

ARTICLE

Development of Differentiation Mobile Learning Media on Chemical Bonding Material for High School

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ABSTRACT

The rapid development of technology means students must have smartphones that support learning. However, a few students use smartphones for learning. Additionally, there is a lack of learning media that can support the diverse learning styles of students. This study aims to develop differentiated mobile learning media on the topic of chemical bonding. The research type used is Research and Development with the Plomp model. The validation of the differentiated mobile learning media is conducted through expert reviews and practicality testing by teachers and students of SMAN 1 Airpura. The data analysis results material validity score is 0.91 and media validity score is 0.87 (categorized as valid). The practicality scores obtained are 96% from teachers and 91% from students (categorized very practical). It can be concluded that the differentiated mobile learning media for the topic of chemical bonding is valid and very practical for use.

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1. Introduction

Technology-based learning enables access to materials and lesson applications anywhere and anytime, and facilitates students understanding of the material [1]. Technology can also be used for simulations, such as 3D videos and augmented reality, which can help students understand abstract concepts [2]. With the aid of information and communication technology, the interaction between teachers and students can be optimized [3]. Another function of technology is to support learning that is more adaptive, innovative, and creative in line with the principles of the independent curriculum. The independent curriculum is designed to provide the freedom to pursue each student's interests and needs in the learning process [4]. This curriculum also gives teachers more freedom to organize learning by taking into account the students interests and needs [5]. To motivate students to learn more and achieve better learning outcomes, teachers must organize contextual, innovative, and engaging [6]. Therefore, the role of instructional media in the learning process [7].

Learning media serve as tools or intermediaries that enable teachers to teach material to students more effectively [8]. Through the use of learning media, students not only listen to the teacher's instructions but also visually perceive what the teacher conveys through the media [9]. Therefore, media that can meet those demands is needed, namely mobile learning media. Mobile Learning is used to describe a model of learning media that utilizes technology as a learning medium, such as displaying text, images, and audio [10]. Mobile Learning is a teaching method that provides a diverse, comfortable, and efficient learning environment [11]. It's main advantages include the potential to expand the scope of learning through the use of technology, promoting more personalized and collaborative learning both inside and outside the classroom, as well as the ability to place learning in the context of real-world environments [12]. The characteristics of mobile learning are a learning style that fully utilizes technology, allowing students to move while learning [13]. Mobile learning provides teachers with access to various pedagogical approaches, such as quizzes, group work, and educational games, each of which can be tailored to the unique learning preferences of students [14].

Differentiation learning is a teaching method where the teacher provides students with various ways to learn the same material [15]. Teachers must also anticipate student diversity [16] and adjust their teaching accordingly [17]. Differentiation learning aims to help teachers maximize the potential of each student by designing learning experiences that meet the diverse needs of students, there by improving learning outcomes [18]. Learning styles related to education must be considered to be addressed [19] so that students have the potential to learn effectively [20]. A person's learning style is greatly influenced by aspects of thought, feelings, and interactions within the social environment [21]. There are various types of learning styles, namely visual, auditory, and kinaesthetic [22]. Visual focuses on sight [23] auditory focuses on understanding learning by listening to the teacher [24] kinesthetic prefers to learn through hands-on practice [25].

Chemistry is one of the subjects that some students find difficult to understand because the material taught is abstract in nature [26] and requires conceptual understanding [27]. Furthermore, students are not accustomed to chemistry learning that relates to the application of concepts, rules, and formulas [28]. A subtopic in chemistry that is considered quite difficult is chemical bonding [29].

The results of the observational questionnaire distributed to phase F students who have studied the topic of chemical bonding at SMAN 1 Airpura and SMAN 1 Linggo Sari Baganti, found: that some students have a limited understanding of chemical bonding; there is diversity in students learning styles, but learning media does not meet their learning needs. By detailing the background of the problem, the research is interested in “Development of Differentiated Mobile Learning Media on Chemical Bonding Material for High School”.

2. Experimental

The type of research used is Research and Development (R&D), while the model employed is the Plomp model. The Plomp model is a utilized model that consists of three stages: preliminary research, development or prototyping, and evaluation [30]. The data processing techniques in this study include validity analysis techniques and practicality analysis techniques. In the validity analysis, validators assess each item of the validity questionnaire, which will be analyzed using Aiken’s V formula. Meanwhile, to evaluate the practicality of the differentiated mobile learning media application, data will be collected from students and teachers at SMAN 1 Airpura. Then, the practicality score will be measured using the practicality percentage formula. However, in this study limited to the prototype phase. For the research procedure using the Plomp model, refer to Figure 1.



Fig. 1. Research Procedure

3. Results and Discussion

3.1 Preliminary Research

There are several stages in preliminary research, namely need analysis, context analysis, literature review, and the development of a conceptual framework [31]. The first step taken is the identification of learning problems. For the needs analysis, data was obtained through interviews with several chemistry teachers and by distributing Google Form questionnaires to students at SMAN 1 Airpura and SMAN 1 Linggo Sari Baganti. In the context analysis stage, it was obtained through the learning outcomes related to the topic of chemical bonds, which can then be broken down into learning objectives and the learning objective flow that will be achieved through differentiated mobile learning media on the topic of chemical bonds for high school.

The literature review stage is carried out by searching for information from various sources such as books, theses, journals, and other sources related to the development of differentiated Mobile Learning media on the topic of chemical bond [32]. The conceptual framework consists of important concepts from the research conducted, based on the needs analysis and context analysis. The goal of this phase is to ensure that the instructional design created can effectively address the learning challenges faced by students and achieve the established learning objectives [33].

3.2 Prototype Phase

Each prototype result will undergo formative evaluation [34]. Evaluation and revision will be conducted iteratively to achieve effective and high-quality interventions. The formation of prototype I involves differentiated mobile learning media on the topic of chemical bonds for high school students, using i-Spring 11 and Web 2 APK Builder. In Prototype II, a self-evaluation of Prototype I is conducted, which is an assessment conducted independently on the produced prototype by checking whether each component item is functioning properly. Based on the results of the self-evaluation, the components in the learning media are complete.

The prototype stage involves testing Prototype II with expert review and one-to-one evaluation [35]. In the validity stage, the content and media aspects are analyzed by expert reviewers. In this study, validity is assessed by five experts, including three chemistry lecturers from the FMIPA UNP and two teachers from SMAN 1 Airpura. The assessment results provided by the validators for each item will be analyzed using Aiken's V formula. The data obtained from the material and media validation must achieve a score greater than 0.8 to be categorized as valid [36]. The results of the validation by content and media experts, can be seen in table 1 and 2.

Table 1. Validity of Material

Aspects assessed	v	Category
Content	0.89	Valid
Language	0.93	Valid
Presentation	0.90	Valid
v Average Validity of Material	0.91	Valid

Table 2. Validity of Media

Aspects assessed	v	Category
Graphics	0.88	Valid
Media Efficiency	0.85	Valid
Button Functionality	0.87	Valid
Physical Quality	0.90	Valid
v Average Validity of Media	0.87	Valid

Based on Table 1, the average material validation score obtained is 0.91, which is categorized as valid. In Table 2, the average media validation score obtained is 0.87, which is also categorized as valid. Therefore, it can be concluded that the developed media is suitable for use. The next stage involves one-to-one evaluation, conducted by three students with varying abilities (high, medium, and low) which is the visual learning style. The evaluation was conducted by filling out a questionnaire. The results indicate that the developed learning media is engaging, the design of the learning media is good, and it is not complicated to operate. The learning media can assist students in discovering and understanding concepts through animations, videos, images, and the questions included.

3.3 Practicality

The stage of Prototype IV involves conducting a small group evaluation [37]. At the practicality analysis stage, the goal is to measure the practicality of the product. The goal of improving prototype III is to enhance its quality so that prototype IV can be used in field [38]. The product's practicality will be evaluated based on a questionnaire completed by two teachers and nine students at SMAN 1 Airpura, who have studied chemical bonding material. Nine students with different abilities and different learning styles. The components assessed in the questionnaire include ease of use; time efficiency; and Benefit. Analysis of practicality questionnaire data using practicality percentage [39]. The overall practicality results can be seen in table 3 and 4.

Table 3. Assessment Results from Teachers

Aspects assessed	%	Category
Ease of Use	98%	Very Practical
Time Efficiency	95%	Very Practical
Benefits	96%	Very Practical
Average Teacher's Practicality	96%	Very Practical

Table 4. Assessment Results from Students

Aspects assessed	%	Category
Ease of Use	89%	Very Practical
Time Efficiency	91%	Very Practical
Benefits	93%	Very Practical
Average Students Practicality	91%	Very Practical

The practicality evaluation was conducted by two chemistry teacher and nine student, consisting of three students with a visual learning style, three with an auditory learning style, and three with a kinesthetic learning style. Based on Table 3 and Table 4, the average score from the practicality questionnaire filled out by teachers was 96% and students was 91% which is categorized as very practical [39]. The ease of use component, indicating that the product is easy to use. The product can be used anytime and anywhere, making the learning process more efficient. In terms of usefulness, this product facilitates both teachers and students in the learning process, especially regarding the topic of chemical bonding. The high practicality scores from teachers and students are attributed to the product's features, which include instructional videos, quizzes, study guides, and the ability for students to choose their preferred learning styles, this makes it highly beneficial for students with varying learning preferences. This study's results indicate that mobile learning media is feasible and highly practical for learning, which aligns with the findings by Cahya (2020) [40].

4. Conclusion

The development process of mobile learning-based instructional media is designed to suit the needs of differentiated learning, allowing students to learn according to their individual learning styles and abilities. The validity test results by material experts were 0.91 (valid), and by media experts were 0.87 (valid). This evaluation covers aspects such as the accuracy of the chemical bonding content, the clarity of the user interface, and alignment with the learning objectives. The practicality test involved students and teachers as the main users of the application. The test results from students showed 91% (very practical), concluding that this learning media is considered practical and easy to use by students. Students felt more supported in understanding chemical bonding concepts through the interactive features provided by the application. Additionally, the test results from teachers showed 96% (very practical), concluding that teachers also find this media effective in supporting the learning process in the classroom.

This study adds evidence that mobile learning media has great potential in education, which has not been thoroughly explored by previous research, where no prior studies have investigated learning media based on students' learning styles.

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