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Gamified Interactive English HOTS E-Book Integrated with Artificial Intelligence: Optimizing Metacognition, Critical and Creative Thinking Through the Exploration of Gorontalo Local Wisdom

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Abstrak

Penelitian ini bertujuan mengembangkan *Gamified Interactive English HOTS E-Book* terintegrasi Artificial Intelligence yang berfokus pada optimalisasi kemampuan metakognitif, berpikir kritis, dan kreatif melalui eksplorasi kearifan lokal Gorontalo. Pengembangan dilakukan dengan mengintegrasikan konten budaya lokal, seperti makanan tradisional, tarian, dan destinasi wisata, sebagai konteks pembelajaran bahasa Inggris yang bermakna. E-book ini dilengkapi elemen gamifikasi (Kahoot, Quizizz, Mentimeter) serta dukungan AI untuk menciptakan pengalaman belajar interaktif yang berpusat pada mahasiswa. Subjek penelitian adalah mahasiswa Pendidikan Bahasa Inggris dan Pendidikan Guru Sekolah Dasar Universitas Pohuwato sebanyak 65 orang. Hasil validasi menunjukkan bahwa media memenuhi kriteria valid, praktis, dan efektif, dengan skor rata-rata keseluruhan berada pada kategori "sangat baik" yang menegaskan efektivitas e-book dalam meningkatkan kemampuan berpikir kritis, kreatif, dan metakognitif. Dengan demikian, produk ini berpotensi menjadi inovasi penting dalam pembelajaran bahasa Inggris berbasis budaya lokal sekaligus memberikan kontribusi terhadap pengembangan strategi pendidikan di era digital.

Kata Kunci: Media Pembelajaran; English HOTS e-book terintegrasi AI; Local Wisdom; Gamified Interactive learning; Metacognitive.

Abstract

This study aims to develop a Gamified Interactive English HOTS E-Book integrated with Artificial Intelligence, designed to optimize students' metacognitive, critical, and creative thinking skills through the exploration of Gorontalo's local wisdom. The e-book incorporates cultural elements such as traditional foods, dances, and tourist destinations as meaningful contexts for English language learning. Gamification tools (Kahoot, Quizizz, Mentimeter) and AI-driven interactivity are embedded to create a student-centered and engaging learning experience. The participants consisted of 65 students from the English Education and Primary School Teacher Education programs at Pohuwato University. Validation results indicated that the e-book met the criteria of validity, practicality, and effectiveness, with an overall average score categorized as "very good." Trial implementation further showed that the majority of students achieved the targeted learning outcomes, demonstrating the effectiveness of the e-book in enhancing critical, creative, and metacognitive skills. Thus, this product has the potential to serve as an innovative approach to English language teaching rooted in local culture while contributing to the advancement of digital-based educational strategies.

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***Keywords**:* Learning Media; AI-Integrated English HOTS E-Book; Local Wisdom; Gamified Interactive Learning; Metacognitive.

Introduction

English is one of the essential competencies in higher education, particularly for students in the English Education and Primary School Teacher Education study programs. Proficiency in English not only supports the mastery of core courses but also equips students to face the challenges of globalization and the increasingly competitive job market. However, in reality, many students still struggle to master English skills, especially in courses such as Reading, Speaking, and English I and II (Samad, 2023; Samad & Kafryawan, 2021). These difficulties indicate low critical thinking abilities and weak metacognitive skills in planning, monitoring, and evaluating their own learning processes (Kupriyanov et al., 2021; Surdyanto & Kurniawan, 2020).

Preliminary studies revealed that the learning process is still dominated by conventional media, which are less engaging and fail to stimulate active student participation (Nursyaida & Samad, 2024; Samad, 2021; Samad & Paris, n.d.). As a result, learning often becomes monotonous and does not fully encourage higher-order thinking skills (HOTS). In addition, most students have limited knowledge of Gorontalo's rich cultural heritage. In fact, integrating local wisdom into learning activities can strengthen the connection between academic content and students' socio-cultural context, making learning more relevant and meaningful.

These problems highlight the urgency of adopting innovative approaches that can optimize students' metacognitive skills, critical thinking, and creativity. One promising solution is the development of a Gamified Interactive English HOTS E-Book integrated with Artificial Intelligence (AI) through the exploration of Gorontalo local wisdom (Qiao & Zhao, 2023; Wahyuni et al., 2023). The integration of gamification can make the learning process more interactive and enjoyable, while the use of AI provides adaptive feedback and personalized learning experiences tailored to students' needs.

innovation is also in line with the National Research Master Plan (RIRN) in the field of education, particularly within the focus of Social Humanities, Education, Arts, and Culture under the topic of Educational Technology and Learning. Through this study, it is expected that an innovative learning medium will be developed to not only improve students' English proficiency but also foster cultural awareness. Therefore, this research focuses on the development and implementation of a Gamified Interactive English HOTS E-Book integrated with AI based on Gorontalo local wisdom to optimize students' metacognitive skills, critical thinking, and creativity.

Problem Research

Based on the above background, the formulation of the problem in this study is as follows:

1. What is the design of the Gamified Interactive English HOTS e-book integrated with Artificial Intelligence through the exploration of Gorontalo local wisdom using the DDDE model?

2. How valid is the development of the AI-integrated e-book in optimizing students' metacognitive, critical, and creative thinking skills using the DDDE model?

3. How effective is the AI-integrated e-book in improving students' metacognitive, critical, and creative thinking skills through the exploration of Gorontalo local wisdom using the DDDE model

Objective of the Research

The objective of the research :

1. To design a Gamified Interactive English HOTS e-book integrated with Artificial Intelligence through the exploration of Gorontalo local wisdom using the DDDE model.

2. To examine the validity of the AI-integrated e-book in optimizing students' metacognitive, critical thinking, and creative skills through the DDDE model.

3. To analyze the effectiveness of the AI-integrated e-book in enhancing students'

metacognitive, critical thinking, and creative skills through the exploration of Gorontalo local wisdom using the DDDE model

Significance of research

This research is expected to create several Theoretical Benefits: Contributing to the development of educational science, particularly in the preparation and implementation of learning materials that integrate Artificial Intelligence, gamification, and local wisdom to enhance students' Higher Order Thinking Skills (HOTS).

Practical Benefits

For Students: Enhancing the learning experience by providing interactive e-books that align with their needs and characteristics, thereby supporting the development of metacognitive, critical thinking, and creative skills.

For Lecturers/Teachers: Offering validated teaching resources that support innovative and diverse teaching strategies in English language learning.

For Institutions: Introducing educational innovations that can improve the quality of learning, increase student engagement, and strengthen cultural awareness through Gorontalo local wisdom.

For Researchers: Expanding insights and experience in the development of AI-integrated, gamified learning media, while encouraging further studies in the fields of educational technology, English teaching, and local culture-based learning.

Method

This study employed a Research and development (R&D) design using the DDD-E (Decide, Design, Develop, and Evaluate) model to create an AI-integrated English HOTS e-book with gamified interactive learning. The research was conducted from May to September 2025 at the English Education Study Program of Pohuwato University, Gorontalo Province. The participants included 65 students purposively selected from the 4th to 6th semester as target users of the e-book and three experts (an IT expert, an English Education lecturer, and a local culture expert) who validated the product. The research procedure began with identifying learning problems through surveys, interviews, and literature studies, followed by the DDD-E stages (Kurnia et al., 2024a, 2024b). The Decide phase involved setting learning goals, team assignments, and resource identification.

The quantitative data obtained from the questionnaires were analyzed using descriptive statistics to measure the feasibility and impact of the HOTS e-book based on gamification integrated with AI through local culture exploration of Gorontalo (Nursyaida & Samad, 2024). Scores from the Likert scale were analyzed to evaluate students' perceptions of the (Widiyastuti et al., 2021)e-book's ability to improve higher-order thinking skills, particularly critical thinking, creativity, and metacognition. For the qualitative feedback provided by experts (IT expert, English education lecturer, English teacher, and native speaker), thematic analysis was applied to identify areas of improvement and to confirm the validity, practicality, and effectiveness of the module's design and content . The procedure are designing into four steps as follows:

1. Decide: This stage begins with determining the learning objectives, dividing the team, setting the theme, developing prerequisite skills, and assessing available resources.
2. Design: In this stage, concepts and outlines are created using flowcharts, layouts, and storyboards.
3. Develop: The development stage involves creating elements such as animations, audio, video, gamified quizzes, and HOTS-based materials integrated with AI and images by utilizing various applications and platforms, including Canva, Flipbook, Flipgrid, and Book Creator.
4. Evaluate: In the final stage, the entire design and development process is evaluated by four experts (an IT expert, an English education lecturer, an English teacher, and a native speaker). Product testing is then conducted with students relevant to the material. A good development product is expected to meet the criteria of validity, practicality,

and effectiveness. The final implementation of the product is carried out after revisions based on the trial results.

Result and Discussion

This study developed science learning media content in the form of a HOTS e-book integrated with AI and gamification through the exploration of Gorontalo's local wisdom, with the product development results as follows:

Decide

At the Decide stage, this study aimed to enhance the critical thinking, creativity, and metacognitive skills of students in the English Education and Primary Teacher Education programs at Pohuwato University through the development of an interactive gamified e-book combining HOTS and gamification. The learning theme focused on HOTS in local content designed around gamified quizzes related to the course material. The participants were English Education students who already had prior knowledge of learning media and science. A prerequisite for the trial was that students must own Android smartphones to access the HOTS e-book design. The materials developed consisted of local cultural content combined with HOTS-based questions [6],[7],[8], further integrated with gamification tools such as Mentimeter, Quizizz, Wardwall, and Kahoot. These were designed in an engaging way to improve motivation, critical thinking, and creativity, so that students could not only develop their creativity as prospective teachers at the university level, but also apply this in teacher training programs at schools and during microteaching practices that require them to create their own learning media using technology based on the subjects they study to be implemented in classroom training.

Design

The developed materials consisted of Gorontalo local content integrated with HOTS and AI, combined with gamification through tools such as Mentimeter, Quizizz, Wardwall, and Kahoot. These were designed in an engaging way to enhance motivation, critical thinking, and creativity, enabling students to grow their creativity as prospective primary school teachers at the university level.

Develop

The development of the HOTS e-book was carried out using Canva and AI, designed to be accessible through links and gamification-based applications for students.

Figure 1: Cover

Figure 2: Lesson 1

Figure 3: Lesson 2

Figure 4: Lesson 3

Figure 5: Exercise

figure 6: feedback

Figure 7: AI

Figure 8: Practicing

Figure 1 shows the opening page or cover of the HOTS e-book, with a design and color scheme representing the cultural diversity of Gorontalo. Figures 2 (traditional food), 3 (tourist destination), and 4 (traditional heritage) present Gorontalo cultural exploration content. Specifically, Figure 2 depicts traditional food such as Binte Biluhuta, which symbolizes togetherness; Figure 3 shows tourist destinations as authentic contexts for language skills; and Figure 4 features traditional heritage such as dances and traditional clothing that foster cultural awareness (Bergman, 2016; Giyatmi, 2020; Kanoksilapatham & Suranakkharin, 2021). All three were presented to integrate English learning with the exploration of Gorontalo's local wisdom. Figures 5, 6, 7, and 8 display AI-based gamified learning access that provides feedback related to the material and guides students to improve their analytical, critical thinking, creative, and metacognitive skills during trials and practice sessions (Nursyaida & Samad, 2024; Pratiwi et al., 2024).

Evaluate

The feasibility of the HOTS e-book was validated by three experts as validators, each with
their respective expertise: a computer expert, a language expert, and a cultural expert.

Tabel 1. *The Result of Validator's Assesssment*

Aspects Assested	**Validator 1**	**2**	**3**	**Average**	**Qualification**
Content of media	4	3.8	3.7	3.83	Valid
Language and appearance	4	3.6	3.65	3.75	Valid
Illustartion and layout	3.77	3.85	3.7	3.77	Valid
Benefits	4	4	3.90	3.97	Very valid
Overall average score				**3.83**	**Valid**

The validator test results indicated that the gamification-based HOTS e-book developed still requires improvements before being declared valid. Several notes provided include enhancements in the integration of HOTS material with gamification activities, clearer instructional design, and adjustments to the visual presentation to make it more engaging and interactive. In addition, the validators also emphasized the importance of strengthening the integration of Gorontalo's local cultural content as well as adding metacognitive reflection components to encourage students' learning awareness [6],[7],[8]. The revisions that require improvement are as follow:

Tabel 2. *Before ane After Revisions of HOTS E-Book in Gamified Interactive of AI*

Before revision	**After Revision**
Sinkronisasin antara tautan kahoot dan Youtube belum sepenuhnya dapat diakses oleh pengguna	Tautan YouTube dan Kahoot telah diperbarui serta diuji menggunakan perangkat android dan laptop
Tampilan ilustrasi budaya Gorontalo perlu ditingkatkan agar lebih menggambarkan kekayaan local yang sesuai.	Ilustrasi budaya telah diperjelas dengan visual yang lebih detail dan relevan, terkait makanan, destinasi wisata, dan warisan tradisional Gorontalo.
Ditemukan kesalahan penulisan pada text, soal kuis dan essay pada gamifikasi dan konten yang ada pada e-book	Bahasa dalam e-book direvisi dengan memperhatikan kejelasan, kesederhanaan, dan akurasi, sehingga lebih mudah dipahami si pembaca.
Petunjuk pengerjaan pada fitur gamifikasi kurang spesifik dan ditemukan membingungkan.	Instruksi gamifikasi telah diperbarui lengkap dengan langkah-langkah jelas, contoh, serta penjelasan fungsi setiap aplikasi.
Aktivitas HOTS perlu ditambahkan panduan yang jelas untuk membantu peserta didik membedakan focus aktivitas metakognitif dan kreativitas yang	Telah ditambahkan penekanan pada aktivitas strategi belajar untuk memahami detail materi HOTS, sehingga mahasiswa menguasai konsep dalam berpikir kritis dan melakukan

diperlukan.	refleksi pengoptimalan metakognitif

After the validation stage, the media was tested on students of the English Education and Primary School Teacher Education

programs at Pohuwato University with the aim of assessing whether the developed product met the criteria of practicality and effectiveness in learning.

Figure 9: socialization and trial to students

Tabel 3. *Students' respond of media*

No	Statements	Ave rage	Qualification
1	The e-book display is attractive and aligned with the theme of Gorontalo's local culture	3.85	Very good
2	The colors and design of the e-book support readability and cultural representation	3.70	Very good
3	Audio/visuals (images, videos, YouTube links) support material comprehension.	3.45	Good
4	The text is easy to read and appropriate for students' level of understanding.	3.68	Very good
5	The material is in accordance with HOTS objectives (critical, creative, and metacognitive thinking)	3.72	Very good
6	Gamification elements (Quizizz, Kahoot, Mentimeter) are well integrated.	3.80	Very good
7	The integration of AI in the e-book enhances interactivity and learning reflection	3.77	Very good
8	The local cultural content (food, dances, tourism in Gorontalo) is easy to understand	3.82	Very good
9	Examples and exercises are relevant to the curriculum and encourage HOTS	3.75	Very good
10	This medium is effective in improving students' critical, creative, and metacognitive thinking skills	3.78	Very good
Total keseluruhan rata-rata		**3.76**	Very good

The results of the student assessment on the HOTS e-book indicate that the product received an overall average score of **3.76**, which falls under the category of *Very Good*. Specifically, the e-book display was considered attractive and aligned with the cultural theme of Gorontalo (3.85), while its colors and design were also rated highly for supporting readability and cultural representation (3.70). Audio-visual components such as images, videos, and YouTube links were found to be helpful in supporting material comprehension, although they received a slightly lower score (3.45) compared to other aspects.

The textual content was deemed easy to read and suitable for students' level of understanding (3.68), and the materials were in accordance with HOTS objectives, namely critical, creative, and metacognitive thinking (3.72). Gamification elements such as Quizizz, Kahoot, and Mentimeter were reported to be well integrated (3.80), while the integration of AI was acknowledged to enhance both interactivity and learning reflection (3.77). Furthermore, the local cultural content covering Gorontalo's food, dances, and tourist destinations was perceived as easy to understand (3.82).

In addition, examples and exercises were rated as relevant to the curriculum and supportive of students' higher-order thinking skills (3.75). Finally, the overall effectiveness of the e-book in improving critical, creative, and metacognitive skills was rated highly (3.78). These findings suggest that the HOTS e-book, integrating gamification and AI with Gorontalo's local wisdom, demonstrates strong potential as an effective learning medium for fostering both cultural awareness and higher-order thinking skills among students.

Table 4: *Students' Percentage Scoring*

Test score (Nt)	Students' percentage
Nt ≥ 70	**82.5%**
Nt < 70	**17.5 %**

Out of 65 students, 54 students (82.5%) successfully achieved a score of ≥70 and were declared proficient, while 11 students (17.5%) did not meet the minimum criteria. These results indicate that more than three-quarters of the students had mastered the material through the gamified HOTS e-book based on Gorontalo's local culture, although additional support strategies are still needed for the group of students who have not yet achieved proficiency.

The development of the gamified HOTS e-book with AI integration through the exploration of Gorontalo's local culture, designed using the DDD-E model, has proven to be an important tool in facilitating the enhancement of students' higher-order thinking skills (Aziz & Rawian, 2022; Maxnun et al., 2024; Usman & Anwar, 2021). Validation results show that this medium not only meets the criteria of being valid, practical, and effective—with consistently high average scores and the majority of students achieving mastery—but also emphasizes the benefits of using interactive e-books as a strategy to foster critical, creative, and metacognitive thinking skills (Kurnia et al., 2024a, 2024b; Martín-Sómer et al., 2024; Nursyaida & Samad, 2024). Furthermore, this study opens opportunities for the application of similar innovations in other educational contexts, while at the same time strengthening local cultural literacy in the digital era. By integrating gamification and AI, pre-service teachers and students are encouraged to be more adaptive to dynamic learning needs, more actively engaged, and more confident in participating in learning practices, thereby creating a sustainable, meaningful, and relevant learning experience in line with the demands of the times.

Conclusion

The development of the gamified HOTS e-book with AI integration through the exploration of Gorontalo's local culture, designed with the DDD-E model, has been proven valid, practical, and effective in enhancing students' higher-order thinking skills. Validation results showed consistently high

average scores, and more than three-quarters of students achieved mastery, confirming the e-book's effectiveness in fostering critical, creative, and metacognitive abilities. Beyond its practical impact, the innovation also strengthens local cultural literacy in the digital era. This study highlights the potential of integrating gamification and AI as a sustainable and meaningful learning strategy, encouraging pre-service teachers and students to adapt to dynamic educational demands and engage more confidently in interactive learning practices.

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