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Application of Fuzzy Delphi Method in the Design of Reading Digital Module for University Students in Riau

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Abstract
The current digital era also demands that English lecturers develop digital-based teaching materials. This study aimed to explore the application of the Fuzzy Delphi Method in the design of reading digital modules for university students in Riau since it benefits to improve students' reading abilities and comprehension. This study answered the research question about the expert evaluations and feedback on the developed e-module regarding appearance/layout interface/navigation, content, reading strategies, language module, and the relevance of the e-reading module. Ten experts chosen from academic higher education or university for their specialization in English teaching, educational technology, and module development were involved in evaluating and providing feedback, ideas, and agreement on the things required to create and implement the digital reading module. The study employed the Fuzzy Delphi Method to synthesize expert perspectives and prioritize these criteria, allowing for a complete framework for digital module development. The FDM was employed to reach an expert agreement on the module's critical design elements. The findings demonstrate the effectiveness of FDM in improving module design through consensus building and uncertainty management, thus contributing to improving educational practices in the digital era. The research results can make it easy to access the module and independently learn the course in unlimited time with interactive content.
Keywords: Digital Modul, Fuzzy Delphi Method, E-reading Module, Indonesian EFL Learners, Reading comprehension
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Introduction

Implementing information technology in the Process of Instruction and Learning (PIL) is necessary to meet the educational goals of the 21st century that demand the mastery of science and sustainable innovation. Technological advances are not only limited to communication but also have a considerable impact on the education sector (Haryono et al., 2017). In today's digital age, e-learning environments are revolutionizing education, offering a dynamic alternative to traditional classrooms. E-learning can go beyond simply delivering information, fostering deeper student engagement and critical thinking, as supported by Boussebha's (2023) statement that students' internal comprehension and thinking about the underlying content are stimulated when e-learning platforms are used in conjunction with traditional classroom settings. It might develop into a tool that encourages deeper introspection. Unlike traditional educational processes that include a single setting and treat students as passive receivers of materials, e-learning learners actively speculate, analyze, and develop understanding utilizing a variety of tactics and technology.

According to Yazid et al. (2023), the module's completeness with digital media components, including photos, audio, and video, is one of the advantages of using an e-module in learning. Combining information in text and images, also known as infographics, can enhance learning. This is because the proper use of multimedia is crucial to achieving the course's educational goals. Using multimedia modules in the educational process can help students improve their learning outcomes, regardless of their original ability level (Hermansyah et al., 2023).

The Delphi Technique has been used in science to obtain expert consent; it is not a new research methodology. The Modified Delphi Technique is a type of Delphi Technique that involves gathering insights from experts and anticipating future events to reach consensus (McMillan et al., 2016; Ridhuan et al., 2014; Saedah, 2013; Linestone & Turoff, 1975 as cited in Kamis et al., 2020). FDM combines the Fuzzy Theory with the classic Delphi method and was first used to make decisions by Guttorp et al. (1990). Delphi is a decision-making approach that uses surveys and expert feedback to reach agreement among expert panels. This method has succeeded in gaining agreement among experts with different views on solving complicated problems, allowing for collective decisions rather than individual decisions.

Reading's definition is ever-evolving (Mirza et al., 2021). Reading involves interaction between readers and writers by processing information through language and thought (Henrietta & Corresponding, 2016). According to Ng et al. (2019), extensive reading is a pleasurable activity that involves self-selected material. Intensive reading enables children to read numerous uncommon terms not contained in Japanese school textbooks (Stephens, 2019). Reading content must be easy, quick, calm, pleasurable, self-selected, fast reading, and directed by teachers (Li et al., 2023). Many obstacles exist while implementing reading programs, which significantly disturb the educational process of reading. The reason is that the comprehensive usage of reading methods includes students' attitudes, interests, talents, and aspirations, and students claim they need more time to read (Martina et al., 2020). Martina et al. (2020) also said that pupils are unaware of the advantages, concepts, and strategies for doing reading activities owing to a lack of knowledge. In this context, the role of the teacher is also crucial. Teachers must try to understand the students' viewpoints on reading, including basic language and English (Hasan, 2023).

Therefore, this study investigates the application of the Fuzzy Delphi Method in designing a digital reading module for university students in Riau, given its potential to enhance students' reading skills and comprehension. This study addressed the research question concerning expert

evaluations and feedback on the developed e-module, focusing on aspects such as appearance/layout, interface/navigation, content, reading strategies, language components, and the relevance of the e-reading module.

Literature Review

Digital Learning

The explosive development of technology for communication and information has prompted many schools and universities to implement e-learning platforms to improve learning flexibility and effectiveness. Although many studies show that using e-learning platforms appears similar to conventional learning, e-learning offers more flexibility. They can also enrich the lesson using various learning resources, such as multimedia, and teachers can quickly perfect it (Garralda Ortega et al., 2023). According to Yadav (2024), digital learning involves many techniques, specifically virtual experiences, virtual classrooms, online courses, and adaptive learning platforms. It is defined as distributing educational material and creating interactive learning experiences using digital technologies.

According to Lestari et al. (2021), instructional materials should be designed and authored according to the instructive rules as teachers will use them to help and support students. A teaching material is a collection of tools or learning aids that are methodically structured and interesting to the desired aim, a competence or sub-competence in all of its complexity. The educational material is the core of the curriculum, i.e. the subject or field of study with topics and sub-themes (Ruhimat, 2011, as cited in Nuryasana & Desiningrum, 2020). Excellent educational materials must continually reflect developments in technology, art, and the realities of life in an ever-globalizing society (Lestari et al., 2021). Educational materials with multiple versions make learning sessions more engaging (Abdelshaheed, 2024). Therefore, Educators must develop digital skills and adopt innovative instructional strategies to effectively implement digital learning technologies (Cormican et al., 2023).

On the other hand, digital learning in Indonesia faces significant challenges, primarily due to the nation's digital divide and insufficient infrastructure (Rasimin et al., 2024). While urban areas have seen rapid adoption of digital education technologies, rural and low-income regions need more internet access, leaving many students unable to participate fully in online learning. This disparity is compounded by a need for more digital literacy among students and teachers, with many educators finding it challenging to operate online learning platforms (Rahman et al., 2019). Additionally, the high cost of digital learning tools and internet access remains a barrier for many families, further widening the educational gap across the country.

Reading Modules

Reading at higher levels demands critical thinking abilities and is intellectually challenging (Erni et al., 2016). One form of educational media, both digital and print, is the learning module. Learning modules can be used as an educational tool to enhance the thinking ability of students in the upper classes (Suhendi et al., 2018). The electronic module, also known as the e-module, is an interactive learning tool that is easily accessible. E-modules can help students understand concepts and develop specific learning skills (Dwiastuty et al., 2018). In addition, e-modules can also help teachers provide more interesting and interactive learning materials (Astra et al., 2020; Ningsih & Mahyuddin, 2021; Pratiwi et al., 2021).

Therefore, e-modules can be an effective and efficient alternative learning medium to improve classroom learning quality (Darmaji et al., 2019; Pratiwi et al., 2021). E-Modules can increase student enthusiasm for reading as they can improve learning outcomes and motivation. Research suggests that developing E-Modules can facilitate students in intensive reading and better learning results (Aufa et al., 2021; Fisnani et al., 2020). In addition, e-modules can help students learn independently and improve learning motivation. Therefore, using e-modules in learning can increase student interest and enthusiasm in reading.

One of the four skills required to master English is reading. It is important because it functions as a component in the language learning process. Reading is a complex process, although it can only be defined as extracting meaning from text (Hall et al., 2020). Reading includes activating strategic processes, developing and using robust introductory passwords, recognizing words quickly and efficiently, and processing sentences to build understanding (Magableh & Abdullah, 2022; Sulaiman & Hasrianti, 2021). Reading requires basic cognitive skills, understanding background knowledge, interpreting and evaluating text in a suitable way for reading, and processing text smoothly over long periods (Putri et al., 2019).

Reading activity is essential because reading is the basis of all school subjects (Siregar et al., 2022; Solikhah, 2015). Reading can also improve language, vocabulary, and text understanding. Besides, students who like to read tend to have greater imagination and more creative abilities in conveying ideas and concepts (Küçükoğlu, 2013).

Fuzzy Delphi Method

The Fuzzy Delphi method can be employed to reach expert agreement on the components used in module development design. It also allows experts to give their opinions regularly. To get a high parity among the experts in the Fuzzy Delphi study, the minimum sample was 10 (Adler & Ziglio, 1996; Jones & Twiss, 1978, as cited in Noh et al. (2013). Therefore, special sampling techniques are used to select 17 experts for this research. They are composed of experts in Islamic studies, technology, problem-based learning, and curricula chosen through specialized sampler techniques (Chua, 2010). Experts have two criteria: (i) at least a bachelor's degree as an academic qualification and (ii) a minimum of ten years of work experience in the field. The criteria for selecting an expert are by Berliner (2004), which states that a person is considered to be skilled in the field if he has worked in that field for more than five years (Gambatese et al., 2008); states that an expert must possess a high level of education.

The Delphi technique has been introduced for a long time and used in previous research. This technique involves respondents that fit the research context and experts in the field studied (Eshak et al., 2020). The Fuzzy Delphi technique, first developed by Murray et al. (1985), has been modified to the goal of improvement (Murray et al., 1985). Kaufmann & Gupta (1988) changed this technique by combining the classic (traditional) Delphi method and a confusing series of numbers based on a binary set (yes or no) (Eshak et al., 2020; Noh et al., 2013).

The Fuzzy Delphi Method (FDM) plays a crucial role in the development of learning media by providing a structured approach to harnessing expert knowledge and navigating the complexities of educational design (Ciptono et al., 2019; Yusof et al., 2022). By integrating fuzzy logic with the traditional Delphi Method, FDM allows for considering diverse expert opinions, even when there is uncertainty or varying levels of agreement. This method facilitates consensus-building among educators, instructional designers, and other stakeholders, ensuring that a broad range informs the development process of perspectives. FDM is particularly valuable in

prioritizing features, addressing ambiguities in user needs, and making informed decisions about content and design elements (Abdullah & Siraj, 2018; Zulkifli et al., 2022). Moreover, its iterative nature and emphasis on reducing bias make it a reliable tool for developing innovative and effective learning media that meet the needs of diverse learners (Zain et al., 2022).

Learning Reading English in Riau

Ehrman et al. (1990) say that language strategies for learning refer to how students combine and use language as a second learning method. Chamot (1987) says language learning strategies refer to how students learn and understand language and educational materials. Kearney & Ellis (1995) divided learning strategies based on Tarone's concepts: language learning and skills. Ras (2013) considered language learning strategies as language learning habits. It can be effortlessly modified and varies depending on the learning style. It is effective or ineffective in various circumstances and frequently at different levels of conscious control. Basic elements such as language usage content and target language use in line with language learning steps, including learning English, can be used to develop language learning strategies.

Students' intelligence in acquiring languages, especially English is well known. In general, these students are capable of taking chances (Rubin, 1975), have strong confidence(Larsen-Freeman, 1991), and have a desire to discover (Slattery & Willis, 2001). Rubin (1975) also mentions the extraordinary qualities of students: a. being able to anticipate unknown events; b. communicate and learn by dialogue; c. learning languages anytime is possible; d. managing their own and others' ways of learning and e. wants. Rubin (1975) also says that some things affect students' success in learning languages: language duties with clear structures, purposes and requirements, way of learning, and an optimistic mindset to targeted languages.

The pilot study result showed that English students at the university in Riau still had the lowest reading comprehension and motivation. Most students did not regularly read English-language texts, and only a tiny percentage had an English reading habit. Nonetheless, most students (70%) acknowledged that reading English will be crucial for their future. These studies indicate areas where changes may be made to improve students' English reading comprehension by offering interactive digital reading modules.

Method

The study focuses on using the Fuzzy Delphi Method to acquire expert perspectives, ideas, and agreements on the elements needed to create and implement a digital reading learning module. The process consists of four main stages (Richey, 2017):

1. Requirements analysis
2. Design
3. Development
4. Qualification evaluation.

This study focuses on the module's design stage using the Delphi Fuzzy method. This method entails confirming or approving the experts who have been picked to get agreement from the experts concerned. The choice of this method is appropriate for emergency purposes.

Participants

The sample research consists of ten expert panels: three related to reading, four related to technological education, and the construction of learning modules. The method of intensive

sampling is used to select the experts. This research was conducted from March to May 2024 at the English Department of Universitas Muhammadiyah Riau. The samples are not randomly selected; instead, they are selected to check the members' expertise and in-depth knowledge of the investigated subject. Those participants were chosen based on their capability in a particular area and the research objectives in determining the feasibility of reading digital modules.

Research Instruments

Research tools for the design and development phases are expert assessment questionnaires developed based on research results. This tool is designed to collect quantitative data using infographics related to the digital reading learning module. To comply with the Delphi Fuzzy Method, which requires the use of mathematical formulas to obtain expert approval, questionnaires are administered.

Data Collection Process and Data Analysis

The Delphi Fuzzy Method is employed for this research's design stage, entailing data gathering by expert analysis and agreement. Considering their fields of competence, the experts are identified. Subsequently, the experts involved will receive an official letter of affidavit with a brief description of the research. This research involves ten experts. Questions will be posed to the chosen experts within a specific time frame. After obtaining the data, the researcher will then analyze it using the Delphi Fuzzy Method. Microsoft Excel will be used to analyze the collected data. Five experts validate the contents before the questionnaires are distributed to the ten experts to ensure that the elements suggested in the Delphi Fuzzy questionnaire match. Experts feedback and feedback are recorded, and suggestions for improvements are included in the questionnaire.

Steps in the Research

The Fuzzy Delphi method (FDM) will process data from research questions. The following procedures were implemented to obtain empirical findings. The process to do is as follows:

Step 1

Use the following methods to create questions for a confusing Delphi questionnaire (Zainudin et al., 2024):

i. Literature review
ii. Speech with a specialist
iii. Group focus conversation
iv. Existing questions (adaptation)

Constructing a questionnaire script is analogous to creating a standard query template. The questionnaire will use the Likert scale according to the required research question, which means it will be used to measure the results the researchers want. This scale will include the approval level, the critical level, and the phase level.

Step 2

Considering oneself an expert, one is requested to evaluate the evaluation standards' importance for the factors that linguistic variables will be used to analyze. To get data and information, the researcher has to be proactive. Some methods that researchers can use are as follows:

i. Host scientific workshops or seminars and ask professionals to attend.
ii. Have in-person meetings with every expert.
iii. Online distribution, such as emailing recognized authorities knowledgeable in the area under study.

During this stage, the researcher decides to employ internet distribution techniques, such as sending emails to academics recognized as authorities in the study area.

Step 3

In this process, all linguistic variables are converted to Fuzzy triangular numbers. Although added with confusing figures, the Likert scale utilized in other studies and the linguistic scale is comparable. Figure One shows three values.

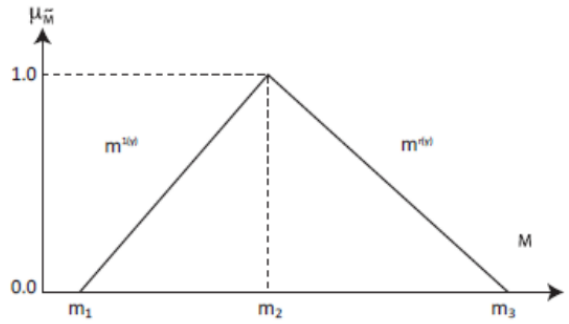


Figure 1. Triangular Fuzzy number
(m1: minimum value; m2: medium value; m3: maximum value)

Stated otherwise, the linguistic variable scale is transformed into a fuzzy number using the linguistic h scale.

Table 1. *Examples of linguistic variable scales*

5-Point *Fuzzy Scale*	*Fuzzy Number*		
	m1	m2	m3
Strongly agree	0.75	1.00	1.00
Agreed	0.50	0.75	1.00
Not sure	0.25	0.50	0.75
Disagree	0.00	0.25	0.50
Strongly disagree	0.00	0.00	0.25

Step 4

Following data collection and expert opinions, the researcher must transform Likert scale responses into fuzzy numbers. The data will be evaluated with Microsoft Excel. Further, the vertex method calculates the deviation of each expert's average line from the overall mean. According to Chen (2000), a formula can be used to calculate the gap between two fuzzy integer numbers, m: (m1, m2, m3) and n: (m1, m2, m3).

$$d(\tilde{m}\tilde{n}) = \sqrt{\frac{1}{3}\left[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2\right]}$$

Step 5

According to Cheng and Lin (2002), if there is less than a 0.2 threshold between expert assessment data and the average, all experts are considered to reach a consensus. If the opposite data is found, the item will either be eliminated or the Delphi Fuzzy Method's second round will be finished.

Step 6

To ascertain each item's position and score value below, it is not very clear to calculate the total score.

$$\tilde{A} = \begin{bmatrix} \tilde{A}_1 \\ \tilde{A}_2 \\ : \\ : \\ \tilde{A}_m \end{bmatrix} \text{ di mana } \tilde{A} = r_{i1} \times w_1 + r_{i2} \times w_2 + \ldots\ldots\ldots\ldots r_{in} \times w_n$$

$i = 1, 2, \ldots\ldots\ldots, m$

The formula for calculating the fuzzy value is as follows: Amax = 1/4 (m1+m2 + m3).

Step 7

The next step is defuzzification, accomplished by applying the formula Amax = 1/4 (m1 + m2 + m3). If the researcher used a fuzzy numerical average or an average response, the score would be between 0 and 1.

Research Findings

The research findings included the experts' consensus and opinions on the components utilized for module creation, as determined by applying the Fuzzy Delphi Method.

The module aims to achieve the following:

i) Appearance/Layout
ii) Interface/Navigation
iii) Content
iv) Reading Strategies
v) Language Module
vi) The Relevancy of the E-Reading Module

Findings and Analysis of Module Appearance/Layout

The module's purpose serves as the initial criterion for expert evaluation of the questionnaire. This assessment uses the Fuzzy Delphi method with a description of Development and Usability (DaU). Based on the finding of module appearance/layout, experts' consensus on module development objectives was established. Since all items have a d value < 0.2, all objects meet the criterion. As a result, experts have reached a high level of approval. See Appendix A

Findings

The second expert evaluation criterion is module interface/navigation. It is assessed through the application of the Fuzzy Delphi method with a description of Development and Usability (DaU). The result of the expert evaluation of the module interface/navigation presents the expert panel's approval of the second criterion: Interface/Navigation. Since d for all of the items is less than or equal to 0.2, all of the contents have already reached the initial condition. Consequently, a high level of approval by experts is evident throughout the study. See Appendix B

Findings and Analysis of Module Content

The third expert evaluation criterion is module content. It is assessed through the application of the Fuzzy Delphi method with a description of Development and Usability (DaU). Based on expert approval of module criteria, it showed that all objects meet the requirement as their d values are consistently below or equal to 0.2. Thus, there is a broad agreement among the experts on the level of agreement. It can be identified by looking at table four in Appendix C

Findings and Analysis of Module Reading Strategies

The fourth evaluation criterion is module reading strategies. It is assessed by applying the Fuzzy Delphi method with a description of Development and Usability (DaU). The module reading strategies analysis can be seen in table five. Table five indicates strong expert approval of the module's reading strategies. All questionnaire items met the established criterion ($d \leq 0.2$). This suggests effective alignment between expert opinions and the module's design regarding reading strategies. See Appendix D

Findings and Analysis of Language Module

The next table presents the fifth evaluation criterion: module language. It is assessed using the Fuzzy Delphi method and a description of Development and Usability (DaU). It demonstrates strong expert approval of module language criteria. All items exhibit d-values within the acceptable range ($d \leq 0.2$), confirming expert approval. See Appendix E

Findings and Analysis of The Relevancy of E-Reading Module

The table below presents the sixth evaluation criterion: the relevancy of e-reading module. It is assessed through the application of the Fuzzy Delphi method with a description of Development and Usability (DaU).

Table 7. *Expert evaluation of the relevancy of the e-reading module*

No	Items	Terms of *Triangular Fuzzy Numbers*		Terms of *Fuzzy Evaluation*				Expert agreement
		Threshold Value, d	Percentage of Expert Group Agreement (%)	m1	m2	m3	Score of *Fuzzy (A)*	
DaU81	The module's content aligns seamlessly with the overall learning	0,098	80,0%	0,440	0,440	0,320	0,440	Accepted

	objectives and desired outcomes.							
DaU82	Learning objectives are clearly stated within the module for learner awareness.	0,098	80,0%	0,440	0,440	0,320	0,440	Accepted
DaU83	The content reinforces and advances the achievement of learning objectives.	0,055	90,0%	0,420	0,420	0,360	0,420	Accepted
DaU84	The module is engaging, utilizing interactive elements and multimedia to maintain learner interest.	0,098	80,0%	0,440	0,440	0,360	0,440	Accepted
DaU85	Learners are encouraged to actively participate and apply their knowledge throughout the module.	0,098	80,0%	0,360	0,360	0,440	0,360	Accepted
DaU86	Opportunities for reflection or discussion are provided to foster engagement.	0,098	80,0%	0,440	0,440	0,420	0,440	Accepted
DaU87	The module is engaging, utilizing interactive elements and multimedia to maintain learner interest.	0,147	100,0%	0,480	0,480	0,360	0,480	Accepted
DaU88	Learners are encouraged to actively participate and apply their knowledge throughout the module.	0,171	90,0%	0,320	0,480	0,440	0,320	Accepted
DaU89	Opportunities for reflection or discussion are provided to foster engagement.	0,171	90,0%	0,320	0,320	0,480	0,320	Accepted

Table Seven presents expert consensus on the sixth criterion, the relevancy of the e-reading module. Since threshold *d* for all items is less than or equal to 0.2, all contents have already reached the initial condition. Consequently, a high level of expert approval is evident throughout the study.

Discussion

The conclusions of the experts' agreement reached using the Fuzzy Delphi Method regarding the module's purpose elements, content, design, learning activities, and assessment are the main topics of debate throughout the design phase. Based on the findings, all experts assess that all the criteria in the e-module, such as appearance/layout, interface/navigation, content, reading strategies, language module, the relevance of the e-reading module, are following the skills chosen and are expected to provide an excellent contribution to improving students' reading comprehension for university students.

Experts also largely agree on the aspects of the module criterion. All experts agree on graphic design features like tables, graphs, and symbols. All experts concur that Indonesian culture is one of its key features. Students will understand the module material more readily if examples of Indonesian culture are given. The content is given to university students at Riau as a guide and point of reference for creating the infographic module application of the Delphi Fuzzi method in digital module reading design. It shows that the fuzzy Delphi method (FDM) helps reach a consensus among experts when developing an e-reading module. Using fuzzy logic accommodates varying degrees of agreement, making it easier to aggregate expert opinions that may be uncertain or imprecise. It is in line with Ciptono et al. (2019) and Yusof et al. (2022) regarding the role of FDM in decision-making throughout the development process. It offers a systematic approach to evaluating different elements of learning media, such as content quality, user interface design, and instructional effectiveness (Abdullah & Siraj, 2018; Zulkifli et al., 2022). Besides, it can enhance teaching quality and help educators refine their existing skills by fostering innovation and utilizing technology within the teaching and learning environment (Zain et al., 2022).

Measuring the learning and assessment components, each element is evaluated by the experts with a 98% confidence level for each component. Activity is a crucial component of the module to boost students' confidence and increase their understanding of the subject matter. Assessment also maintains a crucial role as a measure of student understanding. This means that the developed e-reading module can be expected to be a beneficial e-module for reading comprehension. This is supported by Dwiastuty et al. (2018), which indicates that e-modules can enhance students' reading comprehension. Moreover, e-reading modules can enhance teaching quality and help educators refine their existing skills by fostering innovation and utilizing technology within the teaching and learning environment (Ortega et al., 2023).

Conclusion

This study aimed to develop a module designed to enhance students' reading comprehension, which is a reading digital module. This study also serves as one method of instruction to help students overcome their difficulties when reading texts and tasks. This module will be produced in a statistical infographic format with more visually appealing content and realistic student features. Its design was collaboratively developed through a consensus-building process to ensure alignment with the module's objectives.

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Appendix A

Expert evaluation of module appearance/layout

No	Items	Terms of *Triangular Fuzzy Numbers*		Terms of *Fuzzy Evaluation*				Expert agreement
		Threshold Value, d	Percentage of Expert Group Agreement (%)	m1	m2	m3	Score of *Fuzzy (A)*	
DaU1	The cover design is attractive.	0,147	100,0%	0,480	0,680	0,880	0,680	Accepted
DaU2	The cover design effectively communicates the module's purpose and captures the learner's attention.	0,098	80,0%	0,440	0,640	0,840	0,640	Accepted
DaU3	The cover design is visually appealing and encourages learners to explore the module further.	0,098	80,0%	0,440	0,640	0,840	0,640	Accepted
DaU4	The module's layout is attractive and presented in an appropriate format.	0,153	100,00%	0,500	0,700	0,900	0,700	Accepted
DaU5	The module's layout is well-structured, with clear sections and headings that guide the learner.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU6	Consistency in layout design is maintained throughout the module for a cohesive user experience.	0,153	100,00%	0,500	0,700	0,900	0,700	Accepted
DaU7	The choice of fonts and font sizes ensures readability and supports the module's learning objectives.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU8	Special typography effects, like bold or	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted

	italics, are used purposefully to emphasize key points.							
DaU9	Text size and formatting facilitate comfortable reading without straining the eyes.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU10	The font style and size used are comprehensible and understandable	0,147	100,00%	0,520	0,720	0,920	0,720	Accepted
DaU11	Letter spacing and line spacing are adjusted to prevent overcrowding of text and enhance legibility.	0,153	100,00%	0,500	0,700	0,900	0,700	Accepted
DaU12	Letter spacing is uniform and consistent throughout the module.	0,055	90,00%	0,420	0,620	0,820	0,620	Accepted
DaU13	The picture illustrations used are clear and attractive	0,098	80,00%	0,360	0,560	0,760	0,560	Accepted
DaU14	Pictures, diagrams, or illustrations are relevant and enhance the understanding of the module's content.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU15	Captions or descriptions accompany pictures to provide context and reinforce the content.	0,098	80,00%	0,360	0,560	0,760	0,560	Accepted

Appendix B

Expert evaluation of Module Interface/Navigation

No	Items	Terms of *Triangular Fuzzy Numbers*		Terms of *Fuzzy Evaluation*				Expert agreement
		Threshold Value, d	Percentage of Expert Group Agreement (%)	m1	m2	m3	Score of *Fuzzy (A)*	
DaU16	The module's interface is intuitive and easy to navigate.	0,183	90,00%	0,480	0,680	0,880	0,680	Accepted
DaU17	Learners can easily access different sections or modules without confusion.	0,055	90,00%	0,420	0,620	0,820	0,620	Accepted
DaU18	The interface design enhances the overall user experience.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU19	Navigation elements (links) are clearly labelled and logically organized.	0,098	80,00%	0,440	0,640	0,840	0,640	Accepted

DaU20	Users can quickly locate essential features or content areas.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU21	Navigational consistency is maintained throughout the module.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU22	The layout remains consistent across different sections or pages of the module.	0,183	90,00%	0,480	0,680	0,880	0,680	Accepted
DaU23	Consistency in design and formatting contributes to a cohesive look and feel.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU24	Layout changes are purposeful and enhance content presentation.	0,147	100,00%	0,480	0,680	0,880	0,680	Accepted
DaU25	The module's content follows a logical sequence or structure that aids comprehension.	0,098	80,00%	0,440	0,640	0,840	0,640	Accepted
DaU26	Content is organized in a manner that guides the learner through the material.	0,153	100,00%	0,500	0,700	0,900	0,700	Accepted
DaU27	Clear transitions between sections facilitate smooth navigation.	0,098	80,00%	0,440	0,640	0,840	0,640	Accepted

Appendix C

Experts evaluation module content

Table 4. *Expert evaluation of module content*

No	Items	Terms of *Triangular Fuzzy Numbers*		Terms of *Fuzzy Evaluation*				Expert agreement
		Threshold Value, d	Percentage of Expert Group Agreement (%)	m1	m2	m3	Score of *Fuzzy (A)*	
DaU28	The context of the e-reading module is relevant to the students at UMRI	0,098	80,00%	0,440	0,640	0,840	0,640	Accepted
DaU29	The module establishes a clear context for the topic or subject matter, helping learners understand its relevance.	0,055	90,00%	0,380	0,580	0,780	0,580	Accepted
DaU30	The module's context aligns with the target learner's interests or needs.	0,098	80,0%	0,360	0,560	0,760	0,560	Accepted

DaU31	The topics are appropriate to the student's needs and interests	0,098	80,00%	0,440	0,440	0,440	0,440	Accepted
DaU32	The topics are up to date and related to the local context	0,098	80,0%	0,360	0,360	0,360	0,360	Accepted
DaU33	The topics are supported with illustrative examples, and the reading activities conform to the level of the students	0,098	80,0%	0,360	0,360	0,360	0,360	Accepted
DaU34	The chosen topic directly relates to the module's objectives and the learner's goals.	0,098	80,0%	0,440	0,440	0,440	0,440	Accepted
DaU35	The tasks are appropriate to the given context	0,098	80,0%	0,440	0,440	0,440	0,440	Accepted
DaU36	The tasks can be done easily by the students	0,098	80,0%	0,360	0,360	0,360	0,360	Accepted
DaU37	The tasks are encouraging the development of the students	0,147	100,0%	0,320	0,320	0,320	0,320	Accepted
DaU38	Content is divided into manageable chunks with clear headings and subheadings.	0,110	90,0%	0,360	0,360	0,360	0,360	Accepted
DaU39	Chunking aids learners in processing information incrementally.	0,110	90,0%	0,360	0,360	0,360	0,360	Accepted
DaU40	Headings provide a quick overview of content, helping users find specific information.	0,098	80,0%	0,360	0,360	0,360	0,360	Accepted
DaU41	Instructions for tasks or exercises are clear, concise, and easy to follow	0,000	100,0%	0,400	0,400	0,400	0,400	Accepted
DaU42	The instructions are concise, easy to understand, and follow	0,000	100,0%	0,400	0,400	0,400	0,400	Accepted
DaU43	Instructions guide how to complete tasks, fostering learner independence.	0,055	90,0%	0,420	0,420	0,420	0,420	Accepted
DaU44	The coverage of materials is relevant to the student's needs and interests	0,098	80,0%	0,440	0,440	0,440	0,440	Accepted
DaU45	The module comprehensively covers the necessary material, leaving no critical information gaps.	0,147	100,0%	0,480	0,480	0,480	0,480	Accepted
DaU46	The module balances depth and breadth of	0,098	80,0%	0,360	0,360	0,360	0,360	Accepted

	coverage according to its intended purpose.							
DaU47	Multimedia elements (images, videos, etc.) enhance content comprehension without overwhelming the learner.	0,153	100,0%	0,360	0,500	0,500	0,500	Accepted
DaU48	Visual aids and multimedia support textual information effectively.	0,153	100,0%	0,500	0,500	0,500	0,500	Accepted
DaU49	Multimedia elements are relevant and add value to the content.	0,153	100,0%	0,500	0,500	0,500	0,500	Accepted

Appendix D

Experts Evaluation module reading strategies

Table 5. *Expert evaluation of module reading strategies*

No	Items	Terms of *Triangular Fuzzy Numbers*		Terms of *Fuzzy Evaluation*				Expert agreement
		Threshold Value, d	Percentage of Expert Group Agreement (%)	m1	m2	m3	Score of *Fuzzy (A)*	
DaU50	The text's main ideas are explicitly stated or implied for the learner.	0,147	100,0%	0,500	0,480	0,480	0,480	Accepted
DaU51	Key concepts and main points are highlighted to aid in comprehension.	0,147	100,0%	0,480	0,480	0,480	0,480	Accepted
DaU52	Main ideas are reinforced throughout the module to ensure retention.	0,147	100,0%	0,480	0,480	0,440	0,480	Accepted
DaU53	The module helps learners understand how different ideas within the content connect and relate to one another.	0,098	80,0%	0,480	0,440	0,360	0,440	Accepted
DaU54	Transitions between sections or concepts are smooth and facilitate the flow of information.	0,098	80,0%	0,440	0,440	0,320	0,440	Accepted
DaU55	Cross-references or links are provided to encourage exploration of related concepts.	0,061	80,0%	0,440	0,400	0,360	0,400	Accepted
DaU56	Supporting details are effectively integrated into the module, providing context and depth.	0,098	80,0%	0,400	0,360	0,360	0,360	Accepted

DaU57	Graphics, examples, and anecdotes illustrate and reinforce supporting details.	0,098	80,0%	0,360	0,440	0,360	0,440	Accepted
DaU58	Learners are guided to recognize and distinguish between main ideas and supporting details.	0,098	80,0%	0,440	0,360	0,360	0,360	Accepted
DaU59	Highlighted and hyperlinked vocabularies make the text/task attractive and easy to understand	0,098	80,0%	0,360	0,440	0,400	0,440	Accepted
DaU60	Key vocabulary terms are introduced and defined within the module to aid comprehension.	0,147	100,0%	0,440	0,480	0,400	0,480	Accepted
DaU61	Glossaries or tooltips are provided for quick access to definitions while reading.	0,147	100,0%	0,480	0,480	0,420	0,480	Accepted
DaU62	Vocabulary exercises or quizzes are included to reinforce understanding.	0,098	80,0%	0,480	0,440	0,440	0,440	Accepted
DaU63	The module encourages learners to infer implied meanings or deeper interpretations of the content.	0,171	90,0%	0,440	0,320	0,480	0,320	Accepted
DaU64	Thought-provoking questions or prompts are used to stimulate critical thinking.	0,171	90,0%	0,320	0,320	0,360	0,320	Accepted
DaU65	Learners are guided to explore the subtext or underlying themes within the module.	0,098	80,0%	0,320	0,360	0,500	0,360	Accepted

Appendix E

Expert evaluation of language module

No	Items	Terms of *Triangular Fuzzy Numbers*		Terms of *Fuzzy Evaluation*				Expert agreement
		Threshold Value, d	Percentage of Expert Group Agreement (%)	m1	m2	m3	Score of *Fuzzy (A)*	
DaU66	The language used in the module is clear, concise, and free from unnecessary complexity.	0,098	80,0%	0,360	0,440	0,500	0,440	Accepted

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DaU67	Concepts are explained in straightforward terms, avoiding jargon or ambiguity.	0,055	90,0%	0,440	0,420	0,500	0,420	Accepted
DaU68	The writing style promotes understanding and engagement.	0,098	80,0%	0,420	0,360	0,480	0,360	Accepted
DaU69	Industry-specific jargon and technical terms are defined or explained when introduced.	0,098	80,0%	0,360	0,440	0,480	0,440	Accepted
DaU70	Definitions are readily accessible to learners through tooltips or glossaries.	0,147	100,0%	0,440	0,480	0,480	0,480	Accepted
DaU71	The module strikes a balance between technical accuracy and user-friendly language.	0,147	100,0%	0,480	0,480	0,440	0,480	Accepted
DaU72	Consistent terminology is used throughout the module to prevent confusion.	0,098	80,0%	0,480	0,440	0,440	0,440	Accepted
DaU73	Synonyms or variations in terminology are explained to maintain clarity.	0,098	80,0%	0,440	0,440	0,400	0,440	Accepted
DaU74	Terminology aligns with industry standards or the module's specific context.	0,098	80,0%	0,440	0,440	0,360	0,440	Accepted
DaU75	The module is free from noticeable grammar and spelling errors.	0,147	100,0%	0,320	0,320	0,440	0,320	Accepted
DaU76	Proofreading and editing ensure polished content.	0,055	90,0%	0,420	0,420	0,360	0,420	Accepted
DaU77	Correct grammar and spelling contribute to a professional presentation.	0,061	80,0%	0,400	0,400	0,440	0,400	Accepted
DaU78	The reading level of the module is appropriate for the target audience, considering factors like complexity and sentence length.	0,055	90,0%	0,380	0,380	0,480	0,380	Accepted
DaU79	Content is accessible to learners with varying levels of expertise in the subject matter.	0,098	80,0%	0,440	0,440	0,480	0,440	Accepted
DaU80	Complex concepts are broken down into understandable segments.	0,098	80,0%	0,440	0,440	0,440	0,440	Accepted