

Expert evaluation of a web-based grammatical competence module: Fuzzy Delphi method

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ABSTRACT

Web-based learning modules have been considered indispensable for English as a second language (ESL) learners to utilize autonomously. However, there are still not many reputable grammatical competence modules designed for the transition between secondary school and undergraduate levels. Thus, this study aimed to ascertain expert consensus on developing a web-based grammatical competence module for pre-university ESL learners. The Fuzzy Delphi method (FDM) was employed in this study to create the module. Four broad constructs, which are the design, technical aspects, content, pedagogy of the website were used as references in developing a survey as the instrument for the study. The features in the survey were evaluated by six selected experts based on established criteria for high-quality language learning websites. Data analysis was undertaken using a 5-point fuzzy scale and the Fuzzy Delphi approach Logic Software (FUDELO 1.0). Supported by the findings and a consensus rate of over 75%, a cut-off value (d) of ≤ 0.2 , and a fuzzy score (A) of $\geq \alpha$ -cut value=0.5, expert consensus was reached for the four constructs. The findings support that the module is fitting for pre-university ESL learners and can be used as a supplementary grammar learning module. Empirical studies related to learner performance and engagement outcomes in the future must continue assessing the long-term effectiveness of the module and ensure its long-term efficacy in ESL learning.

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1. INTRODUCTION

In the language education paradigm, web-based learning modules have been established as essential tools for autonomous learning, particularly in the context of grammatical instruction. Nonetheless, the school to post-secondary transition creates challenges for Malaysian pre-university learners in English as a second language (ESL) [1]. The challenge is to transcend conventional methods of teaching grammar that fail to facilitate authentic and meaningful engagement [2]. Furthermore, the development of web-based learning modules for learning grammar, particularly for pre-university ESL learners, remains lacking as a lot of previous research focused mainly on undergraduate students [3]–[5]. Consequently, grammatical knowledge [6], which is crucial for second language (L2) writing [7] and effective communication [8] at the tertiary level, is limited in many pre-university ESL learners. Prior studies also indicated that many pre-university students often faced difficulties in writing due to weaknesses in grammar and vocabulary as well as a lack of motivation [9], [10].

Research in L2 acquisition highlights the importance of explicit grammar instruction and communicative practice. Krashen input hypothesis [11] posited that learners also benefit from noticing and consciously processing grammatical forms. At the same time, as suggested by Schmidt noticing hypothesis [12], exposure to comprehensible input is crucial for language development. A web-based module can provide an orderly domain for learners to focus on grammatical forms, functions, and applications while they engage in meaningful language activities and take control of their own learning pace, which will ultimately boost their academic readiness [13], [14].

As the global demands of the 21st century continue to evolve, there has been an observable increase in the transformation towards the incorporation of internet-based language teaching in the classroom [15]. The utilization of websites has been flourishing significantly, especially in the process of English language learning (ELL) [1]. Strengthening such technology will enable the module to blend adaptive learning practices, instant feedback features, and multimedia resources to fulfil various learning needs [16]. The existing gap can be narrowed through the incorporation of the web-based grammatical competence module by giving learners systematic, interactive, and self-paced learning experiences. Contextual learning and personalized learning experiences are fostered by autonomous learning [17]. Thus, compared to the traditional rote learning method, students are able to internalize grammatical structures more effectively. Additionally, language education has been transformed by the emergence of technology due to rising new opportunities for improving language learning and the effectiveness of instructional efficiency [18].

Numerous technologies have been developed by researchers to assist ESL students with their language education, such as improved writing performance through iPads among adolescents with autism spectrum disorders [19] and enhanced acquisition of English language competence through gamification [20]. Nevertheless, innovations that particularly aid Malaysian pre-university ESL learners with their grammatical competency have received limited attention. Additionally, although instructors and students were frequently included in earlier studies when assessing ELL websites and online resources [21]–[23], subject matter specialists' important viewpoint at every stage of the creation of the website and growth is sometimes disregarded. Field experts are essential to the evaluation of websites since they are able to point out possible areas for development [24]. Hence, technological tools must be evaluated before being implemented for utilization by actual users to enhance quality.

Kartal and Uzun [25] distinguished three criteria of an effective website for language acquisition. The first criterion is physical features that foreshadow the overall design and framework of the website (such as easy access to multimedia resources, seamless transitions, no eye strain from color use, and the ability to use virtual materials and other tools). The second criterion is contextual features related to the features of the content of the site. For example, authentic and up-to-date materials in various formats and types that are apposite for the subject, learners' level and type must be available. The exercises ought to be adaptable to allow user contributions and provide feedback. Similarly, the content should comprise practical exercise tools for different levels. The third criterion is pedagogical, which relates to the components of learning (for example, materials that are simple and provide clear elucidation and direction on activities and exercises, informative, helpful, useful feedback, aligning with education innovation, appropriate in level and pertinent with regards to a website's scope, needs, and purpose). According to Fuentes and Martínez [26], these three traits align with the appropriate fundamentals of a supplementary web-based learning resource.

The Fuzzy Delphi method (FDM) has been applied in several studies to establish expert consensus on essential elements for designing educational modules across diverse disciplines. Most studies have focused on identifying critical components for module development, particularly in online and technology-enhanced learning environments. For instance, several studies [27], [28] emphasized integrating pedagogical strategies with technology by using expert validation to refine scenario-based and problem-based learning modules, respectively. On the other hand, based on expert consensus in four key areas: objectives, content, learning activities, and assessments, Luo *et al.* [29] structured a technical communication module.

Despite most studies utilizing FDM to test module components, the nature of the modules differs across disciplines and instructional approaches. For instance, several studies concentrated on the integration of technology-enabled learning [28], [30]. Lim and Kamin [30] utilized mobile augmented reality for vocational learning, whereas Yusoff *et al.* [28] employed problem-based learning in an Islamic studies course. Conversely, several researchers [27], [29] developed their modules based on concrete skill-based competencies such as front-office operations and technical communication. By applying FDM in the design and development phases to enhance the competencies of English language teachers, Krishnan *et al.* [31] were distinct in the application of gamification with Classcraft. Despite the observable differences, all the studies confirmed expert consensus on critical module components. The findings of the studies demonstrate the ability of FDM to validate instructional design in diverse learning settings.

With all the importance and benefits of technological tools, particularly web-based learning, the need to fill in the transition gap between secondary school and undergraduate levels with a reputable grammatical competence module, as well as the unprecedented use of the FDM in module analysis, the main

objective of the current study which was to assess experts' opinions on a web-based grammatical competence module was established. This study's research question was formulated as: what is the experts' consensus on the design, technical aspects, content, and pedagogy of the web-based grammatical module (MODUGRAM) for pre-university ESL learners?

This module had been designed as a fragment of a developmental research project and was examined according to pre-established criteria by using FDM to determine its effectiveness and relevance in pre-university ESL learners' academic grammatical competence development. The rationale of this study is to attain the consensus of experts on the items of the constructs that underpin the web-based grammatical competence module called MODUGRAM for pre-university ESL learners. The significance of this study would greatly contribute to the body of knowledge and guidelines in the establishment of a quality web-based module that can be implemented by the education policy makers and English language educators around the world.

2. METHOD

The three phases of design and development research (DDR) in this study are needs analysis (phase 1), design and development (phase 2), and implementation and evaluation (phase 3) [32]. The prototype must be assessed before students can use the web-based module. This study was in phase 2 as it focused on getting experts' consensus on the constructs of a MODUGRAM for pre-university ESL learners using the FDM.

This study employed the FDM as expert opinion is needed to arrive at a conclusion [33]. Research by Ciptono *et al.* [34] stated that the FDM helps gather experts' opinions, reach a consensus, identify potential instructional interventions, predict future trends, and engage users without time and geographical limits. The FDM also helped identify the level of understanding among the experts, solve disagreements, and reach a consensus. Latif *et al.* [35] stated that the FDM was often used in surveys. Yusoff *et al.* [28] mentioned that the FDM has more advantages than the Delphi method as it allows experts to give opinions, organize the survey administration process, and save time and resources.

2.1. FDM instrument construction

A literature review served as the groundwork for the creation of the Fuzzy Delphi instrument. The researcher could base the components of the survey on pilot studies, a literature review, and/or prior experiences [28]. Additionally, Mokhtar and Yasin [36] discovered that prior studies should be used as guidelines to construct the items and content parts of a study. The study's survey design methodology was conducted in two phases. Most of the survey items were adapted and included from previous research [1], [37]. The researchers also added a few items to the survey to suit the contents and measurement items. These items were divided with a 5-point Likert scale into four constructs: design, technical aspects, content, and pedagogy, which adapted from Faisal *et al.* study [1], and based on Kartal and Uzun framework [25].

The items included in the survey were tested for validity with the aid of university academics in the teaching English as a second language (TESL) and computer science fields. Some revisions were made particularly in regard to the choice of words and the sentence structures to fix double-barrel statements and simplify them. Subsequently, the researcher finalized the items in the survey and sent it to six selected experts via email to evaluate MODUGRAM. The labels and detailed descriptions of the items in each construct are exhibited in Table 1.

2.2. Sample expert criteria and sampling

Purposive sampling was utilized to select the experts for this study. Their level of expertise and research experience were considered according to the expert criteria. Purposive sampling is the most apposite method for sampling in FDM [36]. In this study, six selected experts assessed the module. The experts must possess at least five years of experience, particularly in their area of specialization, and continuously have teaching and working experience within the education field [36]. Ismail *et al.* [38] affirmed that FDM requires consensus and expert opinion in an attempt to develop a module. Five to ten experts are recommended while selecting experts with similar backgrounds [39]. Therefore, six experts are adequate to gather data and obtain an expert consensus. The list presents the more detailed criteria in appointing the experts: i) a Ph.D. holder in the fields of English language, linguistics, educational technologies, and/or curriculum and instruction; ii) has at least five years of teaching using English as a medium of instruction; and iii) currently working as an in-service lecturer at a pre-university or university institution.

Table 1. Labels and descriptions of items for each construct of the FDM instrument

Construct	Item label	Item description
Design	D11	The layout of MODUGRAM is suitable for pre-university ESL students to develop grammatical competence.
	D12	The images used on MODUGRAM are suitable for the contents.
	D13	The colors used on MODUGRAM are suitable for learning.
	D14	The text formats on MODUGRAM are appropriately used across all pages.
	D15	The graphics used on MODUGRAM are relevant to the contents across all pages.
	D16	The videos used on MODUGRAM are relevant to the contents across all pages.
	D17	The animations in MODUGRAM are easy for users to recognize, making the interface feel smooth and intuitive.
	D18	The types of fonts used on MODUGRAM are easy to be read.
	D19	The sizes of fonts used on MODUGRAM are easy to be read.
	D110	The overall design of MODUGRAM is attractive.
Technical aspects	T11	The layout of MODUGRAM is easy to follow.
	T12	The module is well-organized.
	T13	The module is easy for users to look for the information needed.
	T14	The webpage for users to send feedback to the researcher is displayed with a single click on the send feedback button.
	T15	The options available on the MODUGRAM menu are displayed with a single click.
	T16	The external websites are displayed when the links on MODUGRAM are clicked.
	T17	Clicking to browse MODUGRAM transitions smoothly.
	T18	The audios on MODUGRAM play smoothly with a single click.
	T19	The videos on MODUGRAM play smoothly with a single click.
	T110	The user interface is user-friendly.
Content	C11	The contents used are appropriate for curriculum in education.
	C12	The contents used are appropriate to the learning objectives.
	C13	The contents used are appropriate for pre-university ESL students' proficiency level.
	C14	The contents used are appropriate for pre-university ESL students' schemata.
	C15	There are no typographical errors that could lead to misunderstanding.
	C16	There are no spelling errors that could cause misunderstanding.
	C17	The contents include grammar learning activities for practice opportunities.
	C18	The contents include assessment sections for testing learners' comprehension.
	C19	The contents are presented through various types of media.
	C110	The information on MODUGRAM is accurate.
	C111	The contents of MODUGRAM are current for their intended purposes.
	C112	The external links on MODUGRAM are credible.
Pedagogy	P11	The information delivered on MODUGRAM is easy to understand.
	P12	The grammar exercises on MODUGRAM are suitable for different proficiency levels of pre-university ESL students.
	P13	The instructions on MODUGRAM are direct.
	P14	The grammar activities on MODUGRAM are thoroughly guided.
	P15	The grammar assessments on MODUGRAM provide instant feedback.
	P16	The materials designed are in line with current technological tools for learning.
	P17	The materials provide enough stimulus to promote memory retention.
	P18	The materials reflect the scope of MODUGRAM.
	P19	The materials align with the goal of MODUGRAM.
	P110	MODUGRAM is interesting to be explored as a resource for learning grammar to enhance competency.
	P111	MODUGRAM allows students to be self-directed learners in the absence of an instructor.

2.3. Data collection procedure

Three of the experts were approached in person, while the other three were contacted via email. All experts were individually sent a formal email request, an appointment letter, and the link to the web-based module (www.modugram.com) once they agreed to become an expert for this study. Table 2 summarizes the details of the experts involved.

Table 2. List of experts

Expert	Designation	Area of expertise	Institution	Experience (years)
1	Associate professor	Applied linguistics, teaching English to speakers of other languages (TESOL)	Ryukoku University, Japan	15
2	Assistant professor	Creativity in higher education, creative problem solving	University of Nottingham, Malaysia	5
3	Lecturer	Linguistics	Kolej Tingkatan Enam Shah Alam, Malaysia	13
4	Senior lecturer	TESL, technology enhanced language learning (TELL)	Universiti Poly-Tech Malaysia	15
5	Senior lecturer	TESL, teacher education, DDR, curriculum and instruction	Universiti Teknologi MARA, Malaysia	29
6	Associate professor	Teaching English	Van Lang University, Vietnam	24

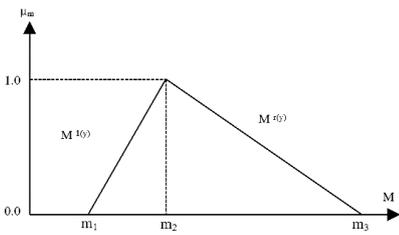
2.4. Data analysis procedure

A 5-point Likert scale was utilized in this study to develop a series of expert questions following extensive sessions with a panel of experts and an in-depth review of the relevant literature. The fuzzy numbers with a Likert scale ranging from 1 to 5 were assigned and labelled as m_1 , m_2 , and m_3 [40], while the fuzzy values were allocated by the Fuzzy Delphi approach Logic Software (FUDELO 1.0) for each of the five linguistic variables to facilitate the expert’s response to the survey, as indicated in Table 3. The gathered data was examined using FDM through FUDELO 1.0. Table 4 describes the steps used for data collection and formulation in the FDM of this study.

Table 3. A 5-point scale linguistic variables

Likert scale	Linguistic variable	Fuzzy numbers (m_1, m_2, m_3)	FUDELO 1.0’s fuzzy value
1	Strongly disagree	0.0, 0.0, 0.2	0.1
2	Disagree	0.0, 0.2, 0.4	0.2
3	Somewhat agree	0.2, 0.4, 0.6	0.4
4	Agree	0.4, 0.6, 0.8	0.6
5	Strongly agree	0.6, 0.8, 1.0	0.8

Table 4. Data collection and formulation steps utilized in FDM

Step	Formulation
1: Selection of experts	Six experts were appointed for this study to evaluate MODUGRAM based on four constructs (design, technical aspects, content, and pedagogy) that would be computed by linguistic variables, as in Table 3.
2: The determination of linguistic scale	Translating all linguistic variables into fuzzy triangle measurement is mandatory. Fuzzy numbers are added to the translations of linguistic variables [41]. Figure 1 presents the triangular fuzzy number that epitomizes and is written as m_1 (the lowest value), m_2 (the rational value), and m_3 (the highest value). Contrarily, the triangular fuzzy number produces a fuzzy scale that converts linguistic variables into fuzzy numbers.
	
3: Determining linguistic variables and average reactions	After the researcher obtains responses from the designated experts, the entire Likert scale must be transformed into the fuzzy scale. This approach is also understood as enumerating the average reaction of every fuzzy number [42]. This procedure is based on the equation: $M = \frac{\sum_{i=1}^n m_i}{n}$
4: Determining threshold value “d”	Expert agreement is subject to the threshold value [43]. Distances for fuzzy integers $m = (m_1, m_2, m_3)$ and $n = (n_1, n_2, n_3)$ are measured by means of the formula: $d(\bar{m}, \bar{n}) = \sqrt{\frac{1}{3} [(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$
5: Distinguishing the alpha-cut aggregate level of the Fuzzy assessment	A fuzzy value is received if experts agree. The calculation and measurement method of the fuzzy value are: $A_{max} = (1) / 4 (m_1 + 2m_2 + m_3)$.
6: The process of defuzzification	This process utilizes the formula $A_{max} = 1/4 * (a_1 + 2a_2 + a_3)$. Average fuzzy numbers or average responses can be used to compute a score between 0 and 1. This process employs three formulas: $A = 1/3 * (m_1 + m_2 + m_3)$ or; $A = 1/4 * (m_1 + 2m_2 + m_3)$ or; $A = 1/6 * (m_1 + 4m_2 + m_3)$. The A-cut value equals the '0' and '1' median with α -cut = 0.5 ((0+1)/2). The item is rejected if the A value does not achieve the α -cut value of 0.5 since it does not indicate the consensus of the experts. Hence, it is recommended that the Alpha-cut value, or α -cut value, is higher than 0.5 [44].
7: The process of ranking	The last process is ranking. The ranking or sub-phase processes of the model have been explained by Saido <i>et al.</i> [45]. Using the placement method, the model element to be placed is decided according to the value of defuzzification determined by the overall agreement from the experts. The placement in the model generates the highest value possible for what the experts consider to be the most significant.

3. RESULTS AND DISCUSSION

In this part, the results of this study are discussed in accordance with the experts' overall agreement regarding the recommendations to develop the steps of the FDM. The information was collected from the six experts in their field who provided responses. Tables 5-8 provide a summary of the findings. Table 5 displays the threshold values of items from DI1 to DI10, all of which were less than 0.2. The defuzzification value for all items was also greater than 0.5. The specific defuzzification values are: DI1 (0.7), DI2 (0.633), DI3 (0.533), DI4 (0.7), DI5 (0.633), DI6 (0.7), DI7 (0.633), DI8 (0.7), DI9: (0.667), DI10 (0.633), all of which indicate that all 10 items under the design construct of MODUGRAM were accepted.

Table 6 exhibits the threshold values of items from TI1 to TI10, which were less than 0.2 except for TI4 (0.269), as expert 3 showed disagreement on the item: "the webpage for users to send feedback to the researcher is displayed with a single click on the send feedback button." Nevertheless, all of the defuzzification values for the 10 items were still greater than 0.5. The specific defuzzification values are: TI1 (0.733), TI2 (0.767), TI3 (0.633), TI4 (0.667), TI5 (0.767), TI6 (0.733), TI7 (0.667), TI8 (0.733), TI9: (0.733), TI10 (0.633), which indicate that all 10 items under the technical aspects construct of MODUGRAM were accepted.

Table 5. The findings of expert consensus on MODUGRAM's design

Expert	DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8	DI9	DI10
1	0.058	0.096	0.038	0.058	0.096	0.058	0.019	0.058	0.077	0.096
2	0.058	0.135	0.077	0.058	0.135	0.058	0.019	0.058	0.038	0.019
3	0.058	0.135	0.077	0.058	0.019	0.058	0.019	0.058	0.154	0.135
4	0.058	0.096	0.077	0.058	0.019	0.058	0.019	0.058	0.038	0.019
5	0.058	0.096	0.154	0.058	0.096	0.058	0.096	0.058	0.077	0.096
6	0.058	0.019	0.038	0.058	0.019	0.058	0.019	0.058	0.077	0.019
Value of the item	0.058	0.096	0.077	0.058	0.064	0.058	0.032	0.058	0.077	0.064
Value of the construct item <0.2	6	6	6	6	6	6	6	6	6	6
% of item <0.2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Average of % consensus										100
Defuzzification	0.7	0.633	0.533	0.7	0.633	0.7	0.633	0.7	0.667	0.633
Ranking	1	3	4	1	3	1	3	1	2	3
Status	Accept									

Table 6. The findings of expert consensus on MODUGRAM's technical aspects

Expert	TI1	TI2	TI3	TI4	TI5	TI6	TI7	TI8	TI9	TI10
1	0.077	0.019	0.019	0.077	0.019	0.077	0.077	0.038	0.038	0.019
2	0.038	0.019	0.096	0.038	0.096	0.077	0.038	0.077	0.077	0.096
3	0.077	0.019	0.135	0.269	0.019	0.038	0.038	0.077	0.077	0.019
4	0.038	0.096	0.019	0.077	0.019	0.038	0.038	0.038	0.038	0.019
5	0.038	0.019	0.096	0.077	0.019	0.038	0.038	0.038	0.038	0.019
6	0.038	0.019	0.019	0.077	0.019	0.038	0.077	0.038	0.038	0.019
Value of the item	0.051	0.032	0.064	0.103	0.032	0.051	0.051	0.051	0.051	0.032
Value of the construct item <0.2	6	6	6	5	6	6	6	6	6	6
% of item <0.2	100%	100%	100%	83%	100%	100%	100%	100%	100%	100%
Average of % consensus										98
Defuzzification	0.733	0.767	0.633	0.667	0.767	0.733	0.667	0.733	0.733	0.633
Ranking	2	1	4	3	1	2	3	2	2	4
Status	Accept									

Table 7 shows the threshold values of items from CI1 to CI12, all of which were less than 0.2. The defuzzification value for each item was also greater than 0.5. The specific defuzzification values are: CI1 (0.7), CI2 (0.733), CI3 (0.7), CI4 (0.667), CI5 (0.6), CI6 (0.733), CI7 (0.733), CI8 (0.733), CI9: (0.7), CI10 (0.7), CI11 (0.667), CI12 (0.733), all of which indicate that all 12 items under the content construct of MODUGRAM were accepted.

Table 8 presents the threshold values of items from PI1 to PI11, which were less than 0.2 except for PI4 (0.231) and PI7 (0.212), as expert 2 showed disagreement on the items: "the grammar activities on MODUGRAM are thoroughly guided" and "the materials provide enough stimulus to promote memory retention." Nonetheless, all of the defuzzification values for the 12 items were still greater than 0.5. The specific defuzzification values are: PI1 (0.667), PI2 (0.733), PI3 (0.667), PI4 (0.6), PI5 (0.767), PI6 (0.667), PI7 (0.567), PI8 (0.667), PI9: (0.7), PI10 (0.667), PI11 (0.7), which indicate that all 11 items under the pedagogy construct of MODUGRAM were accepted.

Table 7. The findings of expert consensus on MODUGRAM's content

Expert	CI1	CI2	CI3	CI4	CI5	CI6	CI7	CI8	CI9	CI10	CI11	CI12
1	0.058	0.038	0.058	0.077	0.115	0.038	0.038	0.038	0.058	0.058	0.077	0.038
2	0.058	0.077	0.058	0.038	0.000	0.077	0.077	0.192	0.058	0.058	0.154	0.077
3	0.058	0.038	0.058	0.154	0.115	0.077	0.077	0.038	0.058	0.058	0.038	0.077
4	0.058	0.077	0.058	0.038	0.115	0.038	0.038	0.038	0.058	0.058	0.077	0.038
5	0.058	0.038	0.058	0.077	0.115	0.038	0.038	0.038	0.058	0.058	0.077	0.038
6	0.058	0.038	0.058	0.077	0.000	0.038	0.038	0.038	0.058	0.058	0.038	0.038
Value of the item	0.058	0.051	0.058	0.077	0.077	0.051	0.051	0.064	0.058	0.058	0.077	0.051
Value of the construct item <0.2	6	6	6	6	6	6	6	6	6	6	6	6
% of item <0.2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Average of % consensus												100
Defuzzification	0.7	0.733	0.7	0.667	0.6	0.733	0.733	0.733	0.7	0.7	0.667	0.733
Ranking	2	1	2	3	4	1	1	1	2	2	3	1
Status	Accept											

Table 8. The findings of expert consensus on MODUGRAM's pedagogy

Expert	PI1	PI2	PI3	PI4	PI5	PI6	PI7	PI8	PI9	PI10	PI11
1	0.038	0.077	0.077	0.000	0.096	0.038	0.019	0.038	0.058	0.038	0.058
2	0.038	0.077	0.038	0.231	0.019	0.038	0.212	0.038	0.058	0.038	0.173
3	0.038	0.038	0.077	0.115	0.019	0.038	0.019	0.038	0.058	0.077	0.058
4	0.077	0.038	0.077	0.115	0.019	0.077	0.135	0.077	0.058	0.077	0.058
5	0.077	0.038	0.154	0.000	0.019	0.077	0.019	0.038	0.058	0.038	0.058
6	0.038	0.038	0.038	0.000	0.019	0.038	0.019	0.077	0.058	0.038	0.058
Value of the item	0.051	0.051	0.077	0.077	0.032	0.051	0.071	0.051	0.058	0.051	0.077
Value of the construct item <0.2	6	6	6	5	6	6	5	6	6	6	6
% of item <0.2	100%	100%	100%	83%	100%	100%	83%	100%	100%	100%	100%
Average of % consensus											96
Defuzzification	0.667	0.733	0.667	0.6	0.767	0.667	0.567	0.667	0.7	0.667	0.7
Ranking	4	2	4	5	1	4	6	4	3	4	3
Status	Accept										

The darkened threshold value that is greater than 0.2 signifies that the value is above the threshold (Tables 6 and 8). The values imply disagreements or a lack of agreement among experts on specific matters in the technical aspects and pedagogy of MODUGRAM. All items' average value in Tables 5-8 demonstrates that the threshold value (d) is less than 0.2, despite varying expert opinions. This finding signifies that each component achieved a sufficient degree of expert consensus [33], [46]. Furthermore, the findings show evidence that the overall consensus percentage is above 75%. Thus, the conditions needed for expert consensus on these matters have been satisfied [28]. Similarly, it was shown that with the α -cut threshold, all of the alpha-cut defuzzification values (also called the fuzzy response average) are more than 0.5. The item in this study is rejected if the α -cut defuzzification value is less than 0.5 since the value signals that the experts would agree to reject the used items [38]. In this study, every alpha cut value exceeds 0.5, and all items acquired high degrees of expert consensus. Thus, all 43 items were accepted as reliable and suitable for use in numerous contexts. Lastly, according to the findings (Tables 5-8), every item was categorized and ranked based on priority.

For the web-based grammatical competence module for pre-university ESL learners, consensus was reached on the effectiveness and applicability of MODUGRAM by utilizing expert evaluation using FDM. The findings denote the relevance of the module and confirm its validity for its intended audience despite several initial disagreements in technical and pedagogical aspects. The findings are in line with prior studies which utilized FDM to validate web-based learning modules in various fields [27], [28]. The alpha-cut defuzzification values above 0.5 show strong agreement among the experts. The findings confirm the reliability of the components of the module. Hence, they fulfil the critical criteria for effective web-based grammar instruction.

Moreover, as identified in the literature, these findings emphasize the requirements for structured technology-improved platforms that can help narrow the gap in the competence of grammar among pre-university ESL learners. The theoretical underpinnings related to acquisition of a L2, particularly Krashen's input hypothesis [11] and Schmidt noticing hypothesis [12], stress the role of structured exposure and metalinguistic awareness in grammar learning. The consensus stated earlier aligns with the mentioned theories. As the module aligns with the framework of Kartal and Uzun [25], which consists of physical, contextual, and pedagogical features, the instructional effectiveness of the module is further validated. The strength of the module as providing ordered explanations, interactive practice, and immediate feedback,

confirming existing studies to highlight the advantages of web-based learning environments in supporting self-directed and individualized learning experiences, is acknowledged by experts [17], [16].

The less significant differences in the technical and pedagogical aspects highlight areas for further improvement, although the MODUGRAM attained a high degree of agreement. Other experts highlighted the prospect of further enhancing adaptive learning capabilities and incorporating more interactive elements to enhance learner engagement and retention to a maximum level. The findings highlight the evolving features of web-based learning tools, focusing on the significance of continuous upgrades and improvements to stay updated with changing pedagogical directions and technological advances [47].

4. CONCLUSION

The study's objective was to attain the experts' consensus on the design, technical aspects, content, and pedagogy of the web-based grammatical competence module (MODUGRAM). According to findings of the FDM analysis, MODUGRAM for pre-university ESL learners is confirmed to be theoretically sound and pedagogically effective in all four constructs. The module is confirmed by the high level of expert consensus as all 43 items from the four constructs were accepted. The module's capability to improve grammatical proficiency is confirmed through structured, interactive, and self-paced learning. By addressing the gap in web-based grammar instruction for Malaysian pre-university learners, this study makes a significant contribution to the expanding body of literature in relation to technology-enhanced language learning.

The findings offer valuable lessons for the development of future modules despite only minor areas for improvement being determined. This study is also expected to be beneficial for the contribution in knowledge of web-based learning module development for education policy makers and instructors worldwide as it can serve as a reference and guideline for them to develop and establish more web-based modules not just for their institutions, but also other ESL students and instructors globally. The outcome of this study is a good educational practice for policy makers and educators in general to share and discuss among one another and make improvements to currently available web-based platforms that suit the English proficiency level of their students. The limitation of this study is that it is focused on developing and establishing a grammatical competence module for pre-university ESL learners from the consensus of experts. Hence, it is recommended that bigger empirical studies in the areas of learner engagement and performance outcomes be undertaken to measure the long-term effectiveness of the module further and determine its ongoing applicability in ESL learning.

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This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : **O** Writing - **O**riginal Draft

E : **E** Writing - **R**eview & **E**ditting

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study. Participants were informed of the study's purpose, procedures, potential risks and benefits, and their right to withdraw at any time without penalty.

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ETHICAL APPROVAL

The Ethical Committee of Universiti Teknologi MARA, Malaysia has granted approval for this study on July 23rd 2024 (Ref. No. REC/07/2024 (ST/MR/127)).

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [NHMY], upon request.

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