ABSTRACT

Purpose: The objective of this research is to describes the process of designing and developing mobile game based-integrated thematic learning (MGBITL) in elementary schools. The mobile game based-integrated thematic learning (MGBITL) is different from Mobile game-based learning (MGBL). Because it is necessary to pay attention to the themes and subthemes that are the basis for developing learning content.

Theoretical Framework: Mobile game-based learning (MGBL) is a serious game, that is, a game designed for educational purposes while still remaining entertaining. MGBL has been shown in numerous studies to aid pupils in learning and reduce psychological stress. This research seeks to develop MGBL for Integrated Thematic Learning (MGBITL) for elementary school students. Building MGBITL based on mobile game development theory and integrated thematic concepts required proper procedures.

Methods: This research employed the MGBL Engineering Model, which consisted of three stages: (1) pre-production (discover & dream), (2) production (design), and (3) post-production (delivery). Literature review and distribution of online questionnaires to teachers were used to collect data about the principles of developing MGBITL for elementary school students.

Findings: The MGBITL application has been design which consists of 21 types of games adapted from Class V Theme 8 Subtheme 1 material which is the result of research activities. Hopefully, the introduction of MGBITL will aid teachers in teaching materials that need imagination, make subject matter easier to understand, and promote fun learning concepts. So that students are unaware that they are participating in a learning activity.

Practical implications: The study provides new knowledge about how to design mobile game-based integrated thematic learning (MGBITL). It's not just thematic learning material, but the game content too. There is a lot of learning material that must be linked by paying attention to the interconnectedness of each content.
Originality/Value: The originality of this research lies in the thematic learning concept used in game content. So far, game content only focuses on one discipline/learning content.

Keywords: mobile game, mobile game-based learning, integrated thematic learning, mgbl engineering model, education technology.

Received: 11/27/2023
Accepted: 02/19/2024
DOI: https://doi.org/10.55908/sdgs.v12i2.3263

TEM UM CONCEITO DIFERENTE: COMO PROJETAR O APRENDIZADO TEMÁTICO INTEGRADO BASEADO EM JOGOS MÓVEIS PARA ESTUDANTES DO ENSINO FUNDAMENTAL?

RESUMO

Propósito: O objetivo desta pesquisa é descrever o processo de concepção e desenvolvimento de MGBITL (aprendizado temático integrado baseado em jogos) nas escolas de ensino fundamental. O MGBITL (Mobile Game-Based-Integrated Temático Learning) é diferente do MGBL (Mobile Game-Based Learning). Porque é preciso dar atenção aos temas e subtemas que são a base para o desenvolvimento de conteúdos de aprendizagem.

Estrutura Teórica: Mobile game-based learning (MGBL) é um jogo sério, ou seja, um jogo projetado para fins educacionais, enquanto ainda continua a ser divertido. O MGBL tem sido demonstrado em inúmeros estudos para ajudar os alunos na aprendizagem e reduzir o estresse psicológico. Esta pesquisa busca desenvolver MGBL para Aprendizagem Temática Integrada (MGBITL) para estudantes do ensino fundamental. Construir MGBITL com base na teoria do desenvolvimento de jogos móveis e conceitos temáticos integrados exigiam procedimentos adequados.

Métodos: Esta pesquisa empregou o Modelo de Engenharia MGBL, que consistiu em três etapas: (1) pré-produção (descobrir e sonhar), (2) produção (design), e (3) pós-produção (entrega). A revisão de literatura e distribuição de questionários on-line aos professores foram usados para coletar dados sobre os princípios de desenvolvimento de MGBITL para alunos do ensino fundamental.

Descobertas: A aplicação MGBITL tem sido design que consiste em 21 tipos de jogos adaptados do tema Classe V 8 Subtema 1 material que é o resultado de atividades de pesquisa. Esperamos que a originação do MGBITL ajude os professores a ensinar materiais que precisam de imaginação, torne o assunto mais fácil de entender e promova conceitos de aprendizagem divertidos. Para que os alunos não saibam que estão participando de uma atividade de aprendizagem.

Implicações práticas: O estudo fornece novos conhecimentos sobre como projetar o aprendizado temático integrado baseado em jogos móveis (MGBITL). Não é apenas material de aprendizado temático, mas o conteúdo do jogo também. Há muito material didático que deve ser articulado prestando atenção à interconectividade de cada conteúdo.

Originalidade/valor: A originalidade desta pesquisa reside no conceito de aprendizagem temática usado no conteúdo do jogo. Até agora, o conteúdo do jogo se concentra apenas em uma disciplina/conteúdo de aprendizagem.

Palavras-chave: jogo móvel, aprendizado baseado em jogos móveis, aprendizado temático integrado, modelo de engenharia mgbl, tecnologia educacional.
TENEMOS UN CONCEPTO DIFERENTE: ¿CÓMO DISEÑAR UN APRENDIZAJE TEMÁTICO INTEGRADO BASADO EN JUEGOS MÓVILES PARA ESTUDIANTES DE ESCUELA PRIMARIA?

RESUMEN

Objetivo: O objetivo desta investigación es describir el proceso de diseño y desarrollo de aprendizaje temático integrado basado en juegos móviles (MGBITL) en escuelas primarias. El aprendizaje temático integrado basado en juegos móviles (MGBITL) es diferente del aprendizaje basado en juegos móviles (MGBL). Porque es necesario prestar atención a los temas y subtemas que son la base para desarrollar contenidos de aprendizaje.

Estructura teórica: El aprendizaje basado en juegos móviles (MGBL) es un juego serio, es decir, un juego diseñado con fines educativos sin dejar de ser entretenido. Se ha demostrado en numerosos estudios que MGBL ayuda a los alumnos en el aprendizaje y reduce el estrés psicológico. Esta investigación busca desarrollar MGBL para el Aprendizaje Temático Integrado (MGBITL) para estudiantes de educación primaria. Construir MGBITL basado en la teoría del desarrollo de juegos móviles y conceptos temáticos integrados requirió procedimientos adecuados.

Métodos: Esta investigación empleó el Modelo de Ingeniería MGBL, que constaba de tres etapas: (1) preproducción (descubrir y soñar), (2) producción (diseño) y (3) postproducción (entrega). Se utilizó la revisión de la literatura y la distribución de cuestionarios en línea a los maestros para recopilar datos sobre los principios del desarrollo de MGBITL para estudiantes de escuela primaria.

Hallazgo: Se ha diseñado la aplicación MGBITL que consta de 21 tipos de juegos adaptados del material Clase V Tema 8 Subtema 1 que es el resultado de actividades de investigación. Con suerte, la introducción de MGBITL ayudará a los profesores a enseñar materiales que necesitan imaginación, facilitará la comprensión de la materia y promoverá conceptos de aprendizaje divertidos. Para que los estudiantes no sepan que están participando en una actividad de aprendizaje.

Conclusiones: The study provides new knowledge about how to design mobile game-based integrated thematic learning (MGBITL). It’s not just thematic learning material, but the game content too. There is a lot of learning material that must be linked by paying attention to the interconnectedness of each content.

Originalidad/valor: La originalidad de esta investigación radica en el concepto de aprendizaje temático utilizado en el contenido del juego. Hasta ahora, el contenido del juego solo se centra en una disciplina/contenido de aprendizaje.

Palabras clave: juego móvil, aprendizaje basado en juegos móviles, aprendizaje temático integrado, modelo de ingeniería mgb, tecnología educativa.

1 INTRODUCTION

The term "Mobile Based Learning" was used to describe the trend of using technology into education (M-learning) (Basak et al., 2018; Behera, 2013). M-learning is defined as a method of learning that takes advantage of the capabilities of mobile devices such as phones, tablets, and personal digital assistants (Caudill, 2021; Zaibon & Shiratuddin, 2010b). Text messages (SMS or MMU) and e-mails, mobile applications,
and mobile games are all examples of M-learning use in academic interactions (m-Game) (Zaibon & Shiratuddin, 2010b). Mobile game-based learning is the name given to this type of m-Game (MGBL) (Cahyana et al., 2017; Yadav & Oyelere, 2021). Students in the MGBL play meaningful games to attain learning goals. Virtual games (not physical games) that may be played on handheld devices are used to offer curriculum-defined learning materials (Edmonds & Smith, 2017; Huizenga et al., 2009; Shiratuddin & Zaibon, 2011).

MGBL is also known as a serious game because, in addition to being entertaining, it also has an educational purpose (Carvalho et al., 2015). The usage of mobile games boosts the effectiveness of learning, which has prompted a major surge in MGBL research over the last two decades around the world (Scepanovic & dkk, 2015). Furthermore, MGBL can help students avoid psychological stress as a result of studying, as well as increase learning motivation through visual quality and animation (Burguillo, 2010; Kebritchi et al., 2010), assist in the promotion of learning materials in an engaging manner (Drigas et al., 2014; Kebritchi et al., 2010), provide an interactive environment through missions and challenge completion (Camilleri & Camilleri, 2017; Zou et al., 2021), stimulate deep learning and creative thinking (Eow et al., 2009), and help assist pupils in constructing knowledge in order to improve their academic performance (Hsu et al., 2011; Wu & Wang, 2012).

Primary schools use an integrated theme approach to learning (Habibi et al., 2020; Hendri et al., 2019; Wardani et al., 2019). Theme-based learning connects and integrates a variety of relevant topic matter (Ghonin Hamidah et al., 2019; Handayani, 2018; Wardani et al., 2019). This is because elementary school pupils' mindsets are still holistic, and they are unfamiliar with the term "dividing" (Ghonin Hamidah et al., 2019; Handayani, 2018; Sasriyanti et al., 2021). As a result, the content of a specific mobile game should reflect an integrated thematic concept, because the MGBL for Integrated Thematic Learning (ITL), also known as MGBITL, is based on a different concept from the standard MGBL. In general, MGBL only takes on one field or subject at a time (Shaffer et al., 2015), such as math games, social studies games that recognize traditional clothing, scientific games that describe different forms of rubbish, and so on. Meanwhile, MGBITL prioritizes academic components while still providing pleasure, is effective and simple to use, and considers game material to integrate the contents of many subjects. The different games in it must be interconnected and integrated in their descriptions and
MGBITL has the same benefits as MGBL, while having a different concept design. To attain these benefits, we are attempting to characterize the systematics of MGBITL development based on the theory of MGBL development and integrated thematic concepts in this study. Because there is currently very little study on how to develop MGBITL, more research on the MGBITL development flow is needed to assist researchers in creating games that are both entertaining and educational (Zaibon & Shiratuddin, 2010a). The methodology and framework of thinking are, of course, the most significant aspects because they will serve as a foundation for future work. Game concepts must also be taken into account to ensure that students are inspired to play and can readily explore knowledge on each subject's topic until all challenges have been solved (Nielsen, 2006; Rollings & Morris, 2004).

### 2 THEORETICAL FRAMEWORK

#### 2.1 INTEGRATED THEMATIC LEARNING CONCEPT

Thematic teaching assumes that students will be at their best learning level if they can associate new information holistically with the curriculum and their own lives (Eliyasni, Habibi, Masniladevi, et al., 2021; Ghunu, 2022). Thinking holistically means assessing everything as a whole based on the main overarching concept, paying attention to the interconnectedness of each part. Holistic thinking is characterized by the belief that interrelated parts can only be explained by referring to the concept as a whole (Setiawan et al., 2023).

Elementary school students who are in the first level of formal school do not yet know that scientific disciplines are very diverse. Intellectual development is at the concrete operational stage (Eliyasni et al., 2019). They are starting to develop their logical thinking, but they are still tied to conceptual reality, still limited to knowledge that originates from real objects. Another characteristic of elementary school student is integrative and hierarchical thinking. Understanding knowledge as something complete and integrated. Elementary school students are not yet able to sort out concepts from various scientific disciplines (Sofa & Sutisna, 2019).

Therefore, learning in elementary schools, especially in the lower grades, must be taught through an integrated thematic approach. An integrated thematic approach aims to enable students to develop a concrete understanding of specific topics, which is used to
illustrate meaningful relationships between subjects. Integrated thematic content is not practiced in isolation, but is translated across subjects. Even though the lesson content is taught sequentially, it is still relevant because it is connected by the theme of the material being taught (Novidha, 2022; Risda Amini et al., 2019)

For example, the theme "Honest Trading" presents social science material about the meaning of buying and selling; parties involved in buying and selling; the concept of production, distribution and consumption. Presents Mathematics material about the concept of profit and loss; and calculate the amount of profit/loss in a sale and purchase. Presenting Citizenship Education material regarding the need for honest actions in buying and selling activities. As well as presenting B. Indonesia learning material about reading buying and selling texts; answer questions related to the content of the text; as well as interpreting understanding that has not been understood using KBBI.

2.2 MOBILE GAME BASED INTEGRATED THEMATIC LEARNING

Mobile game-based learning (MGBL) is a game where the content is a summary of certain lesson topics adapted to the applicable curriculum and can be run on mobile devices/smartphones (Cahyana et al., 2017). At first glance, MGBL looks like a quiz or evaluation of a learning topic that has been studied, presented interactively through a mobile game (Eliyasni, Habibi, Masniladevi, et al., 2021).

Recently, the use of mobile devices has become an alternative solution in creating challenging and meaningful learning. As well as a way to minimize students' interest in smartphones, turning them into learning media that have a positive impact (Zaibon & Shiratuddin, 2010b; Zarraonandia et al., 2012). As a learning medium, MGBL is a learning service that can be applied anywhere and at any time (Alaswad & Nadolny, 2015; Scepanovie & dkk, 2015).

It cannot be denied that electronic games have played an important role in the daily lives of the younger generation (Huizenga et al., 2009). So the researchers hope to combine the instructional motivation shown by students with electronic games that contain summaries of learning topics (Karam & Abd, 2017; Prensky, 2017). The aim is of course to make learning more enjoyable and not provide an academic burden.

MGBL is different from mobile game-based integrated thematic learning (MGBITL). Even though both are based on mobile games, the content and concept are different. MGBL content only contains a summary of material from one of the scientific
disciplines. Meanwhile, MGBITL contains a summary of material from several scientific disciplines in accordance with the theme. As previously explained, integrated thematic learning is theme-based learning that combines several subject contents. MGBITL is no different. MGBITL content is based on learning themes, where there are various types of games taken from material summaries of several subjects according to the theme.

Thus the MGBITL content is clearly broader than the MGBL content. The game flowchart will also be more complex than the MGBL flowchart. The MGBITL game flowchart has a lot of structure because it is adjusted to the number of sub-themes explained in the chosen theme, as well as the number of subjects chosen according to the material coverage of each sub-theme.

3 METHODS

The MGBITL design process follows the MGBL Engineering Model approach, which includes three phases: (1) pre-production (discover & dream), (2) production (design), and (3) post-production (delivery) (Zaibon & Shiratuddin, 2010b).

Figure 1. MGBL Engineering Model

Source: (Shiratuddin & Zaibon, 2011)

The MGBITL design process, however, only reached the production stage based on the title and research objectives. The following are the actions that take place during the pre-production and production stages.

3.1 PRE-PRODUCTION

Requirements analysis and planning, mobile interaction and technical analysis, learning material design, and game features design are the four main activities in the pre-production stage (Zaibon & Shiratuddin, 2010b). During this phase, a literature review
on the development of MGBL research is conducted. In addition, teachers will be given online questionnaires to fill out in order to learn more about the best MGBTITL concept. Designing game interaction models (game flowcharts), learning content, and game features are also included. When creating game interaction models and learning content, the purpose of integrating ITL concepts into MGBL begins. All of the games in MGBTITL must, in essence, be interconnected and represent an integrated thematic concept. Overall, the most important aspect of the pre-production stage is to develop the MGBTITL concept (Aslan & Balci, 2015).

3.2 PRODUCTION

The production stage entails bringing the concept to life in order to create a real-world version of MGBTITL. At this point, the focus is on creating learning content. To create the MGBTITL program, we worked on game features, coding processes, and integrating all game components (Zaibon & Shiratuddin, 2010b). At this point, the most essential thing is to make sure that the development of learning content for an MGBTITL application focuses on integrated thematic concepts and the substance of each subject. The goal is to ensure that the use of MGBTITL truly prioritizes academic functions in order to meet learning objectives (Aslan & Balci, 2015).

At this point, the type of software for the MGBTITL development process is also decided (Rahim et al., 2020). Depending on the function, several types of software are employed. Using Corel Draw software, develop learning content design and gaming elements. Adobe Audition may be used to add music and sound. While Construct 2 is used for coding and integrating all game components in order to create MGBTITL.

4 RESULTS

The research results are explained based on the 8 stages passed in the process of developing MGBTITL, namely requirements analysis and planning, mobile interaction and technical analysis, learning material design, game features design, learning content development, game asset development, coding & mechanical development methods, and game features integration. These eight stages are divided into two main groups, namely pre-production and production.
4.1 REQUIREMENT ANALYSIS & PLANNING

4.1.1 Principles of Developing MGBITL in Elementary Schools

As educators that use MGBL in the classroom, we believe it is critical to obtain the teacher's opinion. This is to ensure that the MGBITL developed meets their expectations and wishes. We surveyed 32 instructors from Padang City schools with digital classes in grades IV, V, and VI. The survey was carried out by issuing a 38-question online questionnaire. The survey's results yielded eight MGBITL development concepts, which are as follows: (1) MGBITL instills moral and educational values in students, (2) MGBITL is simple to use and can be played offline, and (3) MGBITL offers learning chances and experiences. (4) MGBITL content is in accordance with learning materials and combines various disciplines, (5) MGBITL substance prioritizes the function of education over entertainment, (6) MGBITL operations have principles and limitations of use, (7) MGBITL design is in accordance with elementary school students' character, and (8) MGBITL features must be polite and can be used as an example.

4.1.2 Components of MGBITL

Clear understanding about mobile game components is required before constructing MGBITL. The goal is for the developed MGBITL to meet the MGBL's general standards. The MGBITL component is actually the same as MGBL because both are smartphone-based educational games; however, the structure of MGBITL's "Game Play" component is slightly different because it provides material from other disciplines of study. Based on our literature study, there are at least eight main components of MGBITL, namely: (1) initial display (company logo/game logo) (Mewengkang et al., 2018), (2) player identity column (Alaswad & Nadolny, 2015), (3) main menu (Rahim et al., 2020; Red et al., 2013; Shiratuddin & Zaibon, 2011; Tanzil et al., 2018), (4) setting button (Rahim et al., 2020; Red et al., 2013; Shiratuddin & Zaibon, 2011; Tanzil et al., 2018), (5) exit button (Rahim et al., 2020; Red et al., 2013; Shiratuddin & Zaibon, 2011; Tanzil et al., 2018), (6) game play (Anuari & Purwanto, 2020; Mulyatun et al., 2021), (7) navigation and hint buttons (Aslan & Balci, 2015; Lai et al., 2018; Prensky, 2017), and (8) game info (Aslan & Balci, 2015; Lai et al., 2018; Prensky, 2017).

4.2 MOBILE INTERACTION & TECHNICAL ANALYSIS

We attempted to build an interaction model and game operational techniques in
the form of a game flowchart based on the main components of MGBL indicated in point 3.1.3. This MGBITL is for content in class V, sub-theme 1 of theme 8. As a result, the flowchart design carries the thematic concept and accommodates material for various subjects under sub-theme 1. Figure 2 depicts the design of the MGBITL flowchart.

**Figure 2. Flowchart game**

![Flowchart Game](image)

Source: Prepared by authors

### 4.3 LEARNING CONTENT DESIGN

Learning content design is the foundation for developing game concepts. The design of the learning content was inspired by the fifth-grade stents' book's learning materials, theme 8, sub-theme 1. This concept was originally defined as a mapping of subject indicators from Lesson 1 to Lesson 6 (see examples in Figure 3). The mapping of these indicators reveals that the developed mobile games are indeed designed for integrated thematic learning. Furthermore, the learning content for each subject from Lesson 1 to Lesson 6 was derived from these mapping indicators. Table 1 shows the
outcomes of the learning content design.

Figure 3. Example of subject indicator mapping

Source: Prepared by authors

Table 1. Content of learning

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Subjects</th>
<th>Code</th>
<th>Content of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Indonesian Language</td>
<td>1.1</td>
<td>Identify the causes of the difficulty of clean water</td>
</tr>
<tr>
<td></td>
<td>Natural Science</td>
<td>1.2</td>
<td>Identify the role of water in the lives of humans, animals, and plants.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.3</td>
<td>Analyze water-related activities at home</td>
</tr>
<tr>
<td>2</td>
<td>Cultural Arts and Crafts</td>
<td>2.4</td>
<td>Sing the song &quot;Air Terjun&quot;</td>
</tr>
<tr>
<td></td>
<td>Natural Science</td>
<td>2.5</td>
<td>Analyze the flow of the water cycle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.6</td>
<td>Identify the parts of the water cycle</td>
</tr>
<tr>
<td></td>
<td>Indonesian Language</td>
<td>2.7</td>
<td>Compose the fable &quot;The Ant and the Bear&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Indonesian Language</td>
<td>3.8</td>
<td>Identify information on &quot;Ulik Palin Traditional House&quot;</td>
</tr>
<tr>
<td></td>
<td>Social Science</td>
<td>3.9</td>
<td>Match regional language vocabulary according to the region of origin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.10</td>
<td>Match traditional houses and traditional clothes according to the area of origin</td>
</tr>
<tr>
<td></td>
<td>Civic Education</td>
<td>3.11</td>
<td>Determine attitudes towards cultural differences</td>
</tr>
<tr>
<td>4</td>
<td>Indonesian Language</td>
<td>4.12</td>
<td>Identify information on types of business fields</td>
</tr>
<tr>
<td></td>
<td>Social Science</td>
<td>4.13</td>
<td>Determine the distinct characteristics of each business type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.14</td>
<td>Complete the table of work types and outcomes</td>
</tr>
<tr>
<td></td>
<td>Civic Education</td>
<td>4.15</td>
<td>Determine attitudes at work and attitudes towards job disparities</td>
</tr>
<tr>
<td>5</td>
<td>Cultural Arts and Crafts</td>
<td>5.16</td>
<td>Complete the lyrics of the song &quot;Kampungku&quot; and compose the Major Diatonic scales</td>
</tr>
<tr>
<td></td>
<td>Natural Science</td>
<td>5.17</td>
<td>Analyze the sources, benefits, and factors that influence river water availability</td>
</tr>
<tr>
<td></td>
<td>Indonesian Language</td>
<td>5.18</td>
<td>Sort the story of the benefits of water and choose a picture that corresponds to the story</td>
</tr>
<tr>
<td>6</td>
<td>Indonesian Language</td>
<td>6.19</td>
<td>Determine the names of traditional Indonesian children's games</td>
</tr>
<tr>
<td></td>
<td>Civic Education</td>
<td>6.20</td>
<td>Determine the value and benefits of traditional Indonesian children's games</td>
</tr>
<tr>
<td></td>
<td>Cultural Arts and Crafts</td>
<td>6.21</td>
<td>Complete the lyrics of the song &quot;Syukur&quot; and compose the Minor Diatonic scales</td>
</tr>
</tbody>
</table>

Source: Prepared by authors
After each subject's learning content has been described, the content is turned into a game concept. The entertainment function of MGBITL will be explained using this concept, which can be observed in how it operates or how to play the game. Despite efforts to improve the entertainment function through fascinating concepts, the focus of MGBITL development remains on the educational function, namely how to get students to like the learning contents offered. Table 2 shows several examples of turning learning content into game concepts.

Table 2. Example of learning content design

<table>
<thead>
<tr>
<th>No</th>
<th>Subjects</th>
<th>Code of Content</th>
<th>Concept of Game</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cultural Arts &amp; Crafts</td>
<td>2.4</td>
<td>Some lines from the song Air Terjun were left out. Songs that are both instrumental and have lyrics. The song instrument pauses when it comes to empty lyrics; students must fill in the blanks with the words provided so that the song can continue. Removed song lyrics: (1) tak putus, (2) angin, (3) lembah, (4) gemuruh, (5) air terjun, dan (6) mengalir</td>
</tr>
<tr>
<td>2</td>
<td>Natural Science</td>
<td>2.5</td>
<td>Students are given 9 pieces of water cycle images in the shape of a puzzle and are given the task of arranging the puzzles to produce a water cycle plot. If the picture's eight pieces are correctly arranged, the final piece will appear automatically to complete the puzzle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.6</td>
<td>The essential parts of the water cycle, such as evaporation, condensation, precipitation, infiltration, and runoff, are provided a box when the water cycle puzzle is completed. The field, however, is left blank, and students are given the task of filling in the section's name.</td>
</tr>
<tr>
<td>3</td>
<td>Indonesian Language</td>
<td>2.7</td>
<td>The story &quot;The Ant and the Bear&quot; was given to students in nine pieces. Then there are nine blank squares where the story pieces might be placed. In order to build the right story line, students place each story piece in the box. After correctly assembling the story, nine pieces of artwork appear, each depicting the contents of one of the story pieces. Each picture is placed in the appropriate story piece by the students.</td>
</tr>
</tbody>
</table>

Source: Prepared by authors

4.4 GAME FEATURE DESIGN

4.4.1 Main Feature

MGBITL was created with the idea of adventure in mind. To advance to the next lesson, players must complete challenges in each lesson. The game's main feature is a residential model surrounded by trees, crossed by a small river, and containing six houses. Figure 4 shows the design of the main feature.
4.4.2 Additional Features

The developed MGBITL contains various supporting elements, as shown in the flowchart: (1) game information, (2) settings, (3) mini map, and (4) characters. The game info section offers brief information from the development team and sponsors of the game production. A round frame was used to hold a photo of each member. The Tutwuri Handayani logo, which serves as a symbol that this game is intended for educational purposes, the LP2M UNP logo, which serves as a research sponsor, and the Rabbit Dev logo, which serves as a private firm that controls game development, are all shown below the photo.

With the option to "turn on" or "turn off," the setting feature allows you to change the game's operating components such as music, sound, and graphics. This feature is intended to be present on every game display so that players can control it in any game they are playing. The mini map is a scaled-down version of the main feature. The player's character will appear on the mini map when the player walks from one house to the next. As a result, this mini map feature serves as navigation, directing players to the next house.

There is also a character select feature in addition to the above features. When the player is a boy, he can choose a male student's character, and when the player is a girl, he can choose a female student's character. Because the algorithm has concluded that the teacher is female, the character of the teacher cannot be chosen. The characters of students and teachers are supposed to be pleasant and courteous. Long-sleeved shirts, long skirts, and headscarves are worn by female students. Long pants, tucked shirt bottoms, and belts are worn by male students. Female teacher characters are supposed to wear a long headscarf and wear blouse-dress. Students and teachers play a role in each challenge, both at the beginning and at the end. These two characters will speak with one another in order to help players complete each challenge.
4.5 LEARNING CONTENT DESIGN

Learning content development is the first stage of a game's development before it is translated into machine language and made available for use on mobile devices. This content development is customized to the game concept outlined in Table 2. The Corel Draw program is used in the learning content development process, as we discussed in the methodology section. Figure 5 is an example of development result of learning content.

![Figure 5. Development result of content code 2.5 – 2.6](image)

Source: Prepared by authors

4.6 GAME FEATURES DEVELOPMENT

The game's features are customized to the concept outlined in points 3.4.1 and 3.4.2. Corel Draw is used in the development of this feature. The feature game is MGBITL's development house, and the game's features allow learning content that will be turned into a game version to be operated. In a summary, game features are tools for presenting and playing games. Figure 6-7 depict are examples of development result of game features.

![Figure 6. Development result of main feature](image)

Source: Prepared by authors
4.7 CODING AND CORE MECHANICAL DEVELOPMENT

The coding stage is defined as the process of transforming the developed design into machine language form so that the design can be understood and implemented by the computer. Coding, to put it another way, is an attempt to translate a design into a machine-readable format. In this situation, as indicated in table 1, the coding process for the 21-learning content tries to make the content playable according to the game concept developed. Figure 8 shows an example of the coding procedure.

4.8 CODING AND CORE MECHANICAL DEVELOPMENT

This is the final stage of the MGBITL production process. To create the MGBITL application, all game components are integrated. With the help of game features, you can play 21 different sorts of games that have gone through the development process. Simply said, the value code of each type of game and game feature is entered into the system as part of the integration process (conditional). The system will automatically send an electronic signal to the chosen game value when the user plays a game. This activity will
activate the game code, allowing you to play the game. Figure 9-11 show several examples of MGBITL development results.

5 DISCUSSION

In the previous decade, technological developments have compelled every aspect of life to adapt, including education. As a result of this phenomena, the term
"digitalization of learning" develops (Blundell et al., 2016). Until, finally, the concept of digital-based learning media appeared. Teachers will find it easier to create up-to-date learning media with the help of technology (Eliyasni et al., 2019). After all, learning media must be modified in order to continue to provide learning material in an interactive way in accordance with current learning styles (Eliyasni, Habibi, Rahmatina, et al., 2021).

MGBL is a sort of digital-based learning media. MGBL is a learning platform that promotes play-based learning (Gaydos & Devane, 2019). MBGL has emerged as a result of opportunities and realities in the field, where nearly everyone owns a smartphone and children enjoy playing a variety of games on their mobile devices (Rideout & Robb, 2019). MBGL, in our perspective, is not the same as a Smartphone-Based Educational Game (SBEG). Because SBEG exclusively makes educational content available in the form of smartphone games. The scope is broad because the object is anything that feels like education; yet, it is unclear if the educational content in question is included in the learning materials or not. As a result, SBEG has nothing to do with classroom learning activities. While MGBL refers to the usage of smartphone apps to deliver educational materials (Lunn et al., 2016; Yadav & Oyelere, 2021). The MGBL contains the entire content of the classroom's learning materials. Because the subject is students and teachers, the material is the object of study that is turned into a game. As a result, MGBL is intimately involved in student learning activities, and the classroom serves as his home.

In reality, however, the substance of MGBL differs from the existing elementary school curriculum concept. Elementary schools, as we mentioned in the introduction, use an integrated thematic approach to learning. Learning based on themes that integrate the competencies of multiple disciplines, rather than learning for specific subjects (Ghonin Hamidah et al., 2019; Handayani, 2018). As a result, MGBL must be modified to fit the learning approach. That's why we present the term Mobile Game-Based Integrated Thematic Learning (MGBITL).

SBEG, MGBL, and MGBITL all go through the same stages in the development process. A needs analysis is performed first, followed by the creation of a content design, the development of content, the coding process, and finally the integration of all components (Red et al., 2013; Shiratuddin & Zaibon, 2011). Because the content of MGBITL differs from that of other mobile-based educational games, the flowchart model and technique for formulating game concepts in MGBITL are unique.

Figure 2 shows a game play feature. Pay attention to it. This section establishes
the distinction between MGBL and MGBITL in terms of substance and concept. The game play feature in MGBL only has one sort of game that is based on a specific subject matter. Although the game may have various variations, the type remains the same; only the level and degree of difficulty are increased. While the MGBITL game has several types, it does not have any additional types of variation. The focus of Learning Materials 1 – 6 is varied, as shown in Figure 2. Each lesson’s game types do not carry the subject's identity; rather, they are interrelated and connected in explaining the core material. "Water for Living Creatures," for example, is the focus of Learning Material 1. It has three distinct but related types of games, all of which revolve around the theme of "Water," which is the core of the learning material.

The amount of learning content determines the number of games in MGBITL. The curriculum (in the teacher’s and student’s books) determines the substance of this learning, which is modified from the main material of each lesson. This indicates that if a class has three main materials, the amount of learning content is the same, and thus the number of games that may be created is the same. The subject matter is each subject's competence in terms of knowledge and skills (see table 1).

The appearance or workings of a game is reflected in the concept of the game (Chang & Yang, 2016; Laato et al., 2017). As a result, converting learning content into a game concept necessitates a creative thinking process (Laato et al., 2017). Because this will be the primary factor determining whether pupils like or dislike the MGBITL that has been produced, the concepts compiled are also used to identify operational techniques and features in the game. Consider the content code 2.7 found in tables 1 and 2. The learning content in table 1 is summarized in a single sentence: "Composing the fable story of the Ant and the Bear." This sentence does not convey how the game will be conducted. This content was evolved into a game concept after going through the creative thinking process in table 2. It was finally determined that content 2.7 would be provided in nine story pieces based on this concept. If students are successful in arranging the story pieces into a whole story, they will be rewarded with nine pieces of artwork. Each picture must be placed in the right story piece, which is a challenge for students.

One of the things to consider when designing games for elementary school students is if the game concept is developed in accordance with the students' cognitive and intellectual development (Lester et al., 2014). Because MGBITL is aimed at high school students, game content 2.7, for example, is divided into nine story pieces. If the
subject of the MGBITL is a low-grade student, then 3-5 story pieces would be enough. This is due to the fact that the ability to think and remember differs between high- and low-grade students.

Game features are an essential component of the game. Game features can be used to play games. As a result, game features must be built in accordance with the game concept (Lester et al., 2014; Prensky, 2017). The main feature of MGBITL is that it is designed to look like a nice residential model with six houses. The design of this main feature corresponds to the learning theme of "Human, Environment, and Culture," with the six houses representing Lesson 1 to Lesson 6. These houses contain 21 different sorts of MGBITL games. As a result, when the player enters House 1, he will face three obstacles (three different sorts of games) derived from the three main materials in the lesson.

We make every effort to meet or exceed teacher standards. Based on the preliminary study's findings, they wanted the MGBITL to be simple to use and the characters to serve as role models. That's why we included a mini map and allowed teachers and students to interact. The mini map function allows players to quickly determine the location of the house, while the conversation guides them on how to play the game. The player characters are meant to be neat and courteous in the hopes that students will be driven to take care to their appearance while playing this game. Other classroom features, such as the first display of the game and the gaming room, are designed to give students the feeling of studying in class while playing games on their smartphones.

Furthermore, even though the game cannot be played yet, game concepts and features are collaborated on and evolved into a game with a clear form. We chose Corel Draw for this process because: (1) the image resolution produced by this application can be reduced to the lowest level, but the quality is not inferior to that of other applications; (2) the tools in Corel Draw are simple to use, making them very useful for novice users; and (3) Corel excels at collaborating images with words, which is critical in the creation of MGBITL (Februariyanti, 2007; Mulyana, 2017).

The following components are brought together by supplying an operational code that the machine can understand. This is comparable to a life where characters can walk around, game features may be used, and games can be played. We chose Construct 2 for this approach since the MGBITL game is a two-dimensional game, and Construct 2 is
built exclusively for this type of game (Agung Saputro et al., 2018; STEMKOSKI & Leider, 2017). Furthermore, the MGBITL operating system is also not too complicated, so it is very suitable if you use the Construct 2 application (STEMKOSKI & Leider, 2017).

MGBITL must first be exported (formatted) to the "apk" format using the Cordova application before it can be played on mobile devices. Then, using the Android Studio application, proceed to the "build" stage. At this point, make any necessary changes to the ID, application name, application icon, and game orientation. Researchers will find it easier to share games for testing purposes using this MGBITL application.

6 CONCLUSION

As stated in the beginning, the goal of this research is to develop MGBITL for elementary school students. The MGBITL application was finally developed after going through a number of development procedures using the MGBL Engineering model, and it was adopted from the subject matter for Class V Theme 8 Sub-theme 1. The developed MGBITL comprises 21 different types of games divided into six lessons. We are confident that this MGBITL will aid students in understanding the subject matter and will assist teachers in presenting learning in an interesting and enjoyable way for students. Any suggestions and comments will be appreciated so that we may continue to improve the quality of MGBITL in order to fulfill.

ACKNOWLEDGEMENTS

We would like to thank Research and Community Service Institute of Padang State University for funding this research through the Applied Higher Education Leading Research scheme with a contract number of 932/UN35.13/LT/2021
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