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Needs Analysis of the Development of Self-Directed Learning E-Module for the Scientific Writing Course

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Abstract. The integration of course guidelines with learning materials hinders students' comprehension and fosters dependence on tutors. Needs analysis, as the initial step in e-module development, is essential to identify students' limitations and requirements. Employing Borg and Gall's needs analysis model, this study gathered data through observation, questionnaires, and interviews with 30 students, and analysed the data both quantitatively and qualitatively. Results reveal the current guidebook excels in user-friendliness (98.23%), adaptability (94.70%), and self-containment (77.17%), but is merely adequate in stand-alone (68.47%) and self-instruction (61.43%) aspects. Therefore, an e-module equipped with examples, editable templates, self-quizzes with feedback, and tutorial videos is required.

Keywords: Development; E-module; Scientific Writing; Self-directed Learning; Needs Analysis

1. Introduction

The e-module is one of the facilities and infrastructure that are necessary for the teaching and learning process to be successful (Yulando et al., 2019). E-modules are crucial for improving learning efficacy, methodically providing content, and encouraging self-directed learning (Qotimah & Mulyadi, 2021). Additionally, their application can promote innovation, constructive thought patterns, and an engaging, productive, and joyful learning environment (Bacomo et al., 2022). E-modules allow students to use digital devices for self-directed learning at any time and from any location (Pratama et al., 2021). Consequently, e-modules need to be made to satisfy several important requirements: (1) self-instruction, allowing for independent learning; (2) self-contained, with all learning materials complete; (3) stand-alone, usable without dependence on other materials; (4) adaptive, flexible across devices and able to adapt to scientific and technological advancements; and (5) user-friendly, easy to use with straightforward language and clear instructions (Yulando et al., 2019).

To improve student motivation and engagement in self-directed learning, technology has been incorporated into the module (Briscoe & Brown, 2019; Kowitlawakul et al., 2017; Logan et al., 2021). According to Zimmerman (2002), self-directed learning is a self-regulated process in which students translate their cognitive abilities into academic skills. Self-directed learning, self-efficacy, self-awareness, self-reflection, and self-motivation are all important components of this process that are necessary for building students' ability to engage actively in their education (Kowitlawakul et al., 2017; Zimmerman, 2002). This supports the idea put forth by Ellizar et al. (2018) that self-directed

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learning is a purposefully created environment that supports students' autonomous knowledge construction.

The first public university in Indonesia to adopt an open, flexible distance-learning system is the Open University (UT) (Hariyadi et al., 2023; Nasution et al., 2024; Universitas Terbuka, 2025). The Primary School Teacher Education (PGSD) program is among its most highly enrolled and graduating programs. To graduate from this program, students must complete the Scientific Work course. Completion of this course determines program graduation, even though it carries zero credit units (SKS) (Yunus et al., 2022). However, since most UT PGSD students are working professionals, access to independent learning resources is essential, as it allows flexible access to materials without set in-person schedules. These self-directed learning tools are the primary defence against disruptions in education, ensuring graduates stay competitive, preventing dropouts, and preserving learning continuity.

While the theory highlights the need for e-modules to be self-instructional, self-contained, stand-alone, adaptive, and user-friendly to facilitate independent learning, the reality in Universitas Terbuka's (UT) Primary School Teacher Education (PGSD) program reveals a significant gap. The primary teaching resources for the Scientific Work course in the PGSD program at Universitas Terbuka for the 2024–2025 academic year still fall short of providing precise, step-by-step instructions for writing scientific articles, according to document analysis. Rather than providing in-depth educational content, these materials primarily include general guidelines for course tutoring. The three main sections of UT's official guide, Section I on the Implementation of Scientific Work Course Tutoring (27 pages), Section II on Provisions for Writing Scientific Works (20 pages), and Section III on Appendices (7 pages), make this clear. Student interviews support these document analysis findings, highlighting challenges in identifying variables, creating titles, creating background sections, framing research problems, finding and selecting relevant references, and creating bibliographies. These difficulties hinder students' capacity to write logically and methodically about their ideas (Nardo & Hufana, 2014). Therefore, it is imperative to conduct a needs analysis in order to create an e-module on writing scientific articles that is based on self-directed learning.

Development refers to the translation of Design specifications into a physical form to facilitate and enhance learning performance (Januszwesky & Molenda, 2008; Okpatrioka, 2023; Seels & Richey, 2012). Borg and Gall (1983) identified ten stages of product development, with needs analysis serving as the primary foundation. Syam (2020) emphasised that e-module development must prioritise user needs to ensure the module's content relevance and utility. In line with this, prior studies have underscored the importance of needs analysis in developing self-directed learning modules, as in Laili et al. (2019), who developed a science-based module for PGSD students; Mardia and Sundara (2020), who analyzed needs for a self-directed linear programming module; Rahmi et al. (2021), who developed an online module for open and distance learning systems; and Hertiwi et al. (2021) and Juniarti et al. (2021)who analysed needs for Edmodo-based e-modules.

The methods and context of this study differ fundamentally from those of earlier research. The Borg and Gall development model is cited in the needs analysis of this mixed-methods study. On the other hand, the 4D or ADDIE models were typically used in earlier research. Additionally, this study focuses on tutors and PGSD students at Universitas Terbuka. The majority of these individuals are active teachers with a wide age range (22–42) who work in an online learning environment with very little in-person interaction. This differs from participants in earlier research, who were usually regular students at traditional campuses with more in-person interactions. The novelty of this research lies in tailoring e-module development to the unique characteristics of Universitas Terbuka

students and the online learning system implemented. The specific focus on needs analysis for e-module development targeting scientific article writing, as a graduation requirement for the Karya Ilmiah course, represents an innovative aspect, given the absence of in-depth, specialized modules on scientific article writing within the UT environment.

Based on the aforementioned background, the research problems in this study are: 1) What are the characteristics of the Karya Ilmiah PGSD UT guidebook for the 2024/2025 academic year? 2) What are the students' needs regarding self-directed e-modules for the Karya Ilmiah course? Accordingly, the objectives of this study are: 1) to examine the characteristics of the Karya Ilmiah PGSD UT guidebook for the 2024/2025 academic year; 2) to examine the needs of students and tutors regarding self-directed e-modules for the Karya Ilmiah course. Theoretically, the findings of this study can enrich the literature on technology-based instructional material development that emphasises student autonomy in distance learning. The results are expected to serve as references and foundations for subsequent research on instructional Design, needs analysis, and e-module development across various disciplines, thereby broadening insights into innovative learning strategies relevant to the digital era. In practice, this study provides recommendations for e-module development aligned with the needs of PGSD students at Universitas Terbuka.

2. Method

This study used a Research and Development (R&D) Design based on the ten-stage Borg and Gall (1983) model. To determine the needs, shortcomings, and difficulties students encountered during the scientific writing process in the Scientific Works course, the study focused particularly on the needs analysis stage. The subjects were 30 students enrolled in Universitas Terbuka's Scientific Works course during the 2024–2025 academic year. Universitas Terbuka students who were enrolled in or had completed the Professional Competency Enhancement (PKP) course, which is a prerequisite for the Scientific Works course, were between the ages of 20 and 45, unemployed or employed as teachers, and had no prior experience writing scientific articles. They met the inclusion criteria for subjects. Based on these criteria, the respondent profile is presented in Table 1.

Table 1. Respondent Profile

Characteristics	Category	Quantity	Percentage
PKP Prerequisite Enrollment Status	Currently enrolled	10	33%
	Completed	20	67%
Semester	8	27	90%
	9	3	20%
Age	20-25 years	10	33%
	26-30 years	6	20%
	31-35 years	8	27%
	36-40 years	3	10%
	40-45 years	3	10%
Occupation	Full-time student	2	10%
	Elementary school teacher	28	90%
Experience in Scientific Writing	None	30	100%

Four sources of information were gathered: documentation, observations, interviews, and questionnaires. As a result, observation sheets, interview sheets, questionnaire sheets, and

documentation sheets were among the tools. The features of self-directed e-module learning described by Yulando et al. (2019), self-instruction, self-contained, stand-alone, adaptive, and user-friendly, were the basis for the development of these tools. Weaknesses in the current guidebook were examined using the documentation sheet. In the meantime, the questionnaire, observation, and interview sheets were used to determine the difficulties students encountered when writing scientific articles and to assess the need for a self-directed e-module.

Using SPSS version 29, the validity and reliability of the quantitative data from the questionnaires were examined. For validity testing, the Pearson Product-Moment was used, and judgments were made at the 5% significance level. If the Sig. (2-tailed) When the value was less than 0.05, indicating a significant correlation between variables, the validity criteria were satisfied. Cronbach's Alpha was used to measure reliability; values greater than 0.60 were considered reliable. These SPSS analyses showed that all 15 statement items were reliable (0.885>0.60) and valid (<0.005). Technical triangulation was used to establish the validity of qualitative data. Technical triangulation, according to Sugiyono (2020), cross-checks information from several data collection methods to confirm data validity and credibility. As a result, data that was supported by multiple approaches was considered legitimate.

Data analysis followed the interactive model proposed by Miles et al. (2014). Collected data were selected and grouped by specific criteria (data reduction), presented in graphical, chart, or tabular formats (data display). Conclusions were drawn through reduction and display processes (conclusion drawing/verification). Specifically, qualitative interview data were analysed thematically using Braun and Clarke's (2006) approach, consisting of six steps: (1) familiarization with the data, involving thorough Reading and comprehension; (2) generating initial codes by marking meaningful data segments; (3) searching for themes by grouping related codes into potential themes; (4) reviewing and developing themes to ensure they accurately represent the data; (5) defining and naming themes; and (6) producing a straightforward analytical narrative.

Following the analysis, data were presented formally and informally through verbal descriptions, tables, and diagrams. The questionnaire results revealed students' need for a self-directed e-module. Student responses regarding the current guidebook were considered optimal if meeting at least the "good" criterion.

Table 2. Guidebook Suitability Criteria with E-Module Characteristics

Percentage Interval	Criteria
85%–100%	Excellent
75%–84%	Good
60%–74%	Adequate
40%–59%	Poor
0%–39%	Fail

Source: Sunarti & Rahmawati (2012)

3. Result

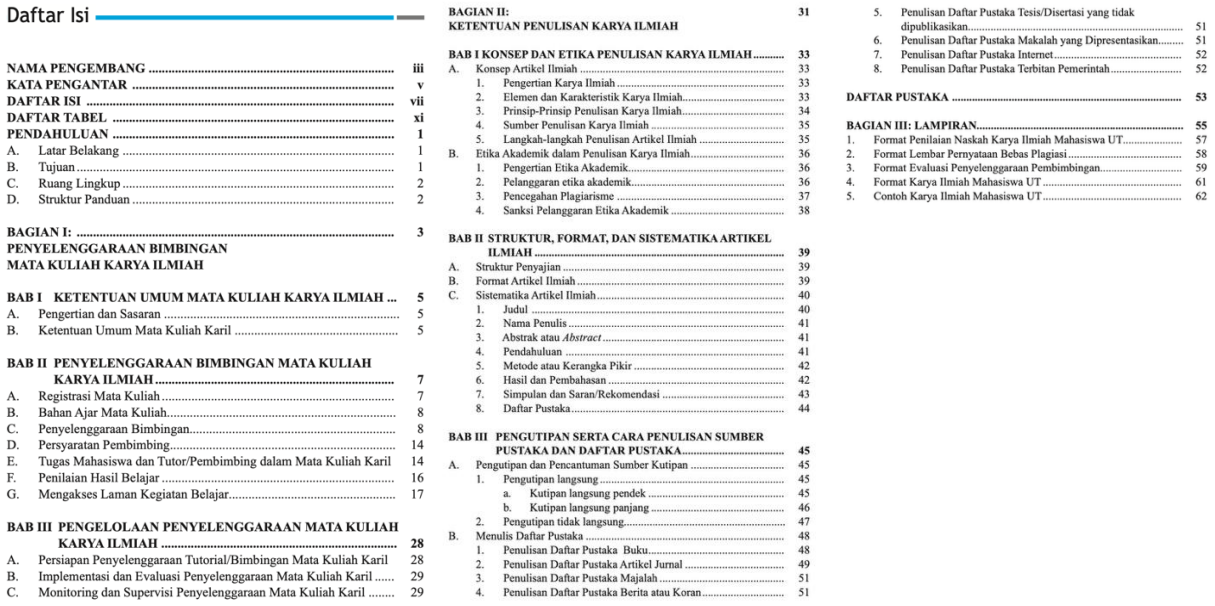
Analysis of the 2024/2025 Academic Year Scientific Writing Handbook

The analysis of the handbook aims to identify weaknesses in its content, structure, and presentation for the Scientific Writing course for the 2024/2025 academic year. This serves as a foundation for developing a self-directed e-module that aligns with students' needs and current advancements in scientific writing. Based on the documentation review, the findings are presented in Table 3 below.

Table 3. Documentation Review of the Scientific Writing Guidelines Manual

Aspect	Documentation Review Findings
Self-instruction	The guidance section on course supervision is merged with the technical materials on scientific writing.
Self-container	The presented materials remain general in nature. They lack detailed steps for determining titles, structuring introductions, methods, results, discussions, conclusions, and recommendations, as well as concrete examples for each section of a scientific article.
Stand alone	The examples in the appendices are general and do not align with the program study's context or students' research backgrounds. Moreover, the bibliography formatting examples are inconsistent with the explanations in the materials, necessitating the inclusion of supplementary content from external sources.
Adaptive	Flexible for use across various devices and accessible both online and offline.
User friendly	Easy for students to use and understand, although instructions remain general.

The documentation review reveals structural weaknesses in the 2024/2025 Scientific Writing handbook, particularly the integration of the course supervision guidelines (Part I) with the technical scientific writing materials (Part II: Scientific Writing Provisions), as illustrated in Figure 1. This primary weakness results in information overload, in which administrative learning elements are intermixed with core instructional content, thereby hindering students' ability to focus independently on the technical aspects of scientific article writing.



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Figure 1. Documentation 1 of the Scientific Writing Course Guidebook
Source: Yunus et al. (2022)

The current Scientific Writing course handbook also fails to provide detailed steps to help students determine and formulate research titles, construct introductions and methods sections,

present research findings, develop discussions, and draw conclusions with recommendations. This is evident in Figure 2 below.



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BAB II

Struktur, Format, dan Sistematika Artikel Ilmiah

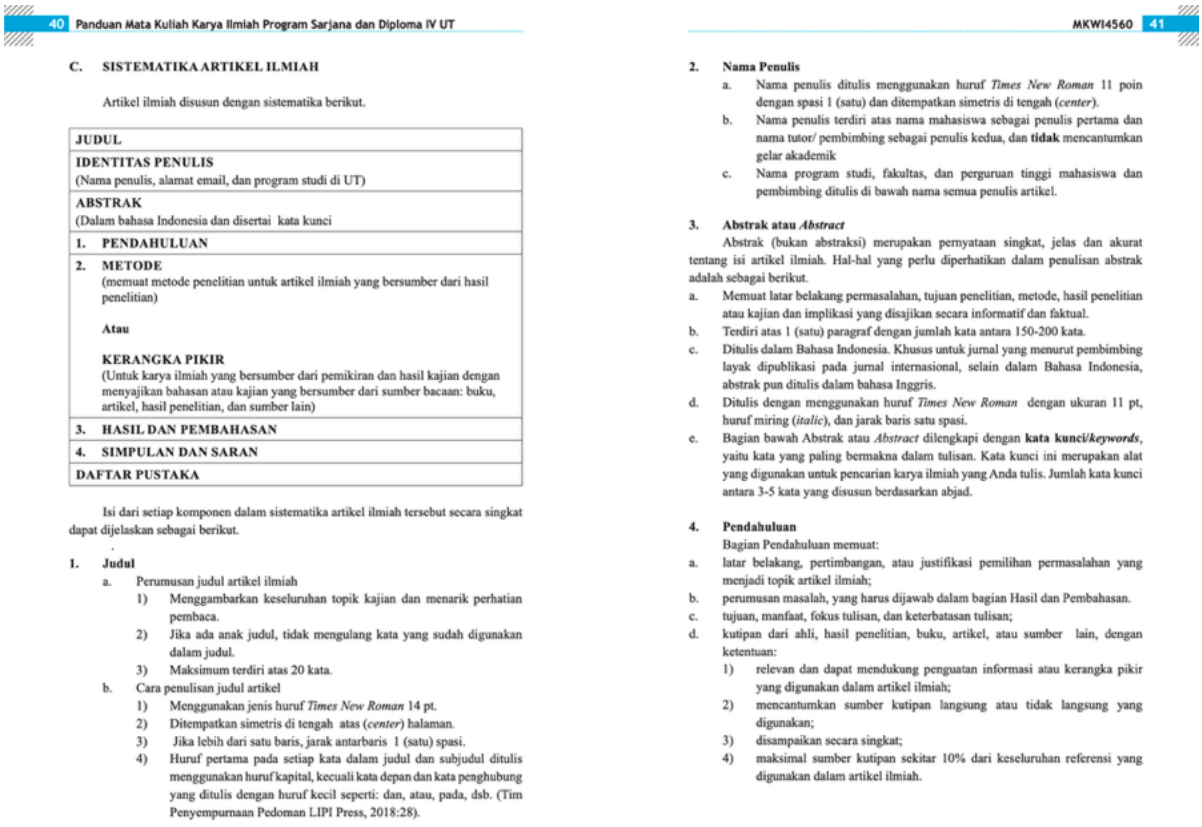
A. STRUKTUR PENYAJIAN

Struktur penyajian artikel ilmiah terdiri atas beberapa bagian berikut.

1. Bagian "Pendahuluan" menggambarkan dapat berupa latar belakang yang menggambarkan pentingnya topik yang akan dibahas, tujuan penulisan, dan mungkin juga ruang lingkup penulisan.
2. Bagian "isi atau pokok pembahasan" sebagai inti dari sebuah karya tulis memuat hasil pemikiran/penelitian yang disajikan dan dibahas secara lengkap dan sistematis.
3. Bagian "Penutup" memuat simpulan dan harapan atau rekomendasi atau tindak lanjut.

Figure 2. Documentation 2 of the Scientific Writing Course Guidebook
Source: Yunus et al. (2022)

Figure 3 illustrates that on page 39 of Chapter II, under the "Structure of Presentation" section, only the general structure of a scientific article is outlined, including the introduction, body (main discussion), and conclusion. This section provides a general explanation of the content for each part, but lacks detailed steps for their construction. Furthermore, in the "Systematics of Scientific Articles" section on pages 40–43, the explanations emphasise writing techniques but provide limited detail on the steps and concrete examples for each article section. This can be observed in Figures 3 and 4 below.



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C. SISTEMATIKA ARTIKEL ILMIAH

Artikel ilmiah disusun dengan sistematika berikut.

JUDUL
IDENTITAS PENULIS (Nama penulis, alamat email, dan program studi di UT)
ABSTRAK (Dalam bahasa Indonesia dan disertai kata kunci
1. PENDAHULUAN
2. METODE (memuat metode penelitian untuk artikel ilmiah yang bersumber dari hasil penelitian) **Atau** **KERANGKA PIKIR** (Untuk karya ilmiah yang bersumber dari pemikiran dan hasil kajian dengan menyajikan bahasan atau kajian yang bersumber dari sumber bacaan: buku, artikel, hasil penelitian, dan sumber lain)
3. HASIL DAN PEMBAHASAN
4. SIMPULAN DAN SARAN
DAFTAR PUSTAKA

Isi dari setiap komponen dalam sistematika artikel ilmiah tersebut secara singkat dapat dijelaskan sebagai berikut.

1. Judul

a. Perumusan judul artikel ilmiah
   1) Menggambarkan keseluruhan topik kajian dan menarik perhatian pembaca.
   2) Jika ada anak judul, tidak mengulang kata yang sudah digunakan dalam judul.
   3) Maksimum terdiri atas 20 kata.

b. Cara penulisan judul artikel
   1) Menggunakan jenis huruf *Times New Roman* 14 pt.
   2) Ditempatkan simetris di tengah atas (*center*) halaman.
   3) Jika lebih dari satu baris, jarak antarbaris 1 (satu) spasi.
   4) Huruf pertama pada setiap kata dalam judul dan subjudul ditulis menggunakan huruf kapital, kecuali kata depan dan kata penghubung yang ditulis dengan huruf kecil seperti: dan, atau, pada, dsb. (Tim Penyempurnaan Pedoman LIPI Press, 2018:28).

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2. Nama Penulis

a. Nama penulis ditulis menggunakan huruf *Times New Roman* 11 poin dengan spasi 1 (satu) dan ditempatkan simetris di tengah (*center*).
b. Nama penulis terdiri atas nama mahasiswa sebagai penulis pertama dan nama tutor/ pembimbing sebagai penulis kedua, dan **tidak** mencantumkan gelar akademik
c. Nama program studi, fakultas, dan perguruan tinggi mahasiswa dan pembimbing ditulis di bawah nama semua penulis artikel.

3. Abstrak atau *Abstract*

Abstrak (bukan abstraksi) merupakan pernyataan singkat, jelas dan akurat tentang isi artikel ilmiah. Hal-hal yang perlu diperhatikan dalam penulisan abstrak adalah sebagai berikut.

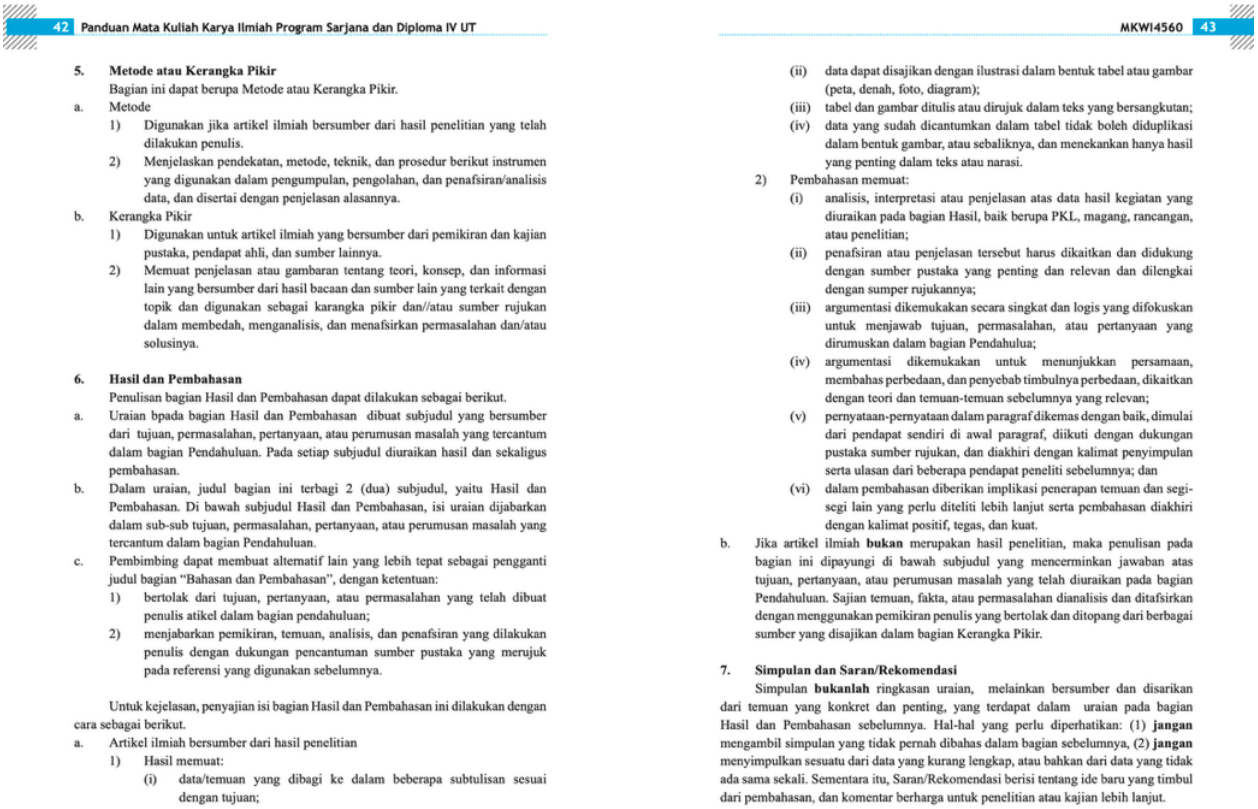
a. Memuat latar belakang permasalahan, tujuan penelitian, metode, hasil penelitian atau kajian dan implikasi yang disajikan secara informatif dan faktual.
b. Terdiri atas 1 (satu) paragraf dengan jumlah kata antara 150-200 kata.
c. Ditulis dalam Bahasa Indonesia. Khusus untuk jurnal yang menurut pembimbing layak dipublikasi pada jurnal internasional, selain dalam Bahasa Indonesia, abstrak pun ditulis dalam bahasa Inggris.
d. Ditulis dengan menggunakan huruf *Times New Roman* dengan ukuran 11 pt, huruf miring (*italic*), dan jarak baris satu spasi.
e. Bagian bawah Abstrak atau *Abstract* dilengkapi dengan **kata kunci/*keywords***, yaitu kata yang paling bermakna dalam tulisan. Kata kunci ini merupakan alat yang digunakan untuk pencarian karya ilmiah yang Anda tulis. Jumlah kata kunci antara 3-5 kata yang disusun berdasarkan abjad.

4. Pendahuluan

Bagian Pendahuluan memuat:

a. latar belakang, pertimbangan, atau justifikasi pemilihan permasalahan yang menjadi topik artikel ilmiah;
b. perumusan masalah, yang harus dijawab dalam bagian Hasil dan Pembahasan.
c. tujuan, manfaat, fokus tulisan, dan keterbatasan tulisan;
d. kutipan dari ahli, hasil penelitian, buku, artikel, atau sumber lain, dengan ketentuan:
   1) relevan dan dapat mendukung penguatan informasi atau kerangka pikir yang digunakan dalam artikel ilmiah;
   2) mencantumkan sumber kutipan langsung atau tidak langsung yang digunakan;
   3) disampaikan secara singkat;
   4) maksimal sumber kutipan sekitar 10% dari keseluruhan referensi yang digunakan dalam artikel ilmiah.

Figure 3. Documentation 3 of the Scientific Writing Course Guidebook. Source: Yunus et al. (2022)



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5. Metode atau Kerangka Pikir

Bagian ini dapat berupa Metode atau Kerangka Pikir.

a. Metode
   1) Digunakan jika artikel ilmiah bersumber dari hasil penelitian yang telah dilakukan penulis.
   2) Menjelaskan pendekatan, metode, teknik, dan prosedur berikut instrumen yang digunakan dalam pengumpulan, pengolahan, dan penafsiran/analisis data, dan disertai dengan penjelasan alasannya.

b. Kerangka Pikir
   1) Digunakan untuk artikel ilmiah yang bersumber dari pemikiran dan kajian pustaka, pendapat ahli, dan sumber lainnya.
   2) Memuat penjelasan atau gambaran tentang teori, konsep, dan informasi lain yang bersumber dari hasil bacaan dan sumber lain yang terkait dengan topik dan digunakan sebagai karangka pikir dan//atau sumber rujukan dalam membedah, menganalisis, dan menafsirkan permasalahan dan/atau solusinya.

6. Hasil dan Pembahasan

Penulisan bagian Hasil dan Pembahasan dapat dilakukan sebagai berikut.

a. Uraian bpada bagian Hasil dan Pembahasan dibuat subjudul yang bersumber dari tujuan, permasalahan, pertanyaan, atau perumusan masalah yang tercantum dalam bagian Pendahuluan. Pada setiap subjudul diuraikan hasil dan sekaligus pembahasan.
b. Dalam uraian, judul bagian ini terbagi 2 (dua) subjudul, yaitu Hasil dan Pembahasan. Di bawah subjudul Hasil dan Pembahasan, isi uraian dijabarkan dalam sub-sub tujuan, permasalahan, pertanyaan, atau perumusan masalah yang tercantum dalam bagian Pendahuluan.
c. Pembimbing dapat membuat alternatif lain yang lebih tepat sebagai pengganti judul bagian "Bahasan dan Pembahasan", dengan ketentuan:
   1) bertolak dari tujuan, pertanyaan, atau permasalahan yang telah dibuat penulis atikel dalam bagian pendahuluan;
   2) menjabarkan pemikiran, temuan, analisis, dan penafsiran yang dilakukan penulis dengan dukungan pencantuman sumber pustaka yang merujuk pada referensi yang digunakan sebelumnya.

Untuk kejelasan, penyajian isi bagian Hasil dan Pembahasan ini dilakukan dengan cara sebagai berikut.

a. Artikel ilmiah bersumber dari hasil penelitian
   1) Hasil memuat:
      (i) data/temuan yang dibagi ke dalam beberapa subtulisan sesuai dengan tujuan;

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      (ii) data dapat disajikan dengan ilustrasi dalam bentuk tabel atau gambar (peta, denah, foto, diagram);
      (iii) tabel dan gambar ditulis atau dirujuk dalam teks yang bersangkutan;
      (iv) data yang sudah dicantumkan dalam tabel tidak boleh diduplikasi dalam bentuk gambar, atau sebaliknya, dan menekankan hanya hasil yang penting dalam teks atau narasi.
   2) Pembahasan memuat:
      (i) analisis, interpretasi atau penjelasan atas data hasil kegiatan yang diuraikan pada bagian Hasil, baik berupa PKL, magang, rancangan, atau penelitian;
      (ii) penafsiran atau penjelasan tersebut harus dikaitkan dan didukung dengan sumber pustaka yang penting dan relevan dan dilengkai dengan sumper rujukannya;
      (iii) argumentasi dikemukakan secara singkat dan logis yang difokuskan untuk menjawab tujuan, permasalahan, atau pertanyaan yang dirumuskan dalam bagian Pendahulua;
      (iv) argumentasi dikemukakan untuk menunjukkan persamaan, membahas perbedaan, dan penyebab timbulnya perbedaan, dikaitkan dengan teori dan temuan-temuan sebelumnya yang relevan;
      (v) pernyataan-pernyataan dalam paragraf dikemas dengan baik, dimulai dari pendapat sendiri di awal paragraf, diikuti dengan dukungan pustaka sumber rujukan, dan diakhiri dengan kalimat penyimpulan serta ulasan dari beberapa pendapat peneliti sebelumnya; dan
      (vi) dalam pembahasan diberikan implikasi penerapan temuan dan segi-segi lain yang perlu diteliti lebih lanjut serta pembahasan diakhiri dengan kalimat positif, tegas, dan kuat.

b. Jika artikel ilmiah **bukan** merupakan hasil penelitian, maka penulisan pada bagian ini dipayungi di bawah subjudul yang mencerminkan jawaban atas tujuan, pertanyaan, atau perumusan masalah yang telah diuraikan pada bagian Pendahuluan. Sajian temuan, fakta, atau permasalahan dianalisis dan ditafsirkan dengan menggunakan pemikiran penulis yang bertolak dan ditopang dari berbagai sumber yang disajikan dalam bagian Kerangka Pikir.

7. Simpulan dan Saran/Rekomendasi

Simpulan **bukanlah** ringkasan uraian, melainkan bersumber dan disarikan dari temuan yang konkret dan penting, yang terdapat dalam uraian pada bagian Hasil dan Pembahasan sebelumnya. Hal-hal yang perlu diperhatikan: (1) **jangan** mengambil simpulan yang tidak pernah dibahas dalam bagian sebelumnya, (2) **jangan** menyimpulkan sesuatu dari data yang kurang lengkap, atau bahkan dari data yang tidak ada sama sekali. Sementara itu, Saran/Rekomendasi berisi tentang ide baru yang timbul dari pembahasan, dan komentar berharga untuk penelitian atau kajian lebih lanjut.

Figure 4. Documentation 4 of the Scientific Writing Course Guidebook. Source: Yunus et al. (2022)

Figures 3 and 4 indicate that the Scientific Article Structure section encompasses the title, author details, abstract, introduction, methods, results, discussion, conclusions, recommendations, and references. In the title section, explanations are provided for formulating and writing scientific

article titles; however, the instructions are overly general. Therefore, it is necessary to incorporate steps for identifying titles, methods for constructing titles aligned with the study program's background, and examples of relevant titles about each study program. A similar issue applies to the abstract, methods, results, discussion, and conclusions and recommendations sections. Although key components in each section are mentioned, students still encounter difficulties with sentence construction. Consequently, concrete examples tailored to students' study program backgrounds are required for each section. Despite the handbook compilers' inclusion of sample articles in the appendix, students remain confused because these examples are insufficiently aligned with their research backgrounds, and certain sections, particularly the references, do not conform to the guidelines.

Needs Analysis for Developing a Self-Directed Learning-Based E-Module

The needs analysis aims to identify students' requirements for an e-module on Scientific Writing to support effective self-directed learning. Based on the questionnaire and interview results, the identified needs are presented in Table 4.

Table 4. Needs Analysis Results by E-Module Aspect

Aspect	Percentage	Category	Needs Based on Interviews
Self-instruction	61.43%	Adequate	Instructions, step-by-step guides for structuring each section of a scientific article, and detailed, concrete examples.
Self-container	77.17%	Good	a. Examples for each article section. b. Guides for using reference managers like Mendeley. c. Tips/guides for reducing plagiarism and AI detection.
Stand-alone	68.47%	Adequate	a. Material descriptions comprehensible without reference to other books or the internet. b. Exercises for each section.
Adaptive	94.70%	Excellent	a. Accessible on various devices. b. Available in responsive digital formats.
User-friendly	98.23%	Excellent	a. Easily understandable, clear, and unambiguous language. b. Glossary included. c. Concrete examples provided.

Table 4 indicates that the self-instruction aspect scored 61.43%, falling into the "Adequate" category. This finding is corroborated by student interviews, which reveal that the current guidebook does not fully facilitate independent learning. As stated by students AM, DO, YW, LM, and PA:

> "Although the current guide is somewhat helpful, it does not fully enable me to learn independently without assistance from others, particularly in the complex context of scientific writing." (Student AM)
> "Most of the guide's content is designed for self-directed learning, but I find it insufficient for learning without external help. For instance, in formulating problems, developing conceptual frameworks, or structuring discussions." (Student DO)
> "Not everything in the guidebook can be learned independently; sometimes more detailed material explanations are needed." (Student YW)

"The guide's explanations remain general and theoretical, often confusing, especially for technical sections like methodology writing or referencing. For students unaccustomed to scientific writing, additional support such as concrete examples, lecturer explanations, or video tutorials is required." (Student LM)

"While the guide provides a general overview of scientific article structure, some sections need deeper explanations. For example, selecting research-worthy topics, formulating sharp problem statements, conducting data analysis, and mastering proper academic writing techniques." (Student PA)

Based on interviews with students AM, DO, YW, LM, and PA (2025), the primary needs for the Scientific Writing guidebook include more detailed, concrete explanations of technical sections such as topics, problem formulation, references, methodology, data analysis, citation practices, and proper academic writing techniques. The current material is still general and theoretical. Students highlighted the lack of detailed content, real examples, and video tutorials as significant barriers, particularly for novices unaccustomed to scientific writing. Thus, the guide requires enhancements like step-by-step flowcharts, editable templates, and multimedia content to bolster self-instruction.

The self-container aspect scored 77.17%, categorised as "Good." Nevertheless, some guidebook sections need supplementation, as noted by PA, AM, PL, and DM:

"The current guide lacks complete scientific article examples for reference. Students would benefit more from real examples of each section (title, abstract, introduction, etc.)" (PA, 2025).

"The suboptimal aspects concern data analysis and interpretation, as well as self-revision techniques. Guides often emphasise structure and format but lack concrete examples or detailed steps for processing and presenting research findings. Additionally, there is insufficient material on self-editing techniques, such as identifying argument weaknesses, style consistency, or common grammatical errors." (Student AM)

"Methods to reduce AI detection and paraphrase scientific works." (Student PL)

"Ways to find references matching the research topic." (Student DM)

Interview results show that the current guide lacks concrete examples per section, data processing and interpretation techniques, AI reduction methods, self-revision and editing strategies, and reference search approaches. Therefore, developing a self-directed e-module necessitates practical additions, such as fully annotated examples of scientific articles, step-by-step data analysis guides with tool templates, AI detection and paraphrasing tutorials, self-revision checklists for arguments and style, and practical reference search strategies using databases such as Google Scholar and Scopus.

The stand-alone aspect scored 68.47%, in the "Adequate" category. Interviews confirm that while the guide's explanations are sufficient, they lack depth, prompting supplementary searches. As expressed by PA, AM, and LM:

"In my view, not all learning materials are fully available in the module. Although the UT module is comprehensive as a primary source, I still need to seek additional materials from other sources, such as lecturer PPTs, scientific articles, instructional videos, or online references. This is particularly true when the module lacks detailed concept applications or varied explanations for better understanding." (Student PA)

"Not all learning materials are fully covered in the module. I often need to consult other sources like lecturer PowerPoint presentations or the internet, as PPTs provide summaries, key emphases, or specific examples absent from the module." (Student AM)

> "Not all learning materials are fully available in the module. The UT module is quite complete as a main guide, but some explanations are too general or insufficiently in-depth." (Student LM)

Interviews reveal the guide's shortcomings in completeness of materials, forcing reliance on external sources such as lecturer PPTs, the internet, or videos—especially for concrete applications and in-depth explanations. E-module development should integrate more comprehensive *stand-alone* content, such as specific case examples, to serve as a single primary resource, enhancing self-directed learning efficiency and student independence.

Meanwhile, the *adaptive* aspect was rated 94.70% as "Excellent," indicating adaptability to scientific and technological advancements and multi-device usability. However, students like AM and LM called for digital innovations for greater flexibility:

> "The current Scientific Writing guide is predominantly print and static PDF. Flexibility would improve with responsive digital formats (e.g., adaptive websites, interactive e-books, or dedicated apps) that auto-adjust displays on phones, tablets, or laptops without compromising readability or navigation." (Student AM)
>
> "Regarding display and comfort, it is sometimes inflexible on small devices like phones—text is too small or formats non-responsive, making Reading and navigation challenging. A mobile-friendly version, such as interactive e-books or web formats, would be better." (Student LM)

These interviews highlight students' need for responsive, flexible digital innovations that adapt to support multi-device accessibility, especially on the mobile devices students commonly use. Despite strong content adaptability, static formats (print/PDF) hinder navigation and Reading comfort. E-module development should thus include interactive web apps, responsive e-books with hyperlinks, real-time search, and multimedia integration to enable self-directed learning anytime, anywhere, without device dependencies.

For the user-friendly aspect, students rated it 98.23% as "Excellent," praising simple language and clear instructions. However, improvements are needed in technical sections, as per AM and LM:

> "The current guide uses simple language, but not always fully clear or detailed instructions. Some are too general, leaving questions on specific applications in scientific writing contexts. This requires interpretation or assumptions, posing challenges for novice or independent learners due to potential confusion or implementation errors." (Student AM)
>
> "Overall, the guide employs simple language and sufficiently clear instructions, aiding my adherence to scientific writing steps. However, some technical aspects, such as proper citation or research methodology, lack detail or clarity and require re-reading or consulting external sources. While helpful, more precise explanations and examples would improve it." (Student LM)

Interview findings emphasise the need to enhance instructional clarity in technical areas such as citations and methodology, where simple language is practical but overly general, requiring additional interpretation for novices. E-module development requires supplementary glossaries for terms and practical examples to minimise confusion, fostering intuitive, compelling user experiences for digital self-directed learning.

These interview results align with observations indicating the need for improvements in self-instruction, self-contained, and stand-alone aspects. Observations showed that while some students completed tasks independently per instructions, many required guidance, step-by-step directions, and examples to comprehend them. For self-contained, university-provided guide materials are sufficiently complete, but explanations lack detail. Additions are needed to the steps for crafting

titles, abstracts, introductions, methods, results, discussions, conclusions, and recommendations in scientific articles. Existing examples are too general and confuse students during writing, particularly for bibliographies. Further, stand-alone observations revealed students using diverse sources, such as tutor PPTs and internet information, which is often overly broad and misaligned with university guidelines, leading to confusion and tutor consultations. Conversely, adaptive and user-friendly aspects showed no device access issues, allowing flexible timing and location adjustments.

4. Discussion

Analysis of the documentation in the 2024/2025 Academic Writing Guide revealed key shortcomings, including the conflation of instructional guidance with technical writing content, overly general explanations lacking detailed step-by-step guidance for each article section, generic supplementary examples accompanied by inconsistencies in reference lists, despite its flexibility across online and offline platforms, and relative ease of comprehension for students. Meanwhile, a needs assessment survey for a self-directed e-module via questionnaire (self-instruction: 61.43% "Adequate"; self-contained: 77.17% "Good"; stand-alone: 68.47% "Adequate"; adaptive: 94.70% "Excellent"; user-friendly: 98.23% "Excellent"), supplemented by interviews and observations, confirmed development priorities such as step-by-step instructions with concrete examples for self-instruction, Mendeley application guides, anti-plagiarism/AI tips, and section-specific examples for self-contained features; comprehensive standalone materials with exercises; multi-device responsive formatting for adaptability; and simple language, glossaries, and detailed examples for user-friendliness.

These findings align with prior studies by Laili et al. (2019), Mardia and Sundara (2020), Rahmi et al. (2021), Hertiwi et al. (2021), and Juniarti et al. (2021)which demonstrates that limitations in existing writing guides can be addressed through more applied, responsive e-modules. The module characteristics theory proposed by Yulando et al. (2019) further underscores the urgency of e-module development. Learning modules should be designed with clear instructions (self-instruction), complete required content (self-contained), independence from external materials (stand-alone), adaptability to technological and disciplinary advancements, and user-friendliness through simple, accessible language. Self-directed learning theories by Zimmerman (2002) and Kowitlawakul et al. (2017) emphasise that students' ability to manage and direct their own learning processes is pivotal in open learning systems such as those at Universitas Terbuka. The absence of tailored modules hinders students' optimal achievement of learning independence.

This needs analysis for a self-directed e-module on academic writing is reinforced by Knowles' (1980) Andragogy principles, which highlight that students in Universitas Terbuka's Primary School Teacher Education (PGSD) program, adult learners aged 20–45 with professional teaching experience, require immediate practical relevance, utilisation of life experiences as learning resources, autonomy in managing learning processes, and problem-based rather than content-based orientations. The limitations of existing modules that integrate instructional guidance contradict these andragogical assumptions by fostering external dependence, thereby impeding self-directed learning among working adult students with demanding schedules and flexible online and offline access. Thus, a self-directed e-module featuring detailed self-instruction, comprehensive self-contained content with concrete section-specific examples, standalone exercises, cross-device adaptability, and user-friendly elements (simple language, glossaries, and practical tips like Mendeley usage and plagiarism/AI mitigation) not only overcomes these barriers but also

personalises learning to their lifestyles, thereby enhancing essential academic writing competencies critical for teaching career advancement.

As a follow-up, the proposed e-module framework for academic writing is designed modularly to mirror the standard structure of a scientific article: title and abstract, introduction (background, problem statement, objectives), literature review, methods, results and discussion, conclusions and recommendations, and references. Each section is self-contained to facilitate adaptive, incremental learning for adult UT PGSD students. Integrated support features include short video tutorials (3–5 minutes per subtopic) that demonstrate practical applications, editable templates in Google Docs or Microsoft Word for direct completion, and interactive self-quizzes with automated feedback to reinforce instant comprehension and self-revision. Development principles emphasise concreteness through authentic primary school teaching case examples, contextualization through practical tips such as Mendeley reference management and plagiarism/AI reduction, and personalised pacing and flexibility via non-linear navigation, progress bookmarks, technical term glossaries, and responsive access across online and offline devices.

The usage process of this self-directed e-module is visualised in the following flowchart:

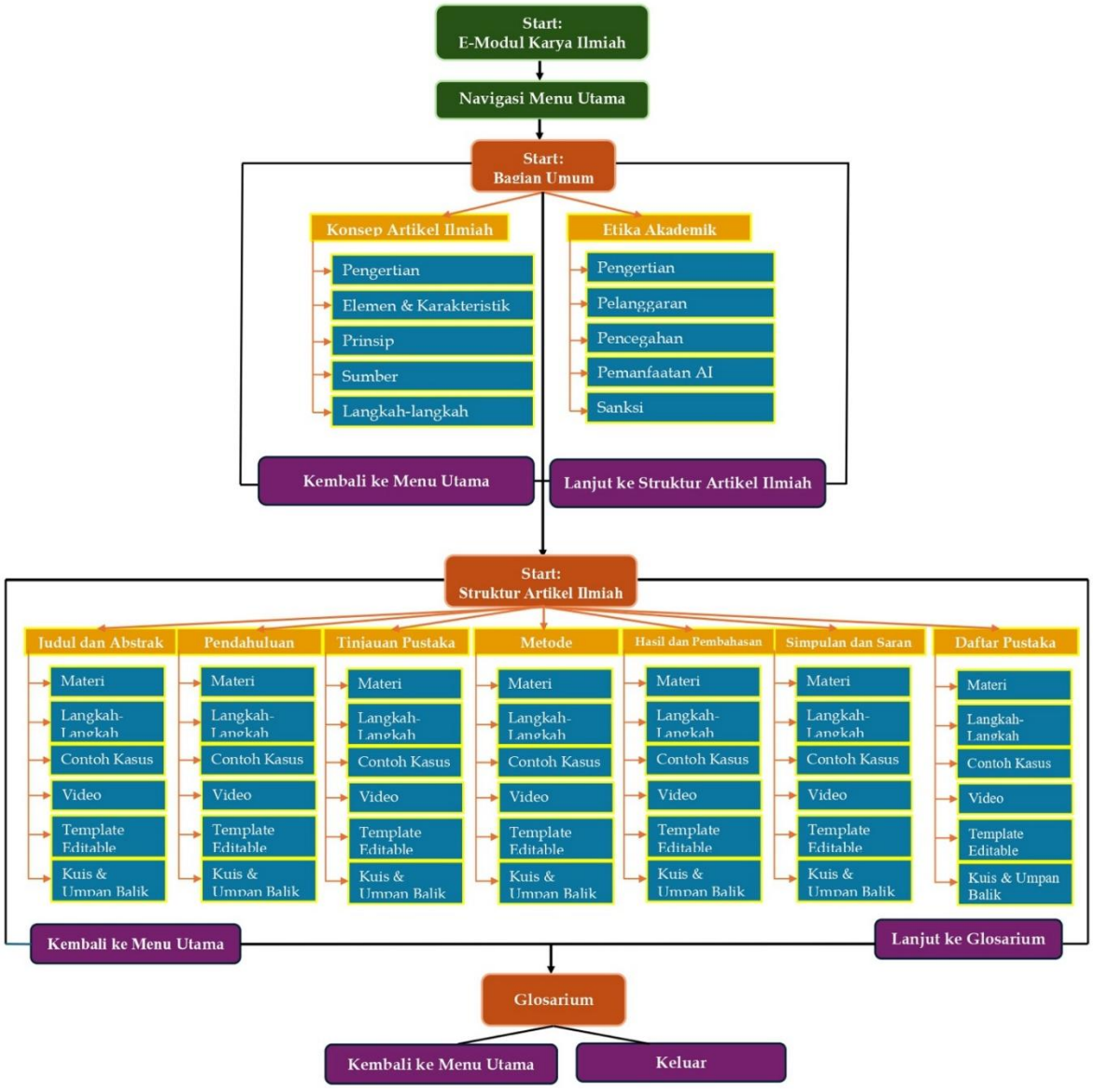


Figure 6. Flowchart of E-Module Usage in Self-Directed Learning

This flowchart for the UT PGSD Scientific Paper e-module visualises a three-tier hierarchical modular learning framework. It begins with a non-linear navigation entry point (green), enabling flexible access, followed by a mandatory General Section with two parallel orange pillars: Scientific Article Concepts (definition, elements, principles, sources) and Academic Ethics (definition, violations, plagiarism prevention, sanctions). These form a self-contained foundation before progressing to seven structured yellow modules following the standard IMRaD format (Title & Abstract, Introduction, Literature Review, Methodology, Results & Discussion, Conclusion & Recommendations, References). Supporting elements at the base include a glossary, loops back to modules, and adaptive navigation to facilitate progressive learning for adult PGSD students, incorporating features such as video tutorials, editable templates, and interactive quizzes in each unit.

5. Conclusion

Based on the research findings, existing scientific writing guidebooks adequately address the aspects of self-contained, adaptive, and user, but they are deficient in self-instruction and stand-alone. Consequently, UT PGSD students remain dependent on tutors and supplementary resources because overly general explanations lack relevance to field contexts. Therefore, the development of a self-directed learning-based e-module for scientific writing is essential to address these shortcomings through a blueprint grounded in four main pillars: (1) Concreteness, incorporating authentic PGSD teaching case examples; (2) Practicality, via editable templates for each section; (3) Interactivity, through self-assessment quizzes with automated feedback and tutorial videos; and (4) Accessibility, featuring a mobile-friendly Design with non-linear navigation, progress bookmarks, a glossary, and online-offline modes. This approach aims to enable UT PGSD adult learners to produce publication-ready scientific works independently.

This study has limitations, as it focused solely on a single program with a small sample size, necessitating caution when generalising its findings to other programs or universities. In light of these limitations, university stakeholders are recommended to prioritise the development of tailored e-modules that bolster self-directed learning, particularly by enhancing the currently suboptimal self-instruction and standalone aspects. This would reduce students' over-reliance on tutors or external resources. Such developments should integrate practical steps, concrete examples, and straightforward, comprehensible language to ensure the modules are truly applicable and aligned with program-specific contexts and needs. For future researchers, it is strongly recommended to conduct follow-up studies with broader and more diverse subject scopes across disciplines to yield more representative and generalizable modules. Longitudinal testing of e-module effectiveness is crucial for comprehensively assessing its impact on academic writing skills.

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