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# Development of a Digital Game for Learning to Write Jawi Characters in Mobile Environment

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**Abstract:** Developing a digital game in education involves several difficult and complicated stages. The selection of an appropriate model is necessary to ensure the development of the digital game is in order and systematic. Thus, a few models have been thoroughly reviewed to help to develop the writing Jawi characters digital game in a mobile environment (PDJAWI). It is found that, through a thorough review, there are three (3) main phases required for the development of PDJAWI that are pre-production, production, and post-production. Each phase involved is discussed one by one until the prototype of PDJAWI is produced and can be applied by the users.

**Keyword:** Digital Games, Writing Jawi, Mobile, Educational Game, Jawi Character.

## 1. INTRODUCTION

Handwriting is a fine motor skill that children should learn beginning the early stage of schooling. The process of learning to write formally starts even from the pre-school stage. In Malaysia, the motor skill in the context of writing skill is not only for alphabets but also being emphasized for Jawi characters. [1] pointed out that Jawi writing should be taught beginning the childhood stage. [2] found that children are also weaker in a mastery of Jawi writing skill compared to reading Jawi. [3] also emphasized that learning Jawi writing should start during childhood through the use of appropriate methods and techniques.

It is viewed that the current teaching Jawi method is not that interesting and motivating. As stated by [4], the teaching method is still using chalk and board as well as flash cards. An appropriate method should be applied to ensure that learning Jawi activities are more interesting and being interested in by the children. A systematic practice with the help of information and communication technology (ICT) can be used apart from the conventional teaching method. ICT is found to be able to increase the students' interest to learn and eventually making teaching and learning process more interesting [5]; [6]; [7]. In addition to ICT, the strength of interactive digital games in education is being accepted by the current generation of parents [8].

Digital games is a huge discovery that manages to capture and captivate students to use their time for learning activities [9]. The current generation is growing up in the world of information technology in which they are very much interested in digital games. As pointed out by [10] children nowadays grow up in a “textual landscape” in which they have various ways to interact and actively playing in a digital technology environment such as computer games, mobile phones, and virtual world. [11] and [12] noted that games in a modern era have been integrated into the education in order to create an innovative and more favored education paradigm.

## 2. BACKGROUND OF THE STUDY

The game development is a complicated and expensive task, and studies about it are also limited [13]; [14]. According to a study by [15], the development of game-based learning (GBL) is a combination of game development method and instructional design model. Meanwhile, [16] stated that the digital game development method consists of pre-production, high-level concept, design document, prototyping, development, alpha testing, beta testing, end users, and expert phases. [17], on the other hand, stated that the user-centred game development method involves pre-production, production, and post-production phases.

Although there are many studies on the development of games in education, but mostly do not propose a step-by-step process of game development [18]. In addition, the model also does not specify on how to develop games in a mobile environment. This is because developing games for mobile devices requires more specification because there are limitations to the mobile environment such as screen design interaction and software/hardware dependencies [19]. Similarly, [20] stated that integrating learning content into mobile games can be complicated because mobile games software primarily for education differs from normal application software [21].

[22] have identified the main steps in the development method that need to be emphasized when developing mobile game-based learning. The identified processes and activities are classified into three (3) general phases that are pre-production, production, and post-production. This model is known as Mobile Game-Based Learning Engineering Model (mGBL Engineering Model) [18]. mGBL model is an educational game development method specifically for learning that is being played on mobile devices such as mobile phones. The main objective of mGBL is to use games to enhance the motivation in learning, engage in knowledge acquisition, and increase the effectiveness of learning via mobile environment [22].

In view of the difficulties to develop digital games, a few design development phases must be identified before carrying out the development. There are a few phases of development design from previous studies being made as references that is educational based development design [15];[23];[24], software development based design [25]; [26] and a combination of a few models based design [27]. While based on the studies by [17];[28], and [18], the phases of user requirement based digital game development design comprises three (3) phases that are pre-production, production, and post-production. The three (3) phases are suitable to develop a writing Jawi characters digital game (PDJAWI) in a multimedia-based mobile environment that is text, graphic, animation, audio, and video.

## 3. METHOD OF DEVELOPMENT STUDY

A prototype development involves three (3) phases that are pre-production, production, and post-production (Figure 1). Each phase contains main activities and followed by the components of the activities involved in ensuring the phase-by-phase success of PDJAWI development.

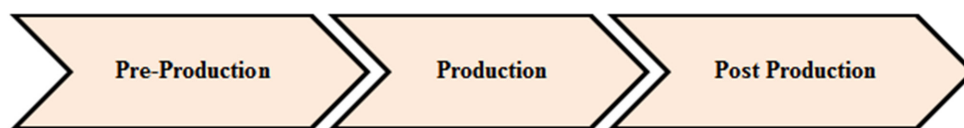


Figure 1: PDJAWI Prototype Development Phase

### A. Pre-Production

The first phase of PDJAWI prototype development starts with the pre-production that comprises five (5) processes that are identifying content, building a storyboard, identifying technical specifications, identifying tracing process and identifying online Jawi characters recognition process. Each process contains a few activities carried out to achieve each method listed. A short description of each process involved in pre-production phase is discussed in Figure 2 below

| <i>Pre-Production Process</i>                          | <i>Activity</i>   | <i>Result</i>  |
|--|---|--|
| Identifying Content                                    | <ul style="list-style-type: none"> <li>Literature Review</li> <li>Questionnaire</li> </ul>  | <div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Framework of Jawi Writing Process</b> </div>   |
| Game Design  | <ul style="list-style-type: none"> <li>How to play game design (scenes)</li> <li>Art design (characters and environment)</li> <li>Game levels design</li> <li>Game feedback design</li> </ul> | <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;"><b>PDJAWI Game Design Document</b></p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; text-align: center;">PDJAWI game design</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; text-align: center;">PDJAWI development technical specifications</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; text-align: center;">Jawi characters tracing engine design</div> <div style="border: 1px solid black; padding: 2px; text-align: center;">Online Jawi recognition engine design</div> </div> |
| Identifying Technical Specifications                   | <ul style="list-style-type: none"> <li>Identifying game engine</li> <li>Identifying software</li> <li>Identifying hardware</li> <li>Identifying programming language</li> </ul>               |  |
| Identifying Jawi Characters Tracing Process            | <ul style="list-style-type: none"> <li>Preparing sample points process</li> <li>Tracing process</li> <li>Tracing feedback process</li> </ul>  |  |
| Identifying Online Jawi Characters Recognition Process | <ul style="list-style-type: none"> <li>Template modeling process</li> <li>Recognition process</li> </ul>  |  |

**Figure 2: Processes involved in PDJAWI development pre-production phase**

### B. Production

The next phase is the development phase in which programming and scripting efficiencies are required. The educational content and game concept are combined to form a digital game. The processes involved in this phase are formulating teaching materials, developing tracing engine, developing online Jawi characters recognition engine and developing the game. Each process has a few activities that are being discussed in the following Figure 3.

| <i>Production Process</i>                            | <i>Activity</i>  | <i>Result</i>  |
|--|--|--|
| Formulating Teaching Resources                       | <ul style="list-style-type: none"> <li>Developing multimedia elements (text, graphic, animation, audio)</li> <li>Formulating teaching materials into a form of game</li> </ul> | <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;"><b>PDJAWI Prototype</b></p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; text-align: center;">Teaching material in a form of game</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; text-align: center;">Tracing engine</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; text-align: center;">Online Jawi recognition engine</div> <div style="border: 1px solid black; padding: 2px; text-align: center;">PDJAWI interface together with media and engine</div> </div> |
| Developing Tracing Engine                            | <ul style="list-style-type: none"> <li>Obtaining sample points</li> <li>Tracing process</li> <li>Feedback</li> </ul>   |  |
| Developing Game                                      | <ul style="list-style-type: none"> <li>Developing interface</li> <li>Integrating all media and feedback engine</li> <li>Developing game levels</li> </ul>                      |  |
| Developing Online Jawi Characters Recognition Engine | <ul style="list-style-type: none"> <li>Template modelling</li> <li>Recognition process</li> </ul>  |  |

**Figure 3: Processes involved in PDJAWI Development Production Phase**

### C. Post-Production

The final phase is the post-production phase. The post-production phase consists of two (2) processes that are unit testing and integration testing. A description of both processes used in each testing that is being carried out is as shown in Figure 4 below.

| <i>Production Process</i> | <i>Activity</i>  | <i>Result</i>  |
|---------------------------|--|--|
| Unit Testing              | <ul style="list-style-type: none"> <li>Ensuring all functions, procedures and logics run smoothly</li> <li>Formulating teaching materials into a form of game</li> </ul>   | <div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>PDJAWI software that has been tested</b> </div> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 5px 0;">Unit Testing</div> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 5px 0;">Integration Testing</div> |
| Integration Testing       | <ul style="list-style-type: none"> <li>Ensuring all modules well function.</li> <li>Ensuring all related modules well function.</li> <li>Data transfer between modules runs smoothly.</li> <li>Top-down testing approach.</li> </ul> |  |

Figure 4: PDJAWI development post-production processes

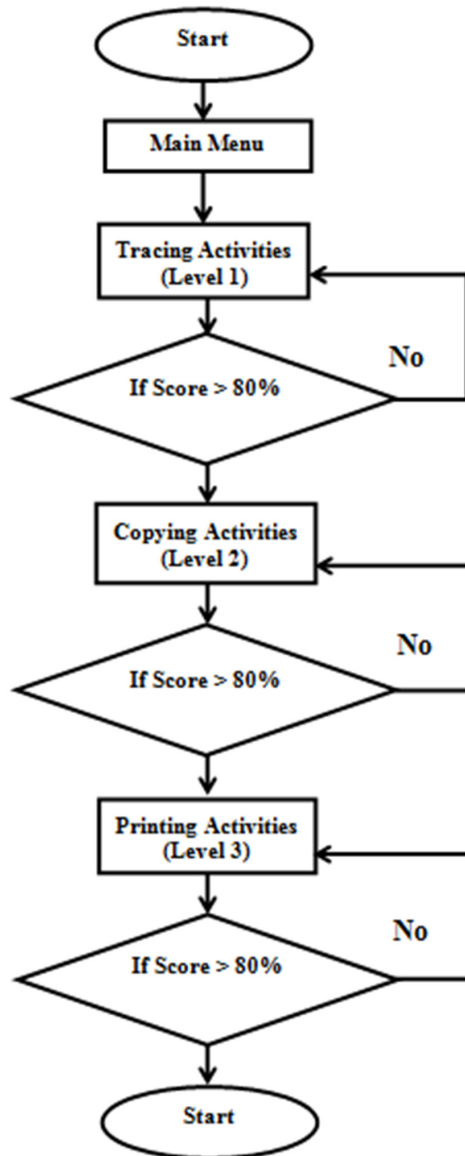
### D. Digital Game Prototype

The result is a PDJAWI game prototype that is being developed using a mobile device that is able to provide a real-time feedback from the input entered using a stylus pen in an Android environment. Java programming language derived from an open system is used on the game engine to develop PDJAWI. The game is divided into three (3) levels that are level one (characters tracing activities), level two (characters copying activities), and level three (characters printing activities). Figure 5 shows the examples of PDJAWI screen interface display.



Figure 5: PDJAWI digital game software interface

The shift from one level to the next level requires a mastery of Jawi writing process skill prior shifting to the next level, (Figure 6). This is consistent with the [29] that students should master each lesson unit before moving on to the next unit. Students should also score more than 80% of the overall marks before moving to a higher level. As stated by [30] students should demonstrate a master at more than 80% score before moving on to the new learning materials.



**Figure 6: PDJAWI game processes flowchart**

Prototype testing is performed to ensure that the prototype produced is free from bugs and logic errors. It is also to ensure that the prototype is ready to be used by the user. Once all testing has been performed and the results are positive without the existence of any bug and problem of logic, the integration testing is then performed. The integration testing is an ongoing testing between one game levels to another level. The results of integration testing are able to help developers to find design errors early and provide confidence to the developers that the strategy design is correct. After obtaining positive results from the testing, the software being developed can be handed over or used by the user without any issue.

## 4. CONCLUSION

The study discusses the development process of Jawi characters writing digital game software (PDJAWI). The development of PDJAWI is being carried out in three (3) phases; pre-production, production, and post-production. Each phase has listed out all steps involved including the activities, processes, and results. A discussion on PDJAWI prototype development process and clear illustrations can help the development of similar educational game software.

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