (Gabriel et al., 2020). Understanding how to design effective prompts not only enhances the quality of the answers obtained but also fosters critical thinking in the application of AI technology in academic and professional contexts (Weidinger et al., 2022).

According to Tanberga & Daniela (2022), there are six key components of AI literacy for educators: understanding the basics of AI, critically evaluating AI technology, considering ethical issues, practical use of AI tools, awareness of social implications, and effective communication about AI. Laupichler (2023) defines AI literacy as a set of competencies that enable individuals to critically evaluate AI technology and communicate and collaborate effectively with AI. There are three factors measured: technical understanding, critical assessment, and practical application. Wang (2022) defines AI literacy as the ability to recognize and understand AI technology in practical applications. AI literacy refers to the awareness of understanding what AI is and its implications.

Based on interviews with one of the students, it was found that students often write only one word or phrase without providing context. ChatGPT cannot accurately understand what the user actually wants, resulting in answers that are too broad and less specific. The use of ChatGPT often results in the system writing only one word or phrase without providing adequate context, making it difficult for the system to understand the true meaning of the question (Liu et al., 2023). This results in answers that are too broad, unspecific, and sometimes irrelevant to the user's needs (Zhang et al., 2022). Therefore, it is important for users to include additional details in the prompt, such as explaining the background of the question, mentioning specific topics, or providing relevant examples (Wei et al., 2022). By adding clearer context, the model can better

understand the user's intent and generate more accurate, focused, and valuable answers (Liu et al., 2023). Understanding this strategy not only improves the effectiveness of communication with AI but also helps users optimize the use of artificial intelligence in various fields, including education and research.

One observation of students' use of ChatGPT reveals that they often accept the first answer provided by ChatGPT without attempting to refine or optimize the prompt. The answer obtained may not be optimal and could be better if the prompt were improved. ChatGPT users often accept the first answer provided without adjusting or optimizing the prompt, even though the response quality can be improved by iterating the question (Wei et al., 2022). The answers obtained from AI can be unspecific, irrelevant, or too general, especially if the initial prompt is ambiguous or lacks detail (Liu et al., 2023). It is recommended that users add context, use clearer language, or modify the question structure so that the AI can provide more relevant answers to their needs.

Haris (2024) has explored the AI skills of students who are capable of changing academic ethics and norms. Suwahyu, Waratman, and Pratama (2024) found that differences in knowledge about AI lead to varying views and approaches to AI use, while the assessment and understanding of AI ethics still require further attention. AI-based teaching modules have been successfully developed to train user competencies (Mahmudah, Nisa, & Masruroh, 2024; Dai & Ramadhan, 2024).

Many users do not utilize the iteration and discussion features of ChatGPT, resulting in them receiving only one answer without exploring further options. The answer may be too general, even though ChatGPT can provide more details if asked again. Use follow-up questions. Many ChatGPT users who only receive one answer without utilizing the iteration and discussion features also improve the AI's skills, thereby not missing the opportunity to obtain more specific and in-depth information (Wei et al., 2022). By asking follow-up questions or requesting clarification, users can obtain more relevant details according to their needs (Shin et al., 2021).

The development of e-modules and e-courses is designed to provide systematic, interactive, and contextual learning access that bridges the gap in students' understanding of basic concepts and the application of AI literacy. These e-modules and e-courses also enable personalized learning that encourages the improvement of AI literacy skills independently, sustainably, and relevant to the needs of the 21st century.

Ghani (2024) emphasizes the need for the education system to adapt and incorporate AI literacy as a crucial component of education. AI literacy is a rapidly growing field, and further research is needed to develop effective and targeted teaching strategies for integrating AI literacy into education. Understanding AI literacy in the context of education provides a basis for developing effective strategies to prepare teachers for the growing development of AI in education.

B. Methods

Research Design

This study employed a design-based research (DBR) approach, utilizing the ADDIE instructional design framework, which comprises five iterative stages: Analysis, Design, Development, Implementation, and Evaluation. DBR was selected because it emphasizes the systematic development and refinement of educational interventions in real learning contexts while generating practical and theoretical insights (Reeves, 2006). The ADDIE model was chosen due to its structured yet flexible nature, enabling formative evaluation at each stage of development (Branch, 2009). Through this approach, e-modules and e-courses were developed

to enhance students' artificial intelligence (AI) literacy competencies, ensuring both instructional effectiveness and contextual relevance.

Research Procedures

The research process began with the Analysis stage, which aimed to identify students' AI literacy needs and learning gaps through a needs assessment and semi-structured interviews. The analysis revealed that students' understanding of AI was primarily limited to operational and functional aspects, with insufficient attention to evaluative skills and ethical considerations. These findings informed the Design stage, during which instructional flowcharts, storyboards, and content structures were developed. The design process emphasized alignment between learning objectives, content sequencing, and media characteristics, while adhering to principles of low cognitive load and instructional coherence (Molenda, 2003; Sweller et al., 2019). During the Development stage, the instructional designs were realized as a text-based e-module and a video-based e-course incorporating infographics, contextual examples, and interactive elements. Prior to implementation, expert validation was conducted to ensure the accuracy of content and its pedagogical suitability. The Implementation stage involved pilot testing with students, followed by a formative Evaluation stage aimed at continuous improvement of the instructional products.

Data Collection Techniques

Multiple data collection techniques were employed to ensure methodological rigor and data triangulation. Semi-structured interviews were used during the Analysis stage to explore students' perceptions, prior knowledge, and learning needs related to AI literacy. Expert validation was conducted during the Development stage, involving three experts in instructional design and educational technology who evaluated the products in terms of content accuracy, media quality, and pedagogical appropriateness, consistent with ADDIE development principles (Branch, 2009). During the Implementation stage, data were collected through a structured questionnaire administered to students to assess the quality of instructional content, visual presentation, and interactivity of the e-modules and e-courses.

Data Analysis Techniques

Data analysis employed both qualitative and quantitative descriptive techniques. Qualitative data from interviews were analyzed through data reduction, thematic coding, and interpretation to identify key patterns in students' AI literacy needs (Miles et al., 2014). Quantitative data obtained from expert validation and student questionnaires were analyzed by calculating mean scores to determine the feasibility and quality levels of the developed instructional products. In addition, qualitative feedback from experts and users was analyzed thematically to guide product revisions. The formative evaluation results led to several improvements, including the integration of quizzes, active hyperlinks, and enhanced visual consistency, thereby strengthening the effectiveness of the e-modules and e-courses in supporting students' AI literacy development.

C. Results and Discussion

Analysis

The analysis stage aims to determine the respondents' skill levels and identify areas for improvement through the development of e-modules and e-courses. This stage involved interviewing several respondents about their AI literacy skills. The questions and answers from the interviews are as follows.

Question: What do you know about artificial intelligence (AI) and how it functions?

Respondent's answer:

“In my opinion, AI is like an artificial brain. It learns from data and can then make decisions. It's like when I tried a machine learning model. The more data I gave it, the better the predictions were. So, AI basically learns from experience, only in a digital version”.

Question: How do you adapt the use of AI to suit specific needs or contexts?

Respondent's answer:

“I usually use it as needed. For example, I use an AI assistant for coding, but I use different tools for designing presentations. So, it cannot be generalized; you have to look at the context”.

Question: How do you assess the accuracy or quality of the results provided by an AI system?

Respondent Answer:

“My way of checking accuracy is simple: compare it with other references. If the answers are consistent, then it's worth using. But honestly, AI often gives random answers, so we still need to filter it ourselves”.

Question: What do you know about ethical issues in the use of AI?

Respondent 1's answer:

“When it comes to ethics, what concerns me the most is plagiarism. Many of my friends just copy and paste AI results for their assignments. In my opinion, universities really need to provide clear guidelines so that we don't make mistakes”.

Respondents had varying levels of understanding of the basic concepts of AI. Respondents demonstrated a relatively technical understanding, mentioning that AI “*learns from data*” and “*makes predictions,*” which indicates insight into the mechanisms of machine learning.

In answering the second question regarding the adaptation of AI use, all respondents demonstrated the ability to adapt AI to the context of their specific tasks or needs. Respondents mentioned the use of AI in the context of productivity and design. Questions about ethical issues demonstrated considerable reflection on the part of the respondents, raising concerns about plagiarism as a potential consequence of using AI in academic tasks.

The respondents' experiences show that artificial intelligence (AI) has been significantly integrated into their daily lives, whether in academic contexts, creative work, or practical activities. AI is used adaptively for various needs, from summarizing articles and designing presentations to translating languages. However, most respondents understand AI functionally rather than conceptually, with limited technical understanding. This indicates that the benefits of AI are felt in a tangible way, but are not yet accompanied by a deep understanding of its underlying technology.

In assessing AI results, respondents employ contextual and subjective approaches, such as comparing them with other sources, evaluating their suitability for the material, or verifying them based on personal experience. This approach demonstrates evaluative efforts, but is not yet grounded in structured standards or scientific methodology. As a result, there is the potential for uncritical or even misleading use of AI if users are not equipped with adequate information literacy skills.

Awareness of ethical issues in the use of AI is growing among users, as evidenced by concerns about plagiarism, copyright infringement, algorithmic bias, and the misuse of technology, such as deepfakes. However, this awareness remains individual in nature and has not been accompanied by systematic ethical policies or guidelines from educational institutions or other authorities. Therefore, there needs to be an institutional effort to develop guidelines for the responsible use of AI and to strengthen digital literacy that comprehensively covers technical, critical, and ethical aspects.

Design

In this development study, several e-module and e-course frameworks and structures have been designed, as shown in the figure below.

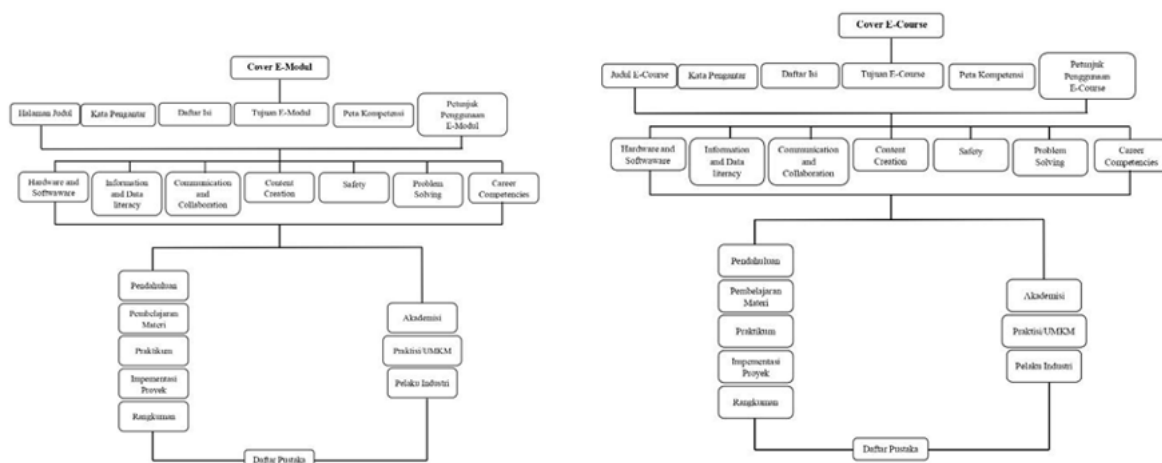


Figure 1. Storyboard of e-module and e-course

The storyboard design displays two content structure charts: one for the E-Module (on the left) and one for the E-Course (on the right). These two structures share similarities in their main components, but differ in their emphasis within the context of use. Each begins with introductory elements, including the Cover, Title Page, Foreword, Table of Contents, E-Module/E-Course Objectives, Competency Map, and Instructions for Use. Next, the core material content is grouped into seven digital competency domains, namely: Hardware and Software, Information and Data Literacy, Communication and Collaboration, Content Creation, Safety, Problem Solving, and Career Competencies.

In the previous version, the learning section in both models (E-Module and E-Course) was divided into five components: Introduction, Material Learning, Practicum, Project Implementation, and Summary. In the revised version, this structure has been simplified. E-Modules utilize three main elements: Unit Learning Objectives, Unit Material Points, and Material Learning. In contrast, E-Course Videos have been simplified into Introduction, E-Course Material Learning, and Practicum/Summary.

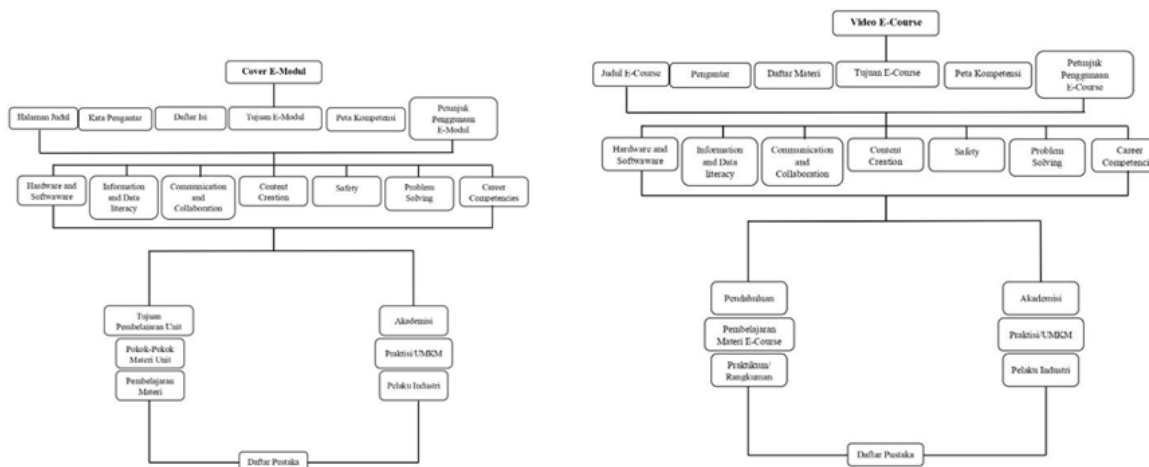


Figure 2. Revision Storyboard of e-module and e-course

This revision streamlines the learning flow to make it more focused and reduces the user's burden by eliminating unnecessary segments. This approach reflects the principle of streamlined instructional design, which is to reduce complexity without losing the essence of the content. This is very important in the context of digital learning, which demands clear navigation and practicality.

The initial version distinguished between E-Modules and E-Courses, while the revised version specifically refers to Video E-Courses. The content structure also began to adapt to the characteristics of the media used: E-Modules are more textual and systematic, while Video E-Courses are more narrative and visual.

The addition of the word 'Video' to 'E-Course' is an important step because it emphasizes that the content is intended for audiovisual media, not just digital text-based media. This demonstrates the adaptation of media-based learning design, in which content is not only converted but also tailored to the delivery format. This is crucial to ensure that learning remains effective, even though the media format differs.



In the revised E-Module, there are additional section titles: Unit Learning Objectives and Unit Material Points, which were not previously explicitly stated. In the Video E-Course, terms such as “E-Course Title,” “Introduction,” and “List of Materials” are used more consistently at the top.

Development

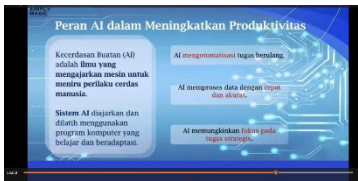
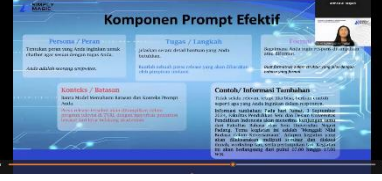




Based on the previous development steps that have been carried out, the next step is to test the e-module and e-course products with several validators. The results of the validators' assessment of product development are presented in the table below.

Table 1. Product Validator Results

Screenshot before evaluation	Validator 1	Screenshot Revision
<p>• Menyediakan Data atau Bahan Pendukung. Gamma dapat menyusun presentasi yang lebih informatif jika diberikan referensi tambahan. Misalnya, pengguna dapat memasukkan ringkasan penelitian, data statistik, atau draft laporan sebelum meminta Gamma mengolahnya. Dengan demikian, hasil yang diperoleh tidak hanya estetik secara visual tetapi juga kuat secara substansi.</p> <p>• Melakukan Iterasi Secara Bertahap. Interaksi dengan Gamma bersifat iteratif. Pengguna dapat memulai dari draft awal, kemudian melakukan revisi atau mempersempit fokus berdasarkan output yang dihasilkan. Contohnya, setelah mendapatkan rancangan presentasi umum, pengguna bisa menambahkan instruksi lanjutan seperti "buatkan versi ringkas untuk audiens eksekutif" atau "tambahkan visualisasi data berbentuk grafik batang".</p> <p>• Menggunakan Gamma untuk Kolaborasi. Gamma AI mendukung kolaborasi tim secara real time. Dengan membagikan rancangan presentasi kepada anggota tim, setiap orang dapat menambahkan masukan langsung tanpa harus mengulang proses desain dari awal. Hal ini mempercepat sinkronisasi ide dan meningkatkan kualitas hasil akhir.</p> <p>• Memadukan dengan Sumber Eksternal. Sebagaimana platform AI lainnya, Gamma tidak boleh dijadikan satu-satunya rujukan. Validasi informasi melalui jurnal ilmiah, laporan resmi, atau data primer tetap diperlukan agar konten presentasi memiliki landasan yang kredibel. Gamma berfungsi sebagai pengolah visual dan fasilitator komunikasi, sementara keakuratan data tetap menjadi tanggung jawab pengguna.</p> <p>• Mengoptimalkan untuk Berbagai Konteks. Gamma dapat diadaptasi dalam konteks akademik, profesional, maupun personal. Pada ranah akademik, Gamma membantu mahasiswa menyusun presentasi penelitian yang ringkas namun jelas. Dalam dunia kerja, ia mempercepat perancangan pitch deck atau laporan strategis. Sedangkan dalam kehidupan personal, Gamma bisa digunakan untuk membuat portofolio atau proposal kegiatan komunitas.</p> <p style="text-align: center;">28</p>	<p>Technology-based interactive features, more contextual presentation of case studies</p>	<p>tren usaha dengan bantuan AI. Setiap praktik mandiri yang dilakukan sebaiknya segera diuji dalam konteks bisnis nyata, sehingga hasil belajar dapat langsung memberikan dampak terhadap efektivitas dan pengembangan usaha.</p> <p>3. Bagi Industri (Profesional dan Karyawan), modul ini memberikan penekanan utama pada Unit 5, Unit 6, dan Unit 7 yang berkaitan dengan keselamatan digital, pemecahan masalah, dan kompetensi karier. Arahan implisit dari penjelasan materi perlu diterapkan dalam bentuk simulasi kerja atau proyek kecil yang relevan dengan lingkungan kerja masing-masing. Melalui praktik tersebut, pembaca akan memperoleh pengalaman yang dapat dijadikan dasar untuk meningkatkan efisiensi, menjaga keamanan sistem, serta mendorong inovasi di dalam organisasi atau perusahaan.</p> <p>Prinsip Umum Penggunaan Modul menegaskan bahwa pembelajaran bersifat mandiri berbasis praktik. Oleh karena itu, praktik langsung dengan tools AI menjadi metode utama dalam memahami isi modul. Proses belajar juga bersifat eksploratif dan reflektif, di mana pembaca diharapkan mencoba berbagai pendekatan, kemudian merefleksikan hasilnya. Selain itu, pembelajaran harus kontekstual dengan menyesuaikan praktik pada kebutuhan masing-masing, baik dalam lingkup akademik, usaha, maupun industri. Setiap hasil keluaran dari AI juga perlu ditinjau secara kritis, dibandingkan dengan sumber yang kredibel, dan disesuaikan dengan standar etika yang berlaku.</p> <p style="text-align: center;">QUIZ 1 HARDWARE AND SOFTWARE LITERACY</p> <p style="text-align: center;">AKSES QUIZ DISINI!!!</p> 
Screenshot before evaluation	Validator 2	Screenshot Revision
<p>Unit 1 – Hardware & Software Literacy</p> <p>Tujuan Pembelajaran</p> <p>Setelah mempelajari bab ini, peserta diharapkan mampu:</p> <ol style="list-style-type: none"> Memahami perangkat keras (hardware) dan perangkat lunak (software) dalam mendukung pemanfaatan prompt AI. Mengidentifikasi aplikasi AI yang relevan dengan kebutuhan penulisan dan produksi konten. Menerapkan strategi pemanfaatan AI melalui perangkat digital untuk mendukung aktivitas akademik, usaha, dan industri. <p>Definisi dan Penjelasan Materi</p> <p>Pemanfaatan kecerdasan buatan berbasis prompt tidak hanya ditentukan oleh kemampuan pengguna dalam merumuskan instruksi, tetapi juga sangat bergantung pada kesiapan infrastruktur teknis yang mendukung proses interaksi manusia dan mesin. Kebutuhan teknis ini dapat dipahami sebagai syarat dasar yang meliputi kapasitas komputasi, stabilitas koneksi, serta perangkat lunak yang mampu mengakomodasi kompleksitas permintaan pengguna. Model bahasa besar (large language models/LLM) seperti ChatGPT, Claude, atau Gemini, pada hakikatnya memerlukan sumber daya komputasi yang tinggi, terutama ketika harus mengeksekusi perintah yang panjang, bersifat multi-tahap, atau memproses data dalam jumlah besar. Dengan demikian, kebutuhan teknis dalam konteks ini dapat dipandang sebagai prasyarat fundamental yang memungkinkan terciptanya interaksi yang efisien, akurat, dan produktif antara manusia dengan sistem AI (Arxiv, 2024).</p> <p>Hardware (Perangkat Keras)</p> <p>Kebutuhan pengguna dapat dibedakan menjadi kategori minimal dan optimal. Pada level minimal, komputer pribadi atau laptop standar yang terhubung dengan jaringan internet sebenarnya sudah memadai untuk mengakses layanan AI berbasis cloud, karena sebagian besar proses perhitungan dilakukan di server penyedia. Namun, ketika dibutuhkan kendali yang lebih besar terhadap keamanan data, latensi rendah, atau kapasitas pengolahan lokal, maka perangkat keras optimal menjadi relevan. Perangkat seperti GPU (Graphics Processing Unit), TPU (Tensor Processing Unit), atau FPGA (Field Programmable Gate Array) terbukti memainkan peran signifikan dalam mempercepat proses inferensi sekaligus mengoptimalkan konsumsi energi (MDPI, 2025). Lebih jauh, infrastruktur hibrida yang mengombinasikan komputasi lokal (on-premise)</p> <p style="text-align: center;">5</p>	<p>material based on the Kemdiktisaintek Book</p>	<p>Tajasan Pembelajaran</p> <p>Setelah mempelajari bab ini, peserta diharapkan mampu:</p> <ol style="list-style-type: none"> Membaca jenis perangkat keras yang diperlukan untuk penggunaan AI. Mengidentifikasi perangkat lunak dan platform AI yang relevan untuk akademik, pelaku usaha, dan industri. Menganalisis kelebihan dan keterbatasan perangkat keras maupun lunak dalam mendukung AI. Mengaplikasikan penggunaan tools AI pada perangkat yang berbeda untuk kebutuhan nyata. <p>Materi</p> <p>1. Perangatan Hardware</p> <p>Hardware merupakan komponen fisik dari sistem komputer atau perangkat digital yang menjadi fondasi utama dalam menjalankan instruksi perangkat lunak. Dalam konteks kecerdasan buatan (Artificial Intelligence/AI), perbedaan hardware tidak dapat dipisahkan dari performa sistem, karena perangkat inilah yang menyediakan kapasitas komputasi, ruang penyimpanan, dan konektivitas yang dibutuhkan agar algoritma AI dapat bekerja secara optimal.</p> <p>Karakteristik hardware:</p> <ul style="list-style-type: none"> Skala komputasi: hardware bersifat nyata dan dapat diukur, mencakup perangkat seperti smartphone, laptop, server, hingga unit pemrosesan grafis (GPU). Pada sisiannya tidak hanya sekedar mendukung perangkat lunak, tetapi juga menentukan tingkat efisiensi pemrosesan. Spesifikasi utama seperti jenis prosesor, kapasitas RAM, kapasitas penyimpanan, serta keberadaan akselerator khusus (GPU, TPU, atau FPGA) secara langsung memengaruhi kualitas kinerja model AI. Semakin kompleks model yang dijalankan, semakin tinggi pula tuntutan spesifikasi hardware yang diperlukan. Bersifat fisik (misalnya laptop, smartphone, server, GPU). Membentuk kinerja software (menjalankan instruksi). Spesifikasi teknis memuat performa (CPU, GPU, RAM, penyimpanan). Dapat ditanggulangi (tepatnya) atau diperluas (misalnya cloud server). <p>Peran hardware dalam AI:</p> <p>Dalam mendukung konsep AI, peran hardware dapat dipahami dari beberapa dimensi. Pertama, aksesibilitas, yakni menjalankan perintah yang</p> <p style="text-align: center;">6</p> <hr/> <p>dibutuhkan perangkat lunak AI, mulai dari inferensi sederhana hingga proses deep learning berbasis besar. Ketika pemrosesan data di mana perangkat keras mengambil input berupa teks, gambar, suara, maupun video untuk menghasilkan output yang relevan. Ketika penyimpanan, yang diperlukan untuk menyimpan dataset berukuran besar, model yang sudah dilatih, serta hasil keluaran sistem. Konsep, konektivitas, yang memungkinkan integrasi antarperangkat melalui jaringan internet. Instance of Things (IoT), maupun cloud computing, sehingga AI dapat beroperasi lintas platform dengan efisiensi tinggi.</p> <ol style="list-style-type: none"> Eksesitas -- menjalankan perintah software AI. Perangatan Data -- mengambil input teks, gambar, suara, video. Penyimpanan -- menyimpan dataset, model AI, dan output. Konektivitas -- memungkinkan integrasi antarperangkat (IoT, cloud).

<p>Mengenal Konsep Dasar AI Definisi & Ruang Lingkup AI</p>  <p>Perkembangan teknologi kecerdasan buatan (Artificial Intelligence/AI) telah menjadi salah satu tonggak penting dalam transformasi digital. Sejak diperkenalkan pertama kali pada pertengahan abad ke-20 oleh tokoh seperti John McCarthy yang dianggap sebagai "Bapak AI", konsep AI berkembang dari sekadar mesin yang mampu melakukan perhitungan hingga menjadi sistem pintar yang dapat memahami bahasa, mengenal pola, dan bahkan mengambil keputusan berbasis data. Pada awalnya, AI hanya sebatas eksperimen akademik, namun kini kehadirannya sudah merambah ke berbagai lini kehidupan—mulai dari dunia akademisi, bisnis, hingga industri berskala global.</p> <p>Artificial Intelligence (AI) pada hakikatnya diposisikan sebagai cabang ilmu pengetahuan yang berfokus pada pengembangan sistem yang mampu merepresentasikan kapasitas intelektual manusia, baik dalam dimensi penalaran maupun tindakan. European Commission sebagaimana dikutip dalam Springer (2022) mendefinisikan AI sebagai sistem yang memiliki kemampuan untuk menganalisis lingkungannya, menafsirkan informasi, melakukan pengambilan</p> <p style="text-align: center;">9</p>		<p>Mengenal Konsep Dasar AI Definisi & Ruang Lingkup AI</p>  <p>Perkembangan teknologi kecerdasan buatan (Artificial Intelligence/AI) menandai salah satu fase paling signifikan dalam proses transformasi digital global. Sejak diperkenalkan pada pertengahan abad ke-20 oleh John McCarthy—yang kemudian dikenal sebagai "Bapak AI"—konsep AI berevolusi dari sekadar perangkat komputasi eksperimental menuju sistem otonom yang mampu memahami bahasa alami, mengenali pola kompleks, serta melakukan pengambilan keputusan berbasis data. Pada tahap awal, AI lebih banyak berfungsi sebagai eksperimen akademik dengan ruang lingkup terbatas. Namun dalam perkembangannya, AI berhasil menembus batas disiplin ilmu dan praktik, sehingga kini mengintegrasikan ke berbagai ranah strategis mulai dari akademisi, dunia bisnis, hingga industri berskala global.</p> <p>Secara epistemologis, AI diposisikan sebagai cabang ilmu pengetahuan interdisipliner yang berfokus pada pengembangan sistem dengan kapasitas menukai kecerdasan manusia, baik dalam aspek kognitif seperti penalaran, maupun dalam dimensi praktis berupa tindakan yang adaptif. European Commission dalam</p> <p style="text-align: center;">9</p>
<p>Screenshot before evaluation</p>	<p>Validator 3</p>	<p>Screenshoot Revision</p>
<p>Tujuan Pembelajaran</p> <p>Setelah mempelajari bab ini, peserta diharapkan mampu:</p> <ol style="list-style-type: none"> 1. Memahami jenis perangkat keras yang diperlukan untuk penggunaan AI. 2. Mengetahui perangkat lunak dan platform AI yang relevan untuk akademisi, pelaku usaha, dan industri. 3. Menganalisis kelebihan dan keterbatasan perangkat keras maupun lunak dalam mendukung AI. 4. Mempraktikkan penggunaan tools AI pada perangkat yang berbeda untuk kebutuhan nyata. <p>Materi</p> <p>1. Pengertian Hardware</p> <p>Hardware adalah komponen fisik dari sistem komputer atau perangkat digital yang dapat disentuh dan dilihat, berfungsi untuk menjalankan instruksi perangkat lunak. Dalam konteks AI (Artificial Intelligence), hardware menjadi fondasi infrastruktur yang memungkinkan aplikasi dan algoritma AI berjalan dengan baik.</p> <p>Karakteristik hardware:</p> <ul style="list-style-type: none"> • Berwujud fisik (misalnya laptop, smartphone, server, GPU). • Mendukung kinerja software (menjalankan instruksi). • Spesifikasi teknis menentukan performa (CPU, GPU, RAM, penyimpanan). • Dapat ditingkatkan (upgrade) atau diperluas (misalnya cloud server). <p>Peran hardware dalam AI:</p> <ol style="list-style-type: none"> 1. Eksekusi → menjalankan perintah software AI. 2. Pemrosesan Data → mengolah input (teks, gambar, suara, video). 3. Penyimpanan → menyimpan dataset, model AI, dan output. 4. Konektivitas → memungkinkan integrasi antarperangkat (IoT, cloud). <p>2. Jenis-jenis Perangkat Keras untuk AI</p> <ol style="list-style-type: none"> 1. Smartphone <ul style="list-style-type: none"> o Fungsi: akses cepat ke aplikasi AI berbasis cloud. o Spesifikasi penting: prosesor octa-core, RAM 6-12 GB, baterai besar, internet stabil. <p style="text-align: center;">6</p>	<p>addition of interactive visual elements (infographics), provision of concept maps</p>	<p>Tujuan Pembelajaran</p> <p>Setelah mempelajari bab ini, peserta diharapkan mampu:</p> <ol style="list-style-type: none"> 1. Memahami jenis perangkat keras yang diperlukan untuk penggunaan AI. 2. Mengetahui perangkat lunak dan platform AI yang relevan untuk akademisi, pelaku usaha, dan industri. 3. Menganalisis kelebihan dan keterbatasan perangkat keras maupun lunak dalam mendukung AI. 4. Mempraktikkan penggunaan tools AI pada perangkat yang berbeda untuk kebutuhan nyata. <p style="text-align: center;">Peta Konsep</p> <pre> graph TD A[UNIT 1 HARDWARE AND SOFTWARE AI] --> B[HARDWARE UNTUK AI] A --> C[SOFTWARE UNTUK AI] A --> D[TOOLS-TOOLS AI] </pre> <p>Materi</p> <p>1. Pengertian Hardware</p> <p>Hardware merupakan komponen fisik dari sistem komputer atau perangkat digital yang menjadi fondasi utama dalam menjalankan instruksi perangkat lunak. Dalam konteks kecerdasan buatan (Artificial Intelligence/AI), keberadaan hardware tidak dapat dipisahkan dari performa sistem, karena perangkat inilah yang menyediakan kapasitas komputasi, ruang penyimpanan, dan konektivitas yang dibutuhkan agar algoritma AI dapat bekerja secara optimal.</p> <p>Karakteristik hardware:</p> <p>Secara karakteristik, hardware bersifat nyata dan dapat disentuh, mencakup perangkat seperti smartphone, laptop, server, hingga unit pemrosesan grafis (GPU). Fungsi utamanya tidak hanya sekadar mendukung perangkat lunak, tetapi juga menentukan tingkat efisiensi pemrosesan. Spesifikasi teknis seperti jenis prosesor, kapasitas RAM, kecepatan penyimpanan, serta keberadaan akselerator khusus (GPU, TPU, atau FPGA) secara langsung memengaruhi</p> <p style="text-align: center;">6</p>

<p>disempurnakan, yang memungkinkan model ini tidak hanya memproses teks, tetapi juga memahami dan menghasilkan output yang melibatkan kombinasi teks dan media lain. Model ini dilatih menggunakan metode:</p> <ul style="list-style-type: none"> Pre-training: Gemini dilatih pada dataset yang sangat luas dan beragam, mencakup teks, kode gambar, audio, dan video, yang memungkinkan model ini untuk memahami dan menghubungkan berbagai jenis informasi. Fine-tuning dengan Reinforcement Learning from Human Feedback (RLHF): Model kemudian disempurnakan dengan masukan dari pelatih manusia dan proses otomatis untuk meningkatkan kualitas, keamanan, dan relevansi jawabannya, khususnya dalam tugas-tugas yang membutuhkan penalaran kompleks dan pemahaman multimodal. <p>Mengintegrasikan Gemini AI dalam Kehidupan Sehari-hari</p> <p>Integrasi Gemini ke dalam kehidupan sehari-hari mencerminkan pergeseran paradigma yang lebih maju dalam interaksi manusia dengan teknologi, melampaui kemampuan percakapan teks. Gemini, sebagai model yang secara alami multimodal, memungkinkan AI untuk tidak hanya memahami bahasa, tetapi juga dunia di sekitarnya melalui gambar, audio, dan video. Hal ini membuka peluang baru yang relevan bagi berbagai kelompok masyarakat, dari akademisi, profesional, hingga individu dalam kehidupan personal.</p> <p>Dalam konteks akademik, Gemini dapat menjadi asisten penelitian dan belajar yang sangat canggih. Mahasiswa dapat menggunakannya untuk menganalisis data visual, misalnya dengan mengunggah grafik atau diagram dari buku teks dan meminta Gemini untuk menjelaskan maknanya. Seorang insinyur dapat menunjukkan video simulasi dan meminta Gemini mengidentifikasi potensi kelemahan desain, sementara seorang dokter dapat mengunggah gambar rontgen dan meminta Gemini menganalisis pola tertentu. Kemampuan penalaran multimodal ini menjadikan Gemini alat yang tak hanya membantu, tetapi juga dapat memecahkan masalah yang kompleks.</p> <p>Dalam dunia bisnis dan industri, Gemini memiliki nilai strategis sebagai "konsultan visual dan analitis." Para profesional kreatif dapat menggunakannya untuk menganalisis tren visual dari gambar atau video di media sosial, lalu meminta Gemini menghasilkan ide-ide konten baru yang relevan. Di sektor manufaktur, seorang teknisi dapat menunjukkan video perakitan mesin dan meminta Gemini mengidentifikasi langkah-langkah yang tidak efisien. Di bidang pemasaran, Gemini dapat menganalisis video iklan kompetitor dan memberikan masukan strategis. Integrasi ini mempromosikan bahwa Gemini dapat menjadi mata dan telaga virtual yang membantu bisnis.</p>		<p>disempurnakan, yang memungkinkan model ini tidak hanya memproses teks, tetapi juga memahami dan menghasilkan output yang melibatkan kombinasi teks dan media lain. Model ini dilatih menggunakan metode:</p> <ul style="list-style-type: none"> Pre-training: Gemini dilatih pada dataset yang sangat luas dan beragam, mencakup teks, kode gambar, audio, dan video, yang memungkinkan model ini untuk memahami dan menghubungkan berbagai jenis informasi. Fine-tuning dengan Reinforcement Learning from Human Feedback (RLHF): Model kemudian disempurnakan dengan masukan dari pelatih manusia dan proses otomatis untuk meningkatkan kualitas, keamanan, dan relevansi jawabannya, khususnya dalam tugas-tugas yang membutuhkan penalaran kompleks dan pemahaman multimodal. <p>Mengintegrasikan Gemini AI dalam Kehidupan Sehari-hari</p> <p>Integrasi Gemini ke dalam kehidupan sehari-hari mencerminkan pergeseran paradigma yang lebih maju dalam interaksi manusia dengan teknologi, melampaui kemampuan percakapan teks. Gemini, sebagai model yang secara alami multimodal, memungkinkan AI untuk tidak hanya memahami bahasa, tetapi juga dunia di sekitarnya melalui gambar, audio, dan video. Hal ini membuka peluang baru yang relevan bagi berbagai kelompok masyarakat, dari akademisi, profesional, hingga individu dalam kehidupan personal.</p> <p>Dalam konteks akademik, Gemini dapat menjadi asisten penelitian dan belajar yang sangat canggih. Mahasiswa dapat menggunakannya untuk menganalisis data visual, misalnya dengan mengunggah grafik atau diagram dari buku teks dan meminta Gemini untuk menjelaskan maknanya. Seorang insinyur dapat menunjukkan video simulasi dan meminta Gemini mengidentifikasi potensi kelemahan desain, sementara seorang dokter dapat mengunggah gambar rontgen dan meminta Gemini menganalisis pola tertentu. 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<p>Screenshot before evaluation</p> 	<p>Validator 1</p> <p>Technology-based interactive features, more contextual presentation of case studie</p>	<p>Screenshot Revision</p> 
<p>Screenshot before evaluation</p> 	<p>Validator 2</p> <p>material based on the Kemdiktisaintek Book</p>	<p>Screenshot Revision</p> 
<p>Screenshot before evaluation</p> 	<p>Validator 3</p> <p>addition of interactive visual elements (infographics), provision of concept maps</p>	<p>Screenshot Revision</p> 

Implementation

This stage covers user/respondent responses to the implementation of the developed modules and e-courses. Several aspects were reviewed to evaluate the effectiveness of the AI literacy modules and e-courses.

Table 2. Respondent questionnaire responses related to the evaluation of the use of AI literacy modules and e-courses

No.	Aspect	Percentage	
		E-modul	E-Course
1	Content Quality	85%	89%
2	Design/Appearance	86%	84%
3	Interactivity	82%	88%

Respondents gave a score of 85% for the e-module and 89% for the e-course, indicating that both were considered to have good and relevant content. The higher score for the e-course indicates that the delivery of content in video or interactive formats was considered more interesting and easier to understand than the text format in the e-module. This suggests that the visual and narrative aspects of the e-course can enhance the user's comprehension of the material.

The design or appearance aspect received a score of 86% for the e-module and 84% for the e-course. This result is quite interesting because it shows that, despite the e-course being digital and visual, the e-module is actually rated slightly better in terms of appearance. This may be due to the more systematic and standardized layout structure of e-modules, or because users are more familiar with written document formats. However, the small difference in scores suggests that the designs of both are at a satisfactory level.

A striking difference is evident in this aspect, where e-courses received a high score of 88%, while e-modules received a score of only 82%. This reinforces the assumption that e-courses are superior in creating an active learning experience, possibly due to features such as videos, interactive quizzes, or other multimedia elements that directly engage participants. In contrast, e-modules tend to be passive and do not support dynamic independent exploration.

Evaluation

To improve the interactivity score of e-modules, it is recommended to add features such as active links to explanatory videos, quizzes based on Google Forms or Learning Management System (LMS), and reflective assignments with automatic feedback. This will help bridge the gap in interactivity between document formats.

e-courses are already well-suited in terms of content and interactivity, but the design aspect can still be improved through the use of more professional visual templates, consistent color schemes, and transition settings that are neither too fast nor too slow. The addition of audio narration that is in sync with the visuals will also increase user comfort in following the material. For both formats, the content can be more detailed or personalized based on user categories (e.g., academics, MSMEs, or industry players). This way, the material will feel more relevant and applicable, improving the perception of content quality among users.

The results of the response show that both e-modules and e-courses have positive evaluative values, but each has different advantages. E-modules excel in systematic design, while e-courses are stronger in content delivery and interactivity. By integrating the strengths of both and improving on the weak aspects, the overall effectiveness of AI literacy learning can be enhanced.

D. Conclusion

The overall research results indicate that students' AI literacy is currently at a functional level, but has not yet reached an adequate critical or ethical level. The development of e-modules

and e-courses has succeeded in significantly improving conceptual understanding, interactivity, and the ability to adapt the use of AI in an academic context. Positive user responses indicate that structured digital learning designs can effectively bridge the gap in students' understanding of how AI works, its benefits, and its associated risks. These findings confirm that AI literacy needs to be developed not only on the technical side but also in critical thinking, information verification, and ethical awareness in the use of artificial intelligence-based technology.

The research findings have strategic implications for education policy, particularly the urgency of integrating AI literacy as a basic competency in higher education curricula. Educational institutions need to develop guidelines on the ethical use of AI, strengthen academic policies related to AI-based plagiarism, and ensure that students receive systematic training on prompt construction, AI result verification, and algorithmic risk awareness. This research has limitations, including the relatively small number of interview respondents, the limited context coverage of one group of students, and the lack of long-term effectiveness testing of the developed e-modules and e-courses. Further research with a broader sample and a longitudinal evaluation approach is needed to obtain stronger and more in-depth generalizations of the findings.

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