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Configuring culturally relevant e-adaptive learning design to facilitate students' digital communication skills acquisition

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Abstract

The purpose of this research was to configure a culturally relevant e-adaptive learning design for the English for Educational Technologists online course by integrating local communication values to facilitate students' learning in mastering digital communication skills. The culturally relevant e-adaptive learning design configuration is called REGARD, an acronym for the five learning phase designs: Readiness (R), Exploration (E), Grouped Activity (G), Assessment (A), Reflection (R), and Decision-making (D). The research method employs research and development approaches. Eight experts reviewed the REGARD design prior to formative evaluation. Thirty-three students were actively involved in the learners' evaluation. Closed and open questionnaires were used to collect data to validate the developed REGARD design, viewed from the perspectives of instructional design, learning materials, learning media, and information communication aspects. Descriptive statistical techniques were used to analyze the collected data. The results showed the overall scores given by all experts and student trials across the three stages of formative evaluation fell within the "Very Good" category according to the five-point criterion-referenced scale. These findings suggest that the REGARD learning design configuration within the learning management system (LMS) is valid and appropriate for use in the *English for Educational Technologists* course.

Keywords: Culturally relevant, Digital communication skills, E-adaptive learning configuration, Learning design, Learning management system.

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1. Introduction

Digital communication, recognized as a key 21st-century skill and one of the core dimensions of the digital learning environment, is essential in equipping students to participate in the contemporary workforce not only as employees but also as job creators [1]. Higher education plays a pivotal role in fostering digital competence, with particular attention to the variety of contexts, including aspects of digital communication proficiency. In today's digital environment, research on information, communication, and internet technologies is no longer confined to the technological domain but has increasingly become a central focus in communication, discourse, and cultural studies. The rise of a new digital culture has enabled scholars to identify, characterize, explain, interpret, and evaluate various discourses that are not only productive but also competitive [2]. Consequently, there is a growing need for more research that specifically addresses communication issues in emerging digital contexts, particularly within developing countries. However, higher education institutions have not yet fully integrated digital competence as a core literacy that encompasses both technical proficiency and a digital citizenship mindset [3]. This highlights the importance of reexamining digital competence, especially regarding the diverse settings in which it develops and the varied student populations it involves. Further investigation is required to understand how higher education institutions can successfully adapt to digital transformation and respond to the demands of current development [4].

One of the key strategies to support students in acquiring digital communication skills within smart and interconnected classroom environments is through the integration of ethical considerations in the design and development of learning environments. There is a significant need for research in the field of digital learning, particularly in training students to develop effective communication skills [5]. As Motwani emphasized, there is a pressing global demand to accelerate digital communication and promote smart teaching practices within connected classrooms, where learning can occur across different locations and in real time. To achieve this vision, institutions must be encouraged to integrate appropriate technologies into classroom settings [6]. However, the effective implementation of such technologies must also be guided by relevant pedagogical principles, not merely technological considerations, to ensure the successful development of students' digital communication competencies.

2. Literature Review

Previous studies have suggested that for technology to be effective, it must be carefully selected, aligned with educational objectives, adjusted according to student proficiency, properly installed and tested, fully operational, and integrated with a variety of pedagogical strategies [7, 8]. Given the diversity of student needs, universities must offer learning experiences that are tailored to accommodate these differences. Students should be provided with learning environments that are adaptable to their individual needs and learning contexts. Two pedagogical strategies that are particularly relevant, among many others, are adaptive learning, which promotes learning personalization, and culturally relevant pedagogy, which emphasizes contextual and cultural responsiveness in learning.

2.1 e-Adaptive Learning

Adaptivity in learning refers to a learning system's capacity to recognize diverse learner characteristics and to respond to each learner's needs by modifying the learning experience in ways that maximize learning outcomes [9]. Several studies have explored the evolution of adaptive learning approaches, including the integration of adaptive learning with personalized learning resulting in what is referred to as personalized adaptive learning [10] the use of monitoring tools and diagnostic feedback to improve adaptive learning design [11] the challenges of implementing adaptive learning in higher education settings [12] and investigations into how learning styles, feedback, and navigation can inform adaptive learning to increase student engagement [13, 14]. However, existing adaptive learning research has yet to explore the integration of cultural contexts as a fundamental component in designing adaptive learning activities.

2.2. Culturally Relevant Pedagogy

Culturally relevant pedagogy, as proposed by Ladson-Billings, is a theoretical framework that not only promotes student achievement but also encourages students to embrace and affirm their cultural identities while developing a critical consciousness [15]. Studies on culturally relevant approaches, such as the incorporation of local community values in learning, have been previously conducted. For instance, there has been research on the integration of local values in science learning to improve student competence in both cognitive and affective domains, particularly through the development of teaching materials that align with local cultural content and learning topics [16]. Other studies have focused on integrating local values through digital storytelling, aiming to enhance students' interest and motivation [17]. However, these studies primarily address local values as learning content, rather than using them as a foundation for designing learning activities, especially within e-adaptive learning environments.

2.3. Communication in Context

In the context of Indonesian society, communication emphasizes the importance of harmonious interaction as a characteristic of a cultured nation. The ways in which people communicate become a distinctive identity of the communities in which they live. For instance, in the context of Balinese society, certain values are embedded in everyday interactions. These values include greeting others upon meeting as a social ritual, reciprocity and equality reflected through the principle of giving and receiving, and self-reflection as a practice for cultivating self-awareness [18]. These culturally embedded values are highly relevant for use as components in designing adaptive learning activities. First, the value of greeting in a learning context can be used to indicate students' readiness when entering an online class and to stimulate engagement in acquiring new skills. Greeting serves as a partial marker of a dialogic value orientation that promotes socio-emotional development, fosters engagement within the classroom community, and supports a safe and supportive learning environment [19]. Second, the principle of giving and receiving can be leveraged to encourage student collaboration by providing group learning interaction options that students can adapt according to their needs. Student engagement in interactive group activities such as discussion forums has been shown to enhance social presence and foster social knowledge construction [20]. Third, the practice of self-reflection can be integrated into the closing session of learning to give students the opportunity to reflect on their learning experiences, thereby enabling more accurate decision-making [21].

Based on previous research, the design of a culturally relevant e-adaptive learning environment is urgently needed and holds strong potential to enhance students' digital communication skills. Such a learning design can offer an environment in which students are able to adapt learning activity options to meet their individual needs in developing communication competencies [22]. Furthermore, the proposed learning design integrates adaptive learning strategies with local community values, recognizing that combining adaptive learning with diverse didactic techniques leads to more effective outcomes [23]. Integrating local communication values as a cultural product into learning not only supports academic success but also signals to students that their cultural and communicative traditions are respected and valued in the digital era [15]. This approach helps bridge the gap between traditional cultural practices and modern educational methodologies, ensuring that students remain connected to their roots while meeting the demands of contemporary education. Digital tools should be used to support, rather than replace, traditional forms of communication [24]. Therefore, the aim of the current research is to configure a culturally relevant online e-adaptive learning design by integrating local communication values to support students in mastering digital communication skills.

3. Materials and Methods

3.1. Research Design

The research design employed in this study follows a Research and Development (R&D) approach. In the field of education, R&D is an industry-based development model that utilizes research findings to design new products and procedures, which are then tested, evaluated, and refined until they meet established criteria for effectiveness, quality, or other specific standards [25]. This study combines the Borg and Gall development model for preliminary research and information gathering with the Dick and Carey model for the subsequent phases, ranging from planning to formative evaluation [26].

3.2. Procedure

Based on the research design, the procedure implemented in this study comprises two primary stages: learning design configuration and product validation [27]. The process of configuring the learning design of the English for Educational Technologist online course is outlined in Table 1. The design configuration is supported by a Learning Management System (LMS), which facilitates the digital implementation of the instructional design. The LMS configuration was validated through three phases of formative evaluation. Prior to user-based formative evaluation, expert reviews were conducted involving: one expert in instructional design, three experts in learning materials, three experts in learning media, and one expert in information technology. Following the expert reviews, learner-based validation was conducted in three phases. The first phase was a one-to-one evaluation, involving three students: one with high academic ability, one with moderate ability, and one with lower ability. The second phase involved a small group evaluation with nine students, representing equal proportions of high, moderate, and low performers. The third phase, a field trial, involved 21 students. In total, 33 students participated in the learner validation process.

Table 1.
Procedure for configuring the learning design.

No	Steps	Activities	Results
1.	Research and collect materials	Conducting a preliminary study.	Need an analysis document.
2.	Identify instructional goals	Formulating course learning outcomes.	Course learning outcomes formulation.
3.	Conduct instructional analysis	Analyzing instructional components.	Learning outcomes classification and steps to achieve them.
4.	Analyze learners and context	Analyzing student characteristics and learning context.	Student profile, performance and learning context analysis document.
5.	Write performance objectives	Writing specific learning objectives.	Learning objectives formulation
6.	Develop assessment instruments	Creating tools to assess the achievement of each learning objective.	Assessment instruments document.
7.	Develop instructional strategies	Designing instructional components: pre-instructional activities, materials presentation, learner participation, assessment, and follow-up activities.	Learning design configuration.
8.	Develop and select instructional materials	Preparing, designing, and developing learning materials, media, and an online learning platform (LMS).	Learning book; digital learning media (audio, video, infographic); LMS.
9.	Conduct Formative Evaluation	Conducting expert reviews and three phases of formative evaluation: one-to-one, small group, and field trial.	Product validation results.
10.	Revise	Revising the learning design based on evaluation feedback.	Final learning design configuration.

(**Source:** Gall et al. [25] and Dick et al. [26]).

3.3. Instrument

The research instruments used to validate the product in this study were questionnaires completed by both experts and students. The questionnaire used by the instructional design expert to evaluate the REGARD learning configuration was developed by referring to components of the Dick and Carey system design model [26]. The instrument used by learning materials experts was also based on Dick and Carey's criteria for instructional content [26]. The questionnaire used by learning media experts was developed in accordance with the online learning development platform proposed by Smaldino et al. [28], while the instrument used by the information technology expert followed criteria developed by Garivaldis et al. [29]. The three questionnaires used by students during each stage of user-based formative evaluation were developed with reference to Dick et al. [26] formative evaluation guidelines. All questionnaires were tested for validity by two experts in educational instrumentation.

3.4. Data Analysis

The data collected from the questionnaires were analyzed using the descriptive analysis technique. This technique lies at the core of most studies that aim to identify and describe trends and variations within a population, create new measures of key phenomena, or simply describe a sample in a study that seeks to identify causal effects [30]. The descriptive analysis techniques used in this study include both qualitative and quantitative descriptive statistical analyses.

Qualitative description is a pragmatic and effective method for illustrating experiences and events [31]. Therefore, qualitative descriptive analysis was employed to analyze the qualitative data obtained from open-ended questionnaire responses in the form of comments regarding the learning design configuration.

Descriptive statistical analysis is a technique used to systematically analyze numerical data and present the results in the form of figures and tables [32]. In this study, descriptive statistical analysis was applied to examine quantitative data collected through closed-ended statements on a five-point Likert scale, which assessed the feasibility of the learning design configuration model. The total scores were averaged and then interpreted using a five-point Criterion-Referenced Test/CRT [33] as presented in Table 2.

Table 2.
Five-scale criterion-referenced test.

Formula	Calculation	Category
X > $\bar{X}$i + 1.80 Sdi	X > 4.20	Very good
$\bar{X}$i + 0.60 Sd < X ≤ $\bar{X}$i + 1.80 Sdi	3.40 < X ≤ 4.20	Good
$\bar{X}$i − 0.60 Sd < X ≤ $\bar{X}$i + 0.60 Sdi	2.60 < X ≤ 3.40	Quite good
$\bar{X}$i − 1.80 Sd < X ≤ $\bar{X}$i − 0.60 Sdi	1.80 < X ≤ 2.60	Not good
X ≤ $\bar{X}$I − 1.80 Sdi	X ≤ 1.80	Bad

Source: Sukardjo [33]

Description: Ideal average ($\bar{X}$i) = 1/2 × (max score + minimum score); standard deviation ideal (Sdi) = 1/6 × (max score − minimum score); maximum score = 5; minimum score = 1; $\bar{X}$i = 1/2 × (5 + 1) = 3; Sdi = 1/6 × (5 − 1) = 0.67; X = actual score

4. Results

4.1. The Configuration of Culturally Relevant e-Adaptive Learning Design: The REGARD Learning Design

The culturally relevant e-adaptive learning design was configured based on the five instructional strategies structured by Dick, et al. [26] as illustrated in Table 3.

Table 3.
Learning design configuration

Learning structure	Local communication values for adaptivity	Learning phases
Pre-instructional activities	Greeting when meeting	Phase 1: Readiness Students demonstrate their readiness by greeting the class (lecturers, peers, and other participants). Students select one of three digital greeting options available in the online learning system: written, oral, and visual.
Presentation materials		Phase 2**:** Exploration Students explore learning materials provided in various digital formats, such as videos, audio recordings and infographics.
Learner participation	Taking and giving	Phase 3: Grouped activity Students actively participate in group activities by selecting one of three available groups in the online learning system—creating messages, sending messages, or receiving messages—based on their learning needs.
Assessment		Phase 4: Assessment. Students complete the individual assessment.
Follow-through activities	Reflection	Phase 5: Reflection and Decision Making Students reflect on their learning experience and, based on this reflection, make a decision regarding their progress. Students choose either to complete the topic or retake it through the system's provided options.

To enhance recall, the developed learning design is named REGARD, an acronym for Readiness (R), Exploration (E), Grouped activity (G), Assessment (A), Reflection (R) and Decision making (D). Figure 1 presents the REGARD learning design flowchart to configure the LMS. Students begin by logging into the system and selecting a learning topic. For each topic, they go through the five learning phases. The process begins with a greeting, where students choose from one of the provided greeting options (A1). Following this, students independently explore the learning content in various digital formats. The knowledge and skills gained during this exploration inform their participation in one of the group activities, chosen based on their specific needs, whether it be creating, sending, or receiving messages (A2). After active participation in the selected group activity, students proceed to take an individual assessment. Finally, they engage in self-reflection and make a decision regarding their learning path, either to complete the topic or retake it (A3). Students who choose to retake the topic will re-enter the learning phases within the allotted timeframe. Those who complete the topic may continue to contribute to group activities and will be rewarded with additional points for their active participation.

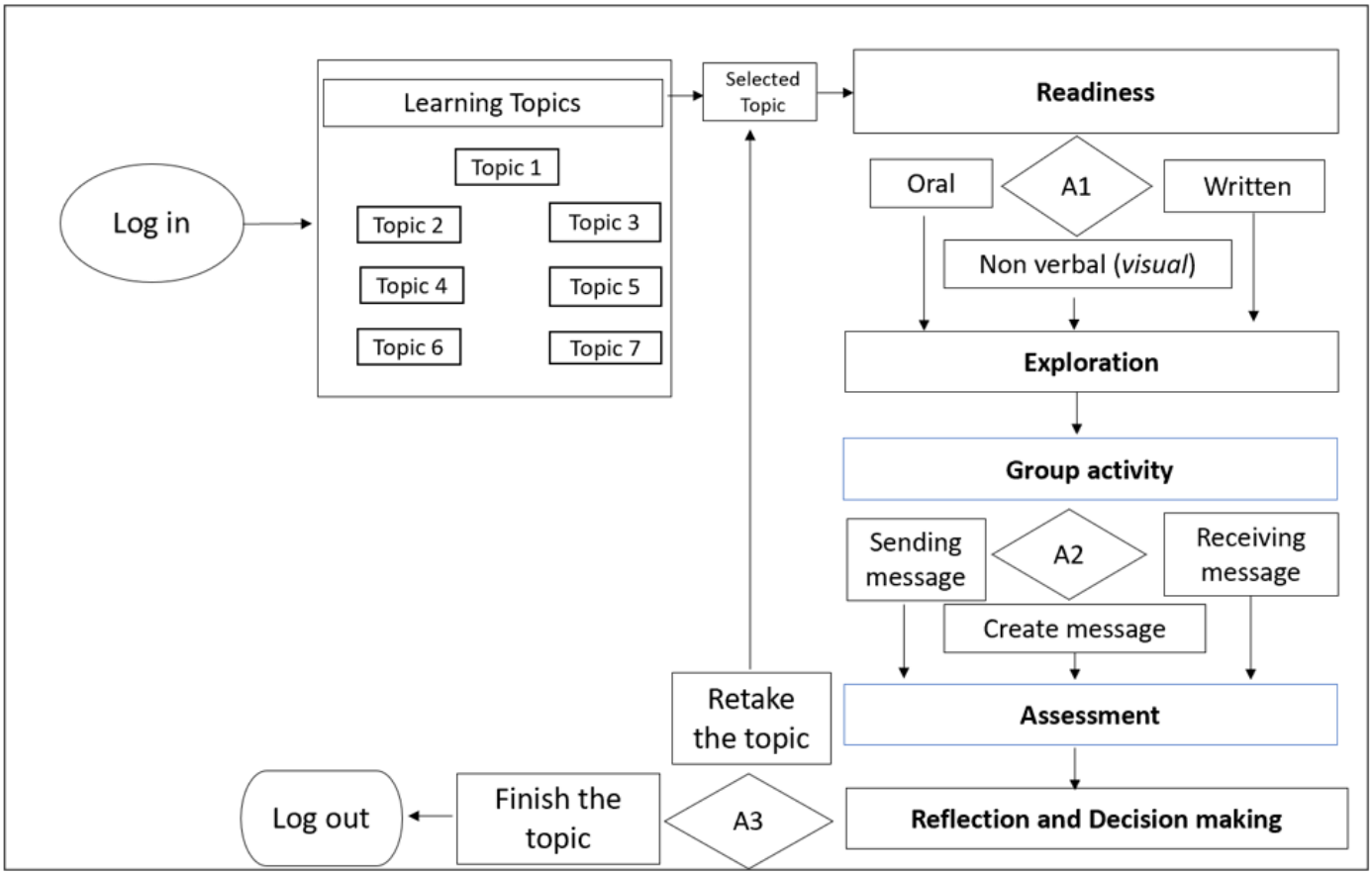

Figure 1.
LMS flowchart of the REGARD learning design configuration.

Based on the flowchart, the LMS was developed and implemented. The *English for Educational Technologist* course consists of seven topics and is organized into 16 online sessions with the following structure:

Learning activities 1 and 2	:	Topic 1 – 21st Century skills
Learning activities 3 and 4	:	Topic 2 – The Definition of Educational Technology
Learning activities 5 and 6	:	Topic 3 – The Scope of Educational Technology
Learning activities 7 and 8	:	Topic 4 – The Roles of Educational Technology
Learning activities 9 and 10	:	Topic 5 – The Development of the Educational Technology Profession
Learning activities 11 and 12	:	Topic 6 – The Development of Educational Technology in the Era of the Industrial Revolution 4.0
Learning activities 13 and 14	:	Topic 7 – The Development of Educational Technology in the Society 5.0 Era
Learning activities 15 and 16	:	Final project – conference simulation.

Each course topic is delivered through the LMS following the REGARD learning design framework. The LMS, which is based on the REGARD learning design for the *English for Educational Technologist* course, can be accessed at https://learning.culturaledtech.academy/, using the username: ourguest and the password: Lms@123456.

4.2. Product Validation

The final configuration of the REGARD learning design within the LMS underwent quality assurance testing. This validation involved expert reviews and student trials.

4.2.1. Experts' Reviews

The results of the instructional design expert review are presented in Table 4. As shown, the average overall score for the instructional design component was 4.95, which falls into the "Very good" category on a 5-point scale. According to the quantitative data conversion guidelines, this score indicates that the instructional design is appropriate for use in educational contexts. The instructional design expert commented that the course structure meets the criteria of a well-designed instructional framework.

Table 4.
Result of instructional design expert review.

Assessment Aspects	Average Scores	Category
Learning goals and objectives	5.00	Very good
Learners' characteristics	5.00	Very good
Learning context	5.00	Very good
Assessment design	5.00	Very good
Instructional strategy design	4.75	Very good
Learning content and media design	5.00	Very good

The next stage involved evaluation of the learning materials component by three experts: one in educational technology (Expert 1), one in cultural studies (Expert 2), and one in English language education (Expert 3). The results are displayed in Table 5. The average total score for the learning materials was 4.96, also categorized as "Very good" on a 5-point scale, signifying suitability for use in instructional settings. The experts provided the following suggestions for revision. First, update reference sources used in the development of teaching materials to ensure they are no more than 10 years old. Second, ensure that the learning content in each topic reflects the flow and principles of the REGARD learning design.

Table 5.
Result of the learning material experts' reviews.

Assessment Aspects	Expert 1	Expert 2	Expert 3	Average Scores	Category
Relevance of material to learning objectives	5	5	5	5	Very good
Up-to-date Materials	5	5	4.5	4.83	Very good
Systematics: Organization of material	5	5	5	5	Very good
Realistic examples and exercises	5	5	5	5	Very good

Further evaluation was conducted by learning media experts, with the results shown in Table 6. Three experts assessed the quality of the learning media, with an average score of 5.00, placing it in the "Very Good" category. This suggests that the media used is highly suitable for educational use according to the established conversion metrics. The feedback from media experts was utilized to enhance the learning media. Key suggestions included: providing an estimated learning time for students who wish to repeat a topic; offering guidance on activity sequencing for students who have completed a topic and are transitioning to the next; and implementing a student feedback management feature within the learning group or community to support interaction and reflection.

Table 6.
Result of learning media experts' reviews.

Assessment Aspects	Expert 1	Expert 2	Expert 3	Average Scores	Category
Alignment of media with standards, learning outcomes and objectives	5.00	5.00	5.00	5.00	Very good
Suitability of media for target learner characteristics	5.00	5.00	5.00	5.00	Very good
Accuracy of information contained in the media	5.00	5.00	5.00	5.00	Very good
A variety of media is used	5.00	5.00	5.00	5.00	Very good
Ease of media use	5.00	5.00	5.00	5.00	Very good

In addition, an expert in the field of information technology reviewed the LMS. The results of the expert review are presented in Table 7. As shown in Table 7, the average overall assessment score for the information technology component of the LMS was 4.83. According to the quantitative data conversion table, this score, which falls within the "Very good" range on a 5-point scale, indicates that the information technology elements embedded in the LMS were appropriate for use in the *English for Educational Technologists* course. The information technology components of the developed LMS were revised based on feedback from the expert. The feedback included the following suggestions: (1) add watermarks to video content; (2) incorporate a learner control feature when accessing content provided via links; and (3) provide references for any external voice, image, or video sources used, if applicable.

Table 7.
Result of information technology expert review

Assessment Aspects	Average Scores	Category
Usability	4.75	Very good
Accessibility	4.80	Very good
Consistency of content	5.00	Very good
User learning and engagement	4.75	Very good

In summary, the results of the expert review are presented in Figure 2. The figure shows that the overall scores given by all experts fell within the "Very Good" category according to the five-point criterion-referenced scale. These findings suggest that the REGARD learning design configuration within the LMS is valid and appropriate for use in the *English for Educational Technologists* course.

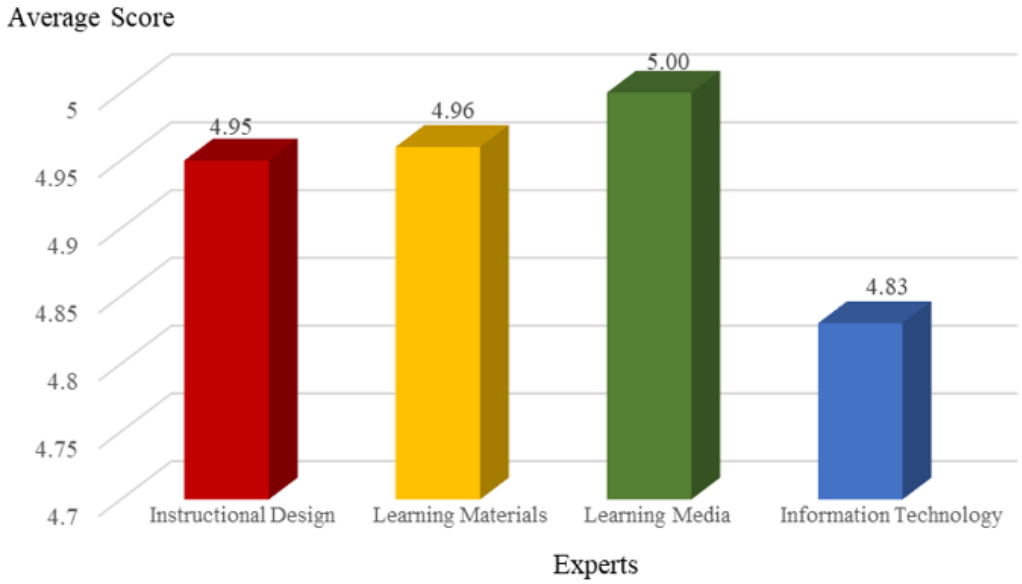

Figure 2.
Results summary of experts' reviews.

4.3. Students' Evaluation

The initial formative evaluation involved three students in a one-to-one evaluation. The results of this evaluation are presented in Table 8. As shown, the average overall assessment score was 4.85. According to the quantitative data conversion table, this score lies within the "Very Good" range on a 5-point scale, indicating that the LMS configuration is appropriate for the *English for Educational Technologists* course. It features clear instructions, demonstrates a positive impact on learners, and is considered feasible. The students involved in this stage provided the following suggestions for improving the LMS. First, the learning materials, particularly audio, video, and infographics, should be presented consistently across all topics. Second, the assessment section should include clear information regarding assessment deadlines.

Table 8.
Result of One-to-One Evaluation.

Assessment Aspects	Student 1	Student 2	Student 3	Average Scores	Category
Clarity of instruction	4.75	4.75	4.75	4.75	Very good
Impact on the learner	5.00	5.00	5.00	5.00	Very good
Feasibility	4.6	5	4.8	4.8	Very good

Next, nine students participated in the second stage of the formative evaluation, known as the small group evaluation. The results are shown in Table 9. The average overall score for this evaluation was 4.77, also within the "Very Good" category on the 5-point scale. The LMS configuration received high ratings for its attractiveness, clarity of learning, alignment between materials and learning objectives, as well as the quality of its exercises, assessments, and feedback. Additionally, it was evaluated positively for facilitating skill acquisition and providing ample time for learning activities. The small group evaluation participants offered the following feedback: the LMS-based learning experience was engaging and comprehensive, covering aspects such as learner

readiness, content exploration, group activities, assessments, and reflection-based decision-making. Overall, the LMS proved effective and was supported by appropriate learning materials. For future development, further enhancements could be made using more responsive technology. The reflection activities introduced for each topic were viewed as an innovative element in online learning. They enabled students to review what they had learned and experienced throughout the process and use that insight in making informed learning decisions. The use of LMS tools, combined with consistent feedback from lecturers and peer interaction, made the learning experience enjoyable and meaningful.

Table 9.
Result of small group evaluation.

Assessment Aspects	Students									Average Scores	Category
	1	2	3	4	5	6	7	8	9		
Attractiveness	4.5	5	5	4.5	4.5	4.5	5	5	5	4.78	Very good
Clarity of learning	5	5	5	4	5	4	5	5	5	4.78	Very good
Suitability of learning materials to objectives	5	5	4.8	5	5	4	5	5	5	4.87	Very good
Availability of exercises	4.7	5	4	4.7	5	4	5	5	5	4.71	Very good
Assessment	5	5	4	4.3	5	4.3	5	5	5	4.73	Very good
Feedback	5	5	5	5	5	5	5	5	5	5	Very good
Initial skills and acquired skills	4	5	5	5	4.5	3.5	5	5	5	4.67	Very good
Time to complete learning	4	5	4	5	5	4	5	5	5	4.67	Very good

Third, a total of 21 students participated in the field trial. The results of this trial are presented in Table 10. As shown in Table 10, the average overall assessment score was 4.56. According to the quantitative data conversion table, this score falls within the "Very good" category on a 5-point scale, indicating that the configuration of the LMS was highly appropriate for use in the *English for Educational Technologists* course.

Table 10.
Result of a field trial.

Assessment Aspects	Average Scores	Category
Attractiveness	4.55	Very good
Clarity of learning	4.35	Very good
Suitability of learning materials to objectives	4.80	Very good
Availability of exercises	4.67	Very good
Assessment	4.73	Very good
Feedback	4.60	Very good
Initial skills and acquired skills	4.30	Very good
Time to complete learning	4.50	Very good
Learning environment	4.52	Very good

Similar to the results of the small group evaluation, the field trial findings demonstrated that the configured REGARD learning design within the LMS exhibited very high levels of attractiveness, excellent clarity, strong alignment between learning materials and objectives, effective exercises, assessments, and feedback, robust facilitation of skills acquisition, and adequate time allocation for completing the learning activities. Furthermore, when implemented in the field, the LMS created a highly supportive learning environment. Students involved in the field trial provided the following comments on the developed LMS: the REGARD learning design configuration within the LMS was engaging and helpful in achieving learning goals. However, they noted a discrepancy in the information regarding the maximum file size allowed for uploads in the assessment section. Despite some initial difficulties in following the learning flow, they reported that it became enjoyable and easier to follow with the assistance of a learning guide. The online class environment was described as more dynamic than usual at each stage of the learning process.

The overall scores from the student trials across the three stages of formative evaluation are shown in Figure 3. As illustrated, these scores fall within the “Very good” category based on a five-point criterion-referenced scale. These findings suggest that, from the students’ perspectives, the REGARD learning design configuration within the LMS is valid and appropriate for use in the *English for Educational Technologists* course.

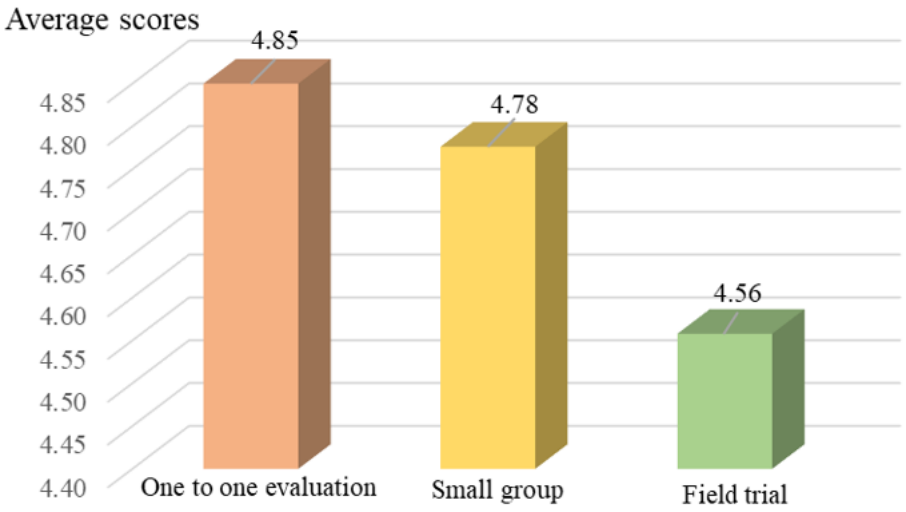

Figure 3.
Scores from the student trials across the three stages of formative evaluation.

5. Discussion

The entire system-based configuration process has resulted in a learning design that is well-suited for implementation in a culturally relevant e-adaptive learning environment for this course. Employing a systems approach in the research highlights the importance of aligning various activities and stakeholders to ensure optimal interventions [34]. This aligns with previous studies suggesting that learning design is often operationalized through a learning system design model, which involves a series of systematic and holistic steps to develop effective educational programs. Institutions that rely on diverse learning materials to deliver content must implement an appropriate system design model to ensure the development of high-quality learning programs [35].

The feasibility of the REGARD learning design configuration was evaluated through expert reviews and student trials. In addition to the closed-ended questionnaire items, the experts' qualitative feedback provided valuable insights for improving the learning design. Overall, the experts agreed that the design was ready to progress to the student-testing phase. The instructional design expert noted that the REGARD model had successfully fulfilled the processes and components required for a culturally relevant e-adaptive learning design. When designing an online learning environment, it is crucial to consider cultural diversity and varied learning preferences, as these factors significantly contribute to achieving intended learning outcomes [36].

Specifically, suggestions for revision were provided for supporting components such as learning materials and media. One key recommendation from content experts was to update reference sources so that the teaching materials were based on literature published within the last ten years. This input was acted upon by sourcing more recent references. High-quality and up-to-date learning materials contribute not only to improved student outcomes but also to enhanced teaching efficiency for lecturers [37]. Learning materials are intended to facilitate interaction and communication among all participants in the learning process, with a focus on the achievement of the stated learning objectives [38].

Recommendations for improving the LMS as a supporting component of the learning design were provided by media and IT experts. Media experts highlighted the need for clearer time-related information, especially for students revisiting previously studied topics, as well as the importance of activity arrangement information for learners progressing to subsequent topics. Their feedback emphasized making the LMS more informative and encouraging students to engage more actively, not only by asking questions but also by responding to their peers' queries. For example, lecturers could foster interaction by reducing social barriers related to asking and answering questions [39]. Student participation in interactive group activities, such as discussion forums, has been shown to enhance social presence and promote social knowledge construction [40].

IT experts emphasized the need for student control (learner control) over access to various content presented in digital format. Therefore, adjustments were made to embedded video, audio, and infographics in the form of automatically displayed media upon opening the LMS. This eliminates the need for students to open videos, audio, or infographics using external applications. Allowing students to control the content they access can enhance the learning experience in terms of enjoyment, ease of use, and perceived autonomy [41]. Implementing the educational program as an online course using a combination of digital communication tools should be continued, as this approach is most likely to meet students' expectations and capabilities [42]. Digital communication skills in online learning not only enhance educational quality but also reduce inequality [43].

During the student trials conducted in the three stages of formative evaluation: individual trial (one-to-one evaluation), small group trial (small group evaluation), and field trial, students indicated that the REGARD learning design is valid and implementable for facilitating the development of digital communication skills. Each phase of the REGARD learning design was meticulously structured, and the following characteristics contributed to the students' highly positive evaluation of the design.

First, the attractiveness and clarity of the learning design were consistently highlighted. Through the five learning phases, students found the learning flow engaging and easy to follow. In the Readiness (R) phase, students greeted their lecturers and peers using their preferred digital greeting formats. Developing the ability to greet others is essential for future social interactions and may increase social opportunities. Mastering digital greeting skills is critical for developing effective social competencies and fostering positive social interactions [44]. These greetings, exchanged among lecturers, peers, and other class participants, not only provided students with opportunities to practice digital communication skills but also strengthened their sense of belonging in the online learning environment. A sense of belonging is a crucial element of online learning before progressing to deeper levels of meaning-making and understanding [45]. In the Exploration (E) phase, students accessed content in various digital formats, allowing them to choose the format that best suited their preferences. Digital content, such as videos, has been shown to maintain emotional and cognitive engagement for extended periods [46]. In the Grouped activity (G) phase, students selected groups to join in order to enhance their digital communication skills collaboratively. Study groups composed of cohesive subgroups tend to achieve better academic outcomes [47, 48]. The Assessment (A) phase authentically measured students' digital communication skills using topic-specific rubrics. The Reflection and Decision-making (RD) phase provided students the opportunity to reflect on their learning. Reflection contributes to deeper knowledge acquisition, helps identify learning gaps or deficiencies, personalizes and contextualizes knowledge, offers comparative learning experiences, and supports the development of both structural understanding and social connection [49]. Based on these reflections, students were able to make informed decisions to either complete the topic or revisit it.

Second, the REGARD model promotes adaptability by integrating local communication values to align with students' contextual needs. The model incorporates cultural communication practices as a foundation for designing flexible learning activities. By considering cultural values in online learning design, the model underscores the importance of cultural context in enhancing student engagement. Different contexts emphasize different configurations of online learning; for instance, some may prioritize student support mechanisms more than others [50]. Learners from diverse social, cultural, economic, linguistic, and religious backgrounds around the world benefit from e-learning. In such contexts, understanding the cultural background of learners is essential for achieving effective learning outcomes. Recognizing cultural diversity when designing e-learning environments can significantly contribute to improved educational results [36].

Student input toward the REGARD learning design primarily focused on scheduling, as students were participating in a learning experience that allowed them to select activities independently for the first time. Although a general timeframe for each stage of learning was already established, students still required clear information about the overall learning schedule at the beginning of each topic. Therefore, in addition to presenting the topic title and learning objectives, the duration of the learning activities was also communicated at the start of each topic. A strong correlation exists between students' time management behavior, the development of time management skills, and the design of online courses [51]. As universities continue to advance in the digital education landscape, it is essential for students to continuously develop their digital competencies, including digital communication skills, in order to fully benefit from higher education institutions' offerings [52].

6. Conclusion

The configuration of the culturally relevant e-adaptive learning design—the REGARD learning design—was deemed valid by experts and positively received by students in supporting their mastery of digital communication skills. However, there are several limitations to the REGARD learning design when applied to culturally relevant e-adaptive learning environments: (1) the local communication values used to adapt the learning activities were derived from a specific province in Indonesia; (2) successful implementation of the REGARD learning design requires adequate digital infrastructure, including a computer with a stable internet connection; (3) this study focused solely on one 21st-century skill, namely digital communication skills; and (4) while the REGARD learning design has been validated as a tool to facilitate student learning, its effectiveness has not yet been empirically tested. In light of these limitations, the following recommendations are proposed. Further studies should explore a wider range of local communication values that could serve as a foundation for creating culturally relevant e-adaptive learning environments. Additionally, future research should investigate the application of the REGARD learning design in facilitating other 21st-century skills, such as collaboration, critical thinking, and creativity. Finally, studies examining the effectiveness of the REGARD learning design are necessary to confirm its practical impact.

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