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Development of Chemistry Edutainment Learning Media to Enhance Students Retention

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Abstract

The teaching media that a teacher uses can have an impact on the comprehension and memory of the students. Chemical bonding material is one of the learning resources that educators are encouraged to employ to assist and promote more creative, engaging, and enjoyable learning experiences. Chemistry Edutainment media is one type of educational resource that can be employed. This study attempts to characterize student learning retention following chemistry lessons using chemistry edutainment on chemical bond material for class X MAN 3 Pontianak, as well as to ascertain the validity, practicality, and efficacy of chemistry edutainment media. The methods of measurement, observation, and interviewing are employed in the data collection process. Student learning outcomes assessments, observation sheets, and interview sheets were the instruments utilized to collect the data. The study employs the ADDIE method, yielding validation rates of 93.3% for the material aspect and 90.6% for the media aspect. These percentages denote a high level of validity. The practicality percentages, derived from the initial and main field trial questionnaire responses, are 87.17% and 94.03%, respectively, indicating a high degree of practicality. Moreover, the effectiveness analysis, based on the learning outcomes following the use of Chemistry Edutainment media, resulted in N-Gain scores of 0.92 and 0.71 for the initial and main field trials, respectively, meeting the high effectiveness criteria. The retention percentages obtained in the initial and main field trials are 75% and 89.97%, respectively, which meet the high retention criteria.

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INTRODUCTION

It is essential to enact reforms within educational system to enhance the quality of education in Indonesia. As a result, educators are encouraged to utilize instructional media to facilitate and support innovative, engaging, and enjoyable independent and classroom learning (Almirasari, 2014). The integration of instructional media in the teaching and learning process has the potential to stimulate new interests and desires, enhance motivation and engagement in learning activities, and even have psychological effects on learners (Falahudin, 2014). The use of instructional media significantly aids students in comprehending learning topics and supports educators in effectively delivering the curriculum to achieve learning objectives.

Upon conducting interviews with 10th-grade students at MAN 3 Pontianak, it was discerned that students encounter difficulties related to being required to memorize extensive content. Additionally, they struggle with mathematical calculations, understanding complex concepts, and visualizing abstract content. According to the students, teachers frequently utilize workbooks and overhead projectors as the primary instructional media. Classroom observations revealed that the teaching approach predominantly centers around the instructor, with instructional materials comprising textbooks, Microsoft PowerPoint presentations, markers, and whiteboards. The learning methodology, which entails requiring students to take notes in their notebooks, induces passivity, disinterest, social distraction, and drowsiness among students. Subsequently, students are instructed to memorize the material following the teacher's explanation. Evaluation of daily assessment scores revealed that the topic with the lowest performance and the highest number of students failing to meet the minimum passing grade (KKM) is chemical bonding, attributed to its abstract nature and the challenges students face in memorizing its structure.

In the context of Bloom's taxonomy, the fundamental cognitive category of remembering or memorization aligns with C1. If the educational objective is to prompt students to retain supplied information, the cognitive emphasis is on remembering. However, students' retention levels are notably low, primarily because their motivation for learning typically revolves around passing examinations. Consequently, once the examination concludes, their interest in the learning material wanes, leading to forgetting (Hulyadi et al., 2023) (Li et al., 2022). Bloom's Taxonomy classifies educational objectives into six hierarchical categories of cognitive processes, with remembering (C1)being the foundational level. This category involves the retrieval, recognition, and recall of knowledge, which is essential for further learning. Activities that focus on remembering include identifying, listing, defining, and recalling facts or concepts. The goal in this stage is not to understand or apply the information, but merely to recognize or recall it (Köksal et al., 2023).

In the context of the classroom, when the objective is purely to get students to memorize information (C1), the emphasis is on rote learning, where the primary goal is retention without necessarily achieving deeper understanding. This type of learning is often associated with traditional assessments like multiple-choice tests or direct questioning, where students are required to retrieve factual information (Metzgar, 2023). However, as highlighted by Hulyadi et al. (2023) while memorization might help students achieve short-term goals like passing exams, it tends to result in low retention over time. This is because their motivation is extrinsically driven—focused on immediate outcomes, such as grades or passing an exam, rather than intrinsic interest in the material itself. Once these external pressures are removed (i.e., the exam is over), the motivation to retain the learned material diminishes, leading to what is commonly known as post-exam forgetting.

This phenomenon is exacerbated by the nature of rote memorization, which does not engage higher cognitive processes such as understanding, application, or analysis. Without meaningful engagement with the material, students are more likely to forget what they have learned, as they never moved beyond the surface level of recall. To counteract this, it is suggested that educators incorporate higher-order thinking processes from Bloom's Taxonomy, such as understanding (C2), applying (C3), or even creating (C6). These stages encourage students to make sense of the material, apply it in real-world contexts, and engage in deeper cognitive processing, which tends to lead to better retention and long-term mastery of the subject matter (Pappas et al., 2013).

Based on the aforementioned assessment, it can be inferred that students' learning impediments encompass difficulties in comprehending concepts, memorization, and visualizing instructional content, resulting in diminished engagement and interest in learning. Due to students' challenges in memorizing the material dispensed by educators, the researcher is endeavoring to devise a solution to foster active learning and elevate the basic cognitive function of remembering (retention). According to retention is the capacity to recall knowledge (such as concepts and theorems) that has been examined (Degeng, 1989). Retention of knowledge is the capacity of the learner to hold onto the knowledge acquired via effort. According to student retention refers to the quantity of performances that students may still exhibit and re-express after a specific amount of time (Yusuf, 2011). Another way to think about retention is the quantity of learning outcomes that students can still generate or recall from memory after a given amount of time (Palennari, 2016). According to this interpretation, a student's capacity to take in, process, and recall previously acquired knowledge is known as their retention or memory.

The proposed solution is anticipated to align with the curriculum to be delivered to the students. Based on this consideration, the researcher has opted to employ chemistry edutainment media as a remedy for enhancing student retention. A collection of resources that teachers can utilize to impart knowledge to their pupils is known as learning media (Darimi, 2017). The utilization of edutainment-based learning media is deemed highly pertinent for development amidst the concerted efforts of the government in achieving national educational objectives. Serving as an educational instrument with an entertaining aspect, its role extends beyond aiding educators, encompassing the facilitation of independent student learning. Edutainment represents a meticulously designed learning approach aimed at seamlessly integrating educational content and entertainment to engender an enjoyable learning experience (Hamid, 2014).

Edutainment-based learning media merges education with entertainment, making learning not only informative but also enjoyable. This approach has gained importance as educators and policymakers recognize the need to adapt to changing learning environments, technology advancements, and student expectations. Governments, particularly in nations striving to meet national educational objectives, see edutainment as a way to modernize education, making it more engaging, accessible, and in line with contemporary learning styles (Khaeruman & Hulyadi, 2016).The primary principle behind edutainment is to use entertaining content as a vehicle for delivering educational material. By incorporating elements like storytelling, animation, video games, music, or interactive digital platforms, edutainment captures students' attention and fosters a more immersive learning experience. Entertainment acts as a motivational tool, reducing the passive consumption of information and making learning a fun activity (Mugitsah et al., 2020; Vyhnal, 2023). Many edutainment platforms are interactive, allowing students to actively engage with the content. This hands-on approach enhances cognitive engagement by encouraging problem-solving, decision-making, and participation, which helps reinforce concepts in ways that are not possible through traditional lecture-based learning (Benzer & Şahin, 2013; Bransford, 1998).

One of the key advantages of edutainment media is its ability to facilitate self-directed learning. Students can access materials outside the classroom at their own pace, giving them greater control over how and when they learn. This form of independent learningis especially useful in promoting lifelong learning habits, helping students build skills necessary to continue learning outside formal settings (Aksakal, 2015; Sari et al., 2018). Today’s learners, often referred to as digital natives, are more accustomed to receiving information through multimedia formats. The edutainment approach meets this expectation by delivering educational content in formats familiar to students, such as apps, games, and videos. By aligning with their natural media consumption habits, edutainment makes learning more relatable and reduces the divide between education and students’ daily experiences (Khaeruman & Hulyadi, 2016).

Edutainment aligns with broader governmental efforts to reform education systems, especially in countries aiming to modernize and digitize their educational infrastructure. It supports the achievement of national educational objectives, such as improving literacy rates, fostering critical thinking skills, and preparing students for a rapidly changing technological world. By creating a more engaging and accessible form of learning, edutainment can help bridge gaps in education, especially in areas with limited access to traditional educational resources. Beyond just academic knowledge, edutainment often aims to develop a well-rounded learner by including social, emotional, and creative elements. For instance, games designed with educational objectives may also enhance teamwork, communication skills, and resilience in the face of challenges.

The educational approach underpinning Chemistry Edutainment emphasizes the fusion of educational and entertainment elements within the domain of chemistry (Ariani, 2013: 28). This encompasses visual and print-based tools and diagrams employed as aids in the learning process. The use of media in education serves to accommodate the diverse learning styles of students and contributes to the creation of a more meaningful learning experience. As articulated by Ausubel, meaningful learning facilitates students' comprehension and retention by allowing educators to facilitate the linking of new knowledge to existing experiences and knowledge (Listiyani, 2018). Similarly, suggests that modifying game media into educational tools is an effective method for enabling students to learn while engaging in play (Poniman, 2018). Demonstrated that there was an increase in the completeness of learning results with the use of this chemo-edutainment medium in his research on the guided note taking learning model. This study also indicates that media that is chemo-edutainment based influences the components that lead to an increase in learning outcome mastery (Christianti, 2012).

According to research, learning through game media has a significant impact on retention ability. The study examined how the element go game was developed as a learning medium on electron configuration material that influences student retention. The analysis of retention ability yielded a result of 93.07% (very good category) students (Mayang, 2021). According to the above formulation, the research aims to explain student learning retention following chemistry lectures utilizing chemistry edutainment on chemical bond material, as well as to ascertain the validity, practicality, and effectiveness of chemistry edutainment media. Building on the outlined insights, the researcher is inclined to embark on a study focusing on the development of chemistry edutainment instructional media specifically tailored to the topic of chemical bonding, aimed at bolstering the retention capabilities of 10th-grade students at MAN 3 Pontianak. This endeavor is intended to serve as instructional media to evaluate students' retention subsequent to their participation in chemistry learning employing chemistry edutainment instructional media.

METHOD

The approach employed for this study consists of Research and Development (R&D) methodologies. R&D research method is a technique used to create a product and evaluate its efficacy (Peprizal and Syah. 2020). As delineated the Research and Development method is utilized to produce specific products and assess their efficacy. In this research, the ADDIE development model was applied, encompassing Analysis, Design, Development, Implementation, and Evaluation phases as depicted in Figure 1 (Sugiyono. 2016).

Population and Sample

The sample is a subset of the population, which is a generalized area made up of items or persons with specific attributes chosen by the researcher to be examined and conclusions made from. (Sugiyono, 2014). The research activities in this study include material expert validation, media expert validation, preliminary field trials, and main field trials. The research is scheduled to take place in April to May 2024 at MAN 3 Pontianak. The study focuses on the population of 10th-grade students in the Science Program at MAN 3 Pontianak. The preliminary field trial involves 6 students, and the main field trial involves 30 students.

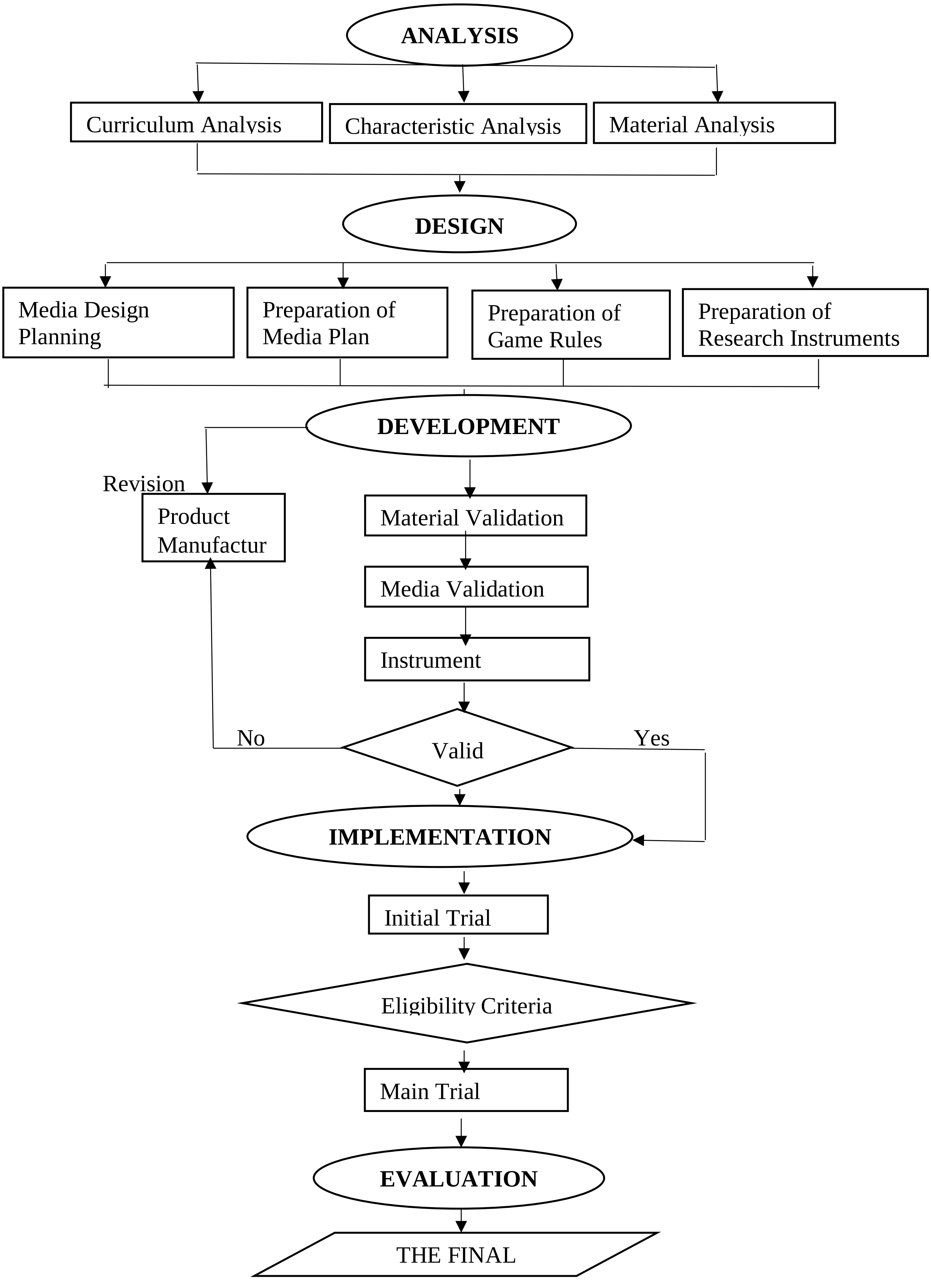

Figure 1. Research and Development Procedure ADDIE (Mulyatiningsih, 2012)

Techniques and Instruments for Data Collection

The approach to gathering data involves indirect communication by presenting a set of written questions to respondents for completion, such as validation and questionnaires. The measurement technique incorporates data collection methods comprising pretest, posttest, and delayed test questions in the form of three essay questions, each with accompanying answers. The pretest is administered prior to the commencement of chemical bonding instruction, the posttest upon its completion, and the delayed test following one week of instruction. Assessing the evaluation components and assigning Likert scale ratings of 4, 3, 2, and 1 allowed for the tabulation of data (Riduwan, 2011).

Table 1. Likert Scale

Answer Choices	Criteria
Strongly Agree (SA)	1
Agree (A)	2
Disagree (D)	3
Strongly Disagree (SD)	4

Data Analysis

Validity

Expert validation can be carried out by evaluating the freshly created product with the help of multiple experts or seasoned experts (Sugiyono, 2015). In this research material experts and media experts used material expert validation sheets and media expert validation sheets to analyze the validity of chemistry edutainment learning products and media. While material experts examined learning material aspects and visual communication features, media experts conducted validity analyses on general media engineering and visual communication aspects.

$$\boldsymbol{V} = \frac{\boldsymbol{Va1} + \boldsymbol{Va2} + \cdots}{\boldsymbol{n}} \boldsymbol{x}\ \mathbf{100}\%$$

Explanation:
V : Validation (combined)
Va1 : First expert validation
Va2 : Second expert validation
Tsh : Total maximum expected score
Tse : Total empirical score (result of the validation from the validator)
Source : (Akbar, 2013:158)

Table 2. Criteria Percentage of Validity

Criteria	Range Percentage
81 – 100 %	Highly Valid, or can be used without revision.
61 – 80 %	Valid, or can be used but needs minor revision.
41 – 60 %	Less Valid, not recommended for use because it requires major revision.
21 – 40 %	Not Valid or not allowed to be used.
0 – 20 %	Highly Not Valid - not allowed to be used.

Source : (Akbar, 2013:42)

Practicality

Analyses of student response questionnaires were utilized to determine how practical the learning materials were. First, the total criterion score for each item on the questionnaire is calculated. Next, figure out how practical each student's questionnaire response is on average. If the practicality value of the chemistry edutainment learning medium in this study is greater than 60%, then it is considered practical according to the criteria.

Criteria Score = Highest score x number of aspects x number of respondents

$$P(\%) = \frac{\text{Total score of criteria}}{\text{score of criteri}} \text{ x } \mathbf{100\%}$$

Table 3. Criteria Percentage Questionnaire

Percentage	Qualification
0 % - 20 %	Not efficient
21 % - 40 %	Somewhat Impractical
41 % - 60 %	Moderately efficient
61 % - 80 %	Efficient
81 % - 100 %	Highly efficient

Source : (Lutfi dan Nugroho, 2019)

Effectiveness

N-Gain was used to analyze effectiveness. If student learning outcomes and comprehension rise on pretest and posttest, the designed learning media can be considered effective.

$$g = \frac{(S\, posttest - S\, pretest)}{(S \max - S\, pretest)}$$

Description:

Spretest : average pretest score
Sposttest : average posttest score
Smax : maximum score
G : gain factor magnitude

Table 4. Qualification of the formula N-Gain

Score N-Gain	Criteria for improvement
G > 0.7	High
0,7 > g > 0.3	Weak
g > 1.00	Worst

Source : (Bintiningtiyas dan Lutfi, 2016)

Retention

In this study, to calculate retention, the following formula was used :

$$Retention = \frac{test\ results\ are\ delayed}{posttest\ results}\ x\ 100\%$$

Table 5. Criteria Retention

Score	Criteria
R ≥ 70%	High
60% < R < 70%	Medium
R ≤ 60%	Low

Source : (Setiawan dkk. 2012)

RESULTS AND DISCUSSION

Analysis Stage

Upon analysis, it has been determined that the media currently utilized by educators is inadequate in providing diverse materials for the topic of chemical bonding. Hence, there is a need for the development of a learning media to facilitate the educational process. The analysis suggests the necessity of a learning media that can enhance the teaching process through the use of Chemistry Edutainment. The researcher will focus on developing Chemistry Edutainment media for the topic of chemical bonding.

Design Stage

The design phase aims to create a learning media in the form of Chemistry Edutainment. The product design process commences with the selection and determination of materials, including plywood, magnet sheet flannel fabric, wood, buttons, cardboard paper, and cardboard, for the creation of Chemistry Edutainment media. This learning media encompasses a document case, compound card set, electronic buttons, a composing board, and paper atoms.

Figure 2. Document Case

Figure 3. Composing Board

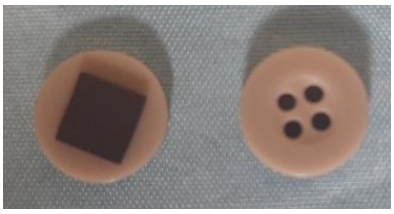

Figure 4. Electronic Buttons

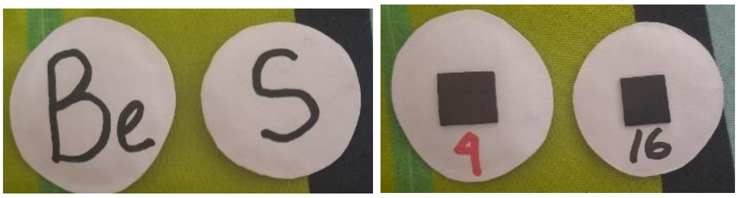

Figure 5. Atoms

Figure 6. Card Set

Development Stage

All components from the design stage are consolidated into a cohesive unit to create a Chemistry Edutainment product. The goal is to make it as engaging as possible, ensuring that students derive enjoyment and demonstrate sustained interest in the learning process. The product is depicted in the image below:

Figure 7. Full Media Chemistry Edutainment

The validation results for the Chemistry Edutainment media indicate that it can be utilized without conditions, with a validity rating of 93.3% from the content expert and 90.6% from the media expert. The Learning and Teaching Materials (LKPD) validation qualifies it for research use without conditions, with a validity score of 89.6% and a valid category without the need for revision. The validation results for the pretest, posttest, and delay test questions demonstrate their suitability for research use without conditions, with a validity rating of 96% and a valid category without the need for revision. The validation of the student response questionnaire reflects its suitability for research use without conditions, with a validity rating of 87.17% at preliminary field trial, and 94.03% in the Primary field test, both categorized as valid without the need for revision.

Implementation Stage

The stage of implementation involved an initial field trial conducted on six students from MAN 3 Pontianak. The trial comprised the collection of pre- and post-usage data on the students' performance with the Chemistry Edutainment media. The learning activities during this trial consisted of introductory, core, and closing stages. The introductory phase included customary salutations, prayers, attendance checks, and the distribution of pretest questions to the students. This was followed by providing preconceptions and outlining the learning objectives. Subsequently, the core activities entailed delivering explanations on chemical bonds, particularly ionic and covalent bonds, and instructing students on using the Chemistry Edutainment media. Students were divided into three groups, each comprising two members.

They engaged in group discussions based on the rules for using the media, devised Lewis structures, and identified bond types within a set timeframe. The closing activities involved students working on a posttest, followed by a subsequent retention test and a questionnaire to gauge their response to the Chemistry Edutainment media. The main field trial replicated the same activities but was distinguished by a larger student cohort, more groups, and a modified learning environment, with 30 students divided into five groups, each with six members.

Evaluation Stage

During the evaluation phase, the average success of the N - Gain value Preliminary field test and the Primary field test was found to be 0.92 and 0.71, respectively, meeting high criteria. The retention value, derived from the delay test compared to the final post-test value, resulted in retention percentages of 75% in the Preliminary field test and 89.97% in Primary field test, both meeting high criteria. Consequently, the Chemistry Edutainment media created has demonstrated its effectiveness in facilitating the understanding of chemical bonds.

Qualification

Validity

Regarding the validity of the media and content, the average media validity scores from validators 1, 2, and 3 are 0.95, 0.86, and 0.91 respectively. The resulting average percentage of 90.6% indicates the high validity of the Chemistry Edutainment media. As for the material validation, the scores from validators 1, 2, and 3 are 0.9, 0.95, and 0.95 respectively. The resulting average percentage of 93.3% signifies the high material validation of the Chemistry Edutainment media. This result is in accordance with the opinion of Akbar (2013) where validity is declared valid if the expected percentage is more than 60%. The results of the validity of the media and materials for the media can be seen in Figure 8.

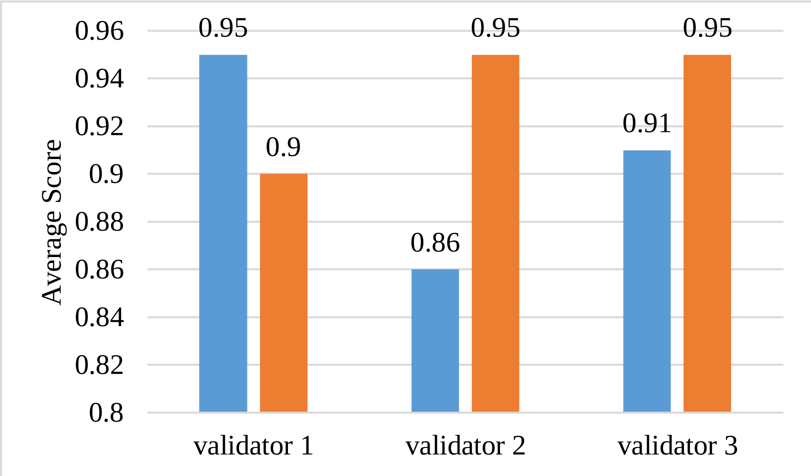

Figure 8. Average Validity Graph of Media and Materials

Practicality

The student response questionnaires demonstrate a general interest in and understanding of the usage of Chemistry Edutainment media. The practicality percentages Preliminary field test and the Primary field test are 87.17% and 94.03% respectively for each indicator in the response questionnaire based on the practicality scale. This result is in accordance with the opinion of Bintiningtiyas and Lutfi (2016) where practicality is declared practical if the expected percentage is more than 60%.

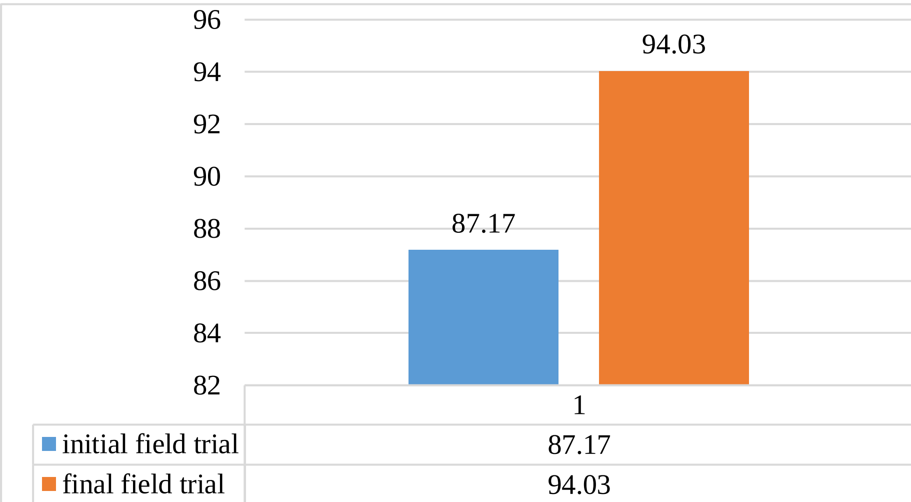

Figure 9. Graph of Practical Result

Effectiveness

Table 6. Recapitulation of Student Learning Outcomes

Field Trials	Quantity of Students	Average		N-Gain
		Pretest	***Posttest***	
Beginning	6 student	11.67	93.34	0.92
Main	30 student	18	76.5	0.71

The table illustrates an increase in values between the pre- and post-implementation stages of utilizing the Chemistry Edutainment media during the Preliminary field test and the subsequent Primary field test, amounting to 81.67 and 58.5 respectively. The average N-Gain values for the Preliminary field test and Primary field test stand at 0.92 and 0.71 respectively, meeting the criteria for a high level of improvement. This result is in accordance with Bintiningtiyas and

Lutfi (2016) where effectiveness is declared effective if the N-Gain value exceeds 0.70. The pretest and posttest values indicating the effectiveness of the Chemistry Edutainment media are shown in Figure 10.

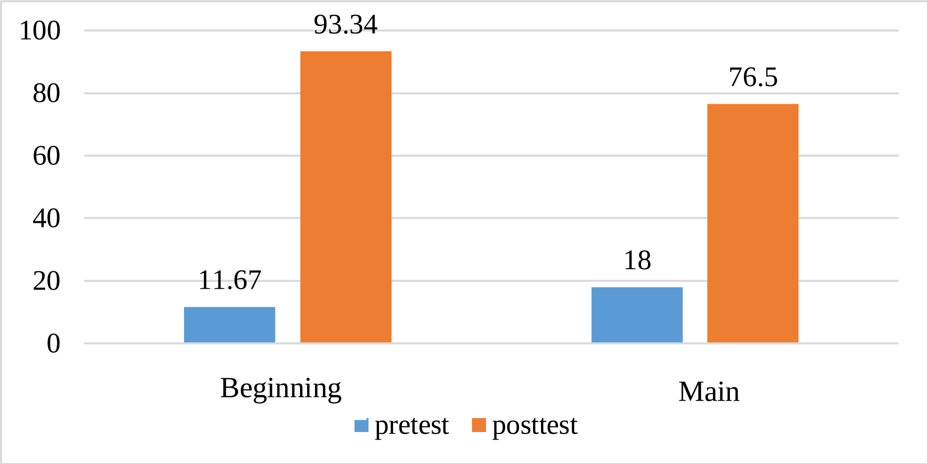

Figure 10. Graph of Average Pretest and Posttest Scores

Retention

Table 7. Summary of Student Retention Results

Field Trials	Quantity of Students	Average		Retention
		Posttets	*Delaytest*	
Beginning	6 student	93.34	70	75%
Main	30 student	76.5	68.3	89.97%

The table illustrates a reduction in the delaytest value, attributed to the one-week timeframe provided for students to revisit the same three chemistry questions. The decrease in delaytest value after completing the posttest in Preliminary field test and Primary field test is 23.34 and 8.2, respectively. Despite the decline in the retention score in, which are 75% and 89.97% respectively, both meet the high criteria. This result is in accordance with the opinion of Setiawan (2012) where retention is declared to have high criteria if the percentage achieved is more than 70%.

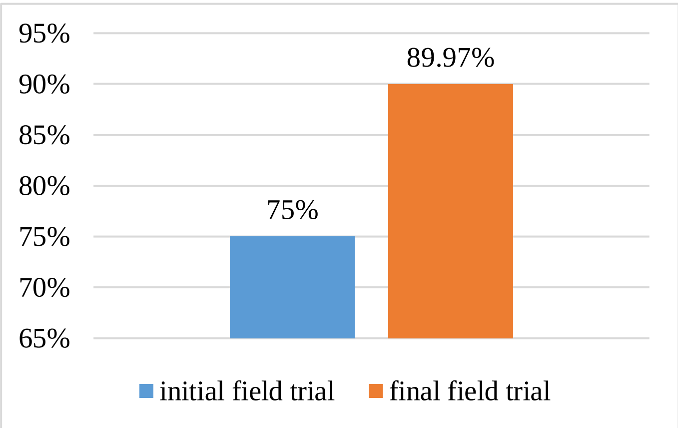

Figure 11. Graph of Retention Results

Following the learning process through chemistry edutainment games, students' ability to retain chemical bonding material comes from play activities that have been carried out and implemented to allow students to build their own concepts, in addition to the teacher's thoughts that are poured into their minds. Ideas and recalling the information acquired through learning. This is consistent with Silmiati's (2017) assertion that if students find the work they are doing worthwhile, their retention will be more sustained.

CONCLUSION

The research has concluded that the Media Chemistry Edutainment developed in this study is deemed appropriate for utilization as an instructional resource for the topic of chemical bonding. The validation results for both the material and media aspects stand at 93.3% and 90.6% respectively, meeting the criteria for high validity. The practicality percentages, based on the questionnaire responses obtained during the initial and main field trials, were 87.17% and 94.03% respectively, indicating a high level of practicality. Furthermore, the analysis of learning outcomes after employing the Chemistry Edutainment media yielded N-Gain scores of 0.92 in the initial field trial and 0.71 in the main field trial, denoting a high level of effectiveness. Additionally, the retention percentages obtained In the initial and primary field trials were 75% and 89.97% respectively, indicating a high level of retention.

RECOMMENDATIONS

Upon the completion of our research and development endeavors, we have devised several recommendations. Specifically, we propose that Chemistry Edutainment media be employed as a viable instructional tool for educators in elucidating the concept of chemical bonding, with a specific focus on ionic and covalent bonding. Consequently, it is imperative to meticulously ascertain the comprehensiveness of the media before its utilization. Additionally, the content of the Chemistry Edutainment media can be tailored to adhere to educators' preferences by integrating additional compounds and atoms, thus aligning with specific instructional requisites.

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