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# Development of Differentiated Interactive Media to Encourage Student's Number Sense

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**Abstract**: Number Sense ability is crucial to have as a basis for students' knowledge in solving numeracy problems. The use of learning media with number sense material content is very necessary today. Another problem arises in the variation of students' learning styles that require differentiated media to meet all needs. This study aims to develop differentiated learning media with number sense content. This research is research and development (R&D), where this study uses the ADDIE development model. This research was conducted at MTs Sunan Kalijogo Malang with a total of 36 students as subjects. The data obtained from the validation sheet is divided into qualitative and quantitative data which are analyzed to determine the feasibility of the learning media developed. The results of the media evaluation show an average percentage of 86.3%, with the category "Very Feasible". The question aspect obtained an average percentage of 84.5%, also with the category "Very Feasible". In addition, the results of the practicality questionnaire involving 36 students gave an average practicality percentage of 87.1%, also in the "Very Feasible" category. Thus, seeing the assessment results indicates that the developed learning media is very feasible to be implemented in the classroom learning process as a form of implementing the merdeka curriculum.

**Keywords:** Articulate Storyline 3; Learning Media; Number Sense

## A. INTRODUCTION

Number sense is a term for number control or number sensitivity. Number sense is the mastery of numbers and operations and the relationships between them flexibly and not fixated on basic formulas or traditional algorithms (Nurdiana & Asmah, 2021) The ability to solve problems involving numbers, number operations, and their relationships is known as number sense. Therefore, someone with high number sense can solve mathematical problems more gracefully and flexibly without being limited by standard algorithms. Each student has a different number sense because this number sense grows as a result of the student's experience and education, both formal and informal. Therefore, the role of educators is very important in the process of developing students' number sense. One of the efforts to develop these abilities is through interactive learning media.

Learning media is a tool that can facilitate the teaching and learning process with the aim of clarifying the message conveyed, so as to achieve learning objectives better and efficiently. (Dewi, 2017). The existence of media that can be accessed in online and offline learning in mathematics subjects that contain theories, practice questions, and practices makes it easier for students to access teaching resources. Various developer software such as SAC, iSpring, Articulate Storylines and so on can be used to build interactive multimedia content based on Android that can be downloaded on smartphones. Android-based learning media is in line with current

technological advances, considering that students who have mastered technology can be used in the mathematics learning process as an effort to achieve the goals of the Merdeka curriculum.

The Merdeka Curriculum brings a new study in classroom learning, where teachers are able to organize learning by adjusting the learning preferences of each student, known as differentiated learning (Halimah et al., 2023). The differentiated learning method prioritizes student comfort during the learning process, including readiness to participate in learning, interest in learning, and skills mastered. In addition, differentiated learning becomes a learning method that adjusts teaching methods, materials, and learning strategies to the characteristics of individual students (Aprima & Sari, 2022). Thus, each student can develop their skills according to their own learning pace, interests, talents, and personal abilities.

The limited use of mathematics learning media available in schools causes many students to be unable to understand abstract mathematical concepts (Ilahi et al., 2022). Moreover, learning media with number sense content is still very rare. The number sense abilities of elementary school students are still at a low level, making the existence of learning media with number sense content crucial. Learning Media in the Google Play Store Application still has not found content with differentiated learning (Purwanto & Dwi Gita, 2023). The limitations of learning media that are linear with the current independent curriculum paradigm make the need for differentiated learning media very necessary.

Through this approach, students can experience a more personal and relevant learning process, which has the potential to increase their motivation and learning outcomes. One of the efforts to increase students' learning motivation is by integrating local cultural values into learning. Cultural attitudes are intended as an effort to improve the quality of life both in technology and in everyday life and not disrupt the harmony between human life and the life of the universe (Budi Setyaningrum, 2018). Indonesia, which is located between two continents, Asia and Australia, also has tropical rainforests. This causes many typical animals to be spread throughout its islands. Kalimantan, one of the largest islands in Indonesia, is known as a region crossed by the equator, and also has a variety of endemic animals such as Orang Utan and Bekantan. In this increasingly widespread era of globalization, only a few students realize that Kalimantan still has many endemic animals that must be protected and preserved (M. Maulana & A. Firman, 2017).

Media with the theme of Kalimantan's rich fauna aims to increase student's knowledge about rare fauna that is difficult to find on the island. In addition, it also functions as a means to introduce the island of Kalimantan to the Indonesian people (Br Girsang & H, 2021). Animal extinction is caused by various factors, including the inability of species to adapt to environmental changes, periodic mass extinction events, the impact of global warming, and predation due to poaching. The large number of people who do not care about this problem is increasingly exacerbating poaching and the threat of extinction of these animals. By using the fauna theme it is hoped that it can attract students' attention and increase motivation to learn.

Each individual has a unique learning style, determined by the way they understand and absorb the material taught by the teacher. Therefore, a different approach is often needed to ensure that each student understands the same information or lesson. Strengthening Number Sense skills can be maximized for all students with a variety of learning styles that can be selected. Differentiated learning is present in the merdeka curriculum to meet the needs of different students. Researchers are interested in developing learning media that are in accordance with the description above, so a study was compiled with the title "Development of Differentiated Interactive Media to Encourage Student's Number Sense".

## B. METHODS

The research model used is the ADDIE research and development model (Analysis, Design, Development, Implementation, Evaluation) which is a model that represents the stages systematically (organized) and systematically in use aimed at achieving the desired results. The research and development method is used to create a particular product and test the extent to which the product is effective . (Jayusman et al., 2017). In the process of developing this learning media, needs analysis and testing were carried out to ensure that the product can be used

effectively, especially in the context of the world of education. The flow of learning media development in this study can be described as follows:

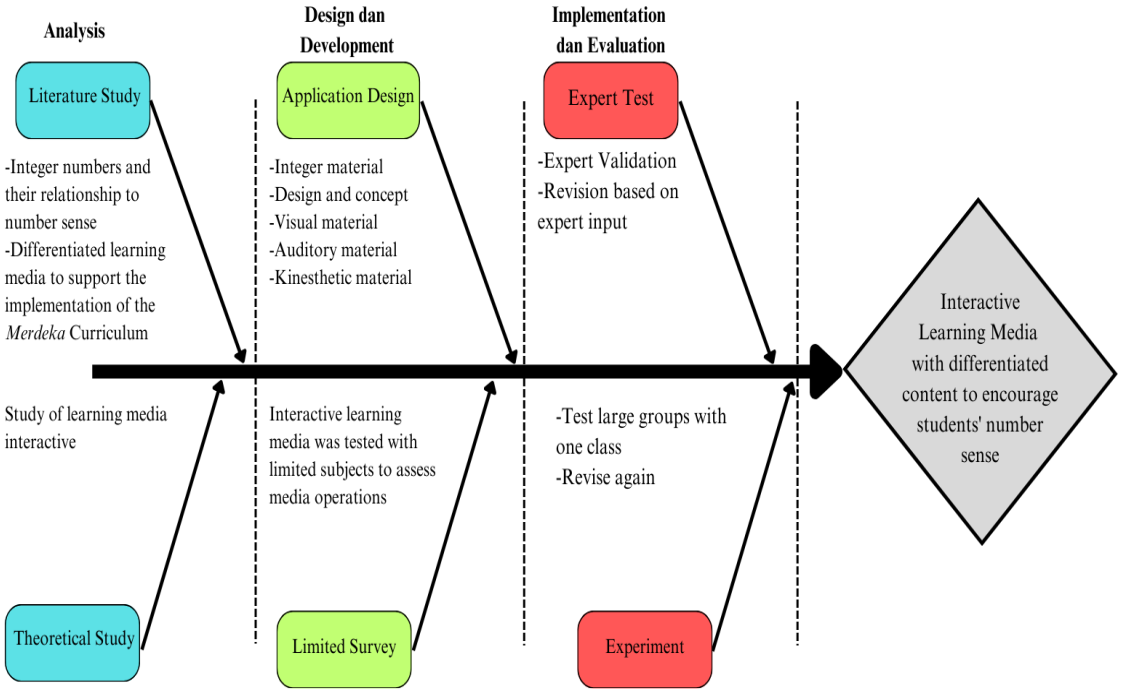


**Figure1. Media Development Flow**

The population in this study were 36 students in grades VIIA and VIIC at MTs Sunan Kalijogo Malang. The selection of the research location was based on the criteria of schools that had implemented the merdeka curriculum, one of which was MTs Sunan Kalijogo Malang. The research was conducted in the time interval from July to August 2024. The method used to collect data in this study was through validation sheets and questionnaires. The validation sheet was used to find out the validator's opinion regarding the learning media that had been created. This validation sheet was given to the media expert validator and the question expert from the mathematics teacher who taught grade VII and lecturers in related disciplines. The aspects assessed in the media include the suitability of the information and communication technology (ICT) of the media created, the use of standard and communicative language, the accuracy of the number sense material developed, and the standardity of the questions created. Then the practicality questionnaire was given to students to obtain data on the extent to which the learning media created was practical according to them. In analyzing the feasibility and practicality of learning media, the following formula was considered (Septia et al., 2021):

$$P = \frac{\Sigma x}{\Sigma x_i} \times 100\%$$

Notes:
$P$ = Percentage sought
$\Sigma x$ = Total respondent scores
$\Sigma x_i$ = Ideal value amount

**Table 1. Eligibility Level Criteria**

| No. | Value Range | Qualification |
|---|---|---|
| 1. | 81% - 100% | Highly Feasible |
| 2. | 61% - 80% | Feasible |
| 3. | 41% - 60% | Quiet Feasible |
| 4. | 21% - 40% | Less Feasible |
| 5. | 1% - 20% | Not Feasible |

**Table 2. Practicality Level Criteria (Puji et al., 2014)**

| No. | Value Range | Qualification |
|---|---|---|
| 1. | 81% - 100% | Very Practical |
| 2. | 61% - 80% | Practical |
| 3. | 41% - 60% | Quiet Practical |
| 4. | 21% - 40% | Less Practical |
| 5. | 1% - 20% | Not Practical |

Research and development methodology has a close relationship with the realm of learning technology (Miasari et al., 2022). Research in the field of learning technology often involves product development and design, such as learning media, teaching materials, and learning systems. Learning technology often includes concepts and practices of designing, developing, implementing, managing, and evaluating the processes and resources used in learning. Therefore, this research aims to produce learning media that are in accordance with the needs of students.

The data analysis technique in this study is descriptive analysis. Where the use of this technique aims to analyze quantitative data in the form of validator sheets and student questionnaires using the Likert scale to determine the validity of product efficiency. While for qualitative data in the form of comments and suggestions from validators and trial users. From the comments and suggestions received, this is used as a reference for developing the product. therefore the validity test and practicality test on the teaching materials developed.

1. Trial Data Analysis Technique (Practicality Test)
   The data used in the practicality test of this book is quantitative data with the following scoring criteria.
   Score 5: very feasible/practical,
   Score 4: feasible/practical,
   Score 3: quite feasible/practical,
   Score 2: less feasible/practical,
   Score 1: not feasible/practical

**Table 3. Practicality Criteria**

| Mark | Practicality Criteria | Keterangan |
|---|---|---|
| $X \geq \bar{X}_i + 1{,}5\ Sb_i$ | Very Practical | No Revision |
| $\bar{X}_i + 1{,}5\ Sb_i > X \geq \bar{X}_i$ | Practical | Little Revision |
| $\bar{X}_i > X \geq \bar{X}_i - 1{,}5\ Sb_i$ | Quite Practical | Partial Revision |
| $\overline{X < X_i} - 1{,}5\ Sb_i$ | Not Practical | Total Revision |

2. Trial Data Analysis Technique (Effectiveness Test) The data used in this book's effectiveness test is quantitative data with the following analysis formula.

$$P = \frac{\sum x}{\sum xi} \times 100\%$$

Formula description:

$P$ = percentage of eligibility

$\sum x$ = validation score count

$\sum xi$ = maximum score

## C. RESULT & DISCUSSION

**Media characteristics**

The media developed is based on Articulate Storyline 3 with a total of 152 pages with 109 pages of material divided into three learning styles. The media size in HTML 5 is 101 MB which can be operated online or offline. The Android version has a size of 91.8 MB which can also be operated online or offline.

The strengths of our application include the presentation of numbersense material, which is rarely covered, despite being a fundamental concept that students must master before advancing to more complex mathematics topics. We also implement differentiated learning tailored to the students' learning styles. Additionally, the theme we present is relaxing yet carries a strong message about environmental conservation and fostering a love for Indonesia's native fauna.

One of the challenges we face is the absence of a student learning outcomes database that can be accessed by teachers. Additionally, our app is not yet available on Google Playstore, which means that users have to download the Android app through an external link. This poses an issue for some users who are unable to disable the Google Play Protect feature on their smartphones. Furthermore, our app cannot be installed on iOS devices due to differences in operating systems.

**Development Process**

This learning media development research uses a development process with the ADDIE model that has been explained previously, which involves the stages of Analysis, Design, Development, Implementation, and Evaluation.

a) Analysis

In the analysis stage in mathematics lessons on number sense material, the necessary data was obtained through interviews with practitioners and reviewing teaching modules that were used as a guide in developing learning media. The application developed will focus on the number sense material of the mathematics subject. The results of the initial needs interview with teachers showed that students still had difficulty in linking theory to real contexts, especially in textual questions. Teachers have not used specific learning media to develop number sense, but believe that interactive media will be more effective than lectures

and books alone. Currently, the resource school has not provided specific resources or learning media to support number sense teaching.

b) Design

After collecting materials for the development of learning media at the analysis stage, the next step is to design learning media based on articulate storyline 3. During this stage, the researcher held discussions with the supervising lecturer and practitioners. The results of this stage include determining the theme color and application logo, compiling the menu layout in the application, compiling the application usage scenario, and compiling the contents of each menu.

In the design of differentiated learning materials and methods. Researchers refer to literature related to number sense content. Differentiated learning includes three learning styles with each of its uniqueness, where visual emphasizes number sense material that is made to contain illustrations, audio material plays oral explanations of the material, and kinesthetic provides activity-oriented material.

c) Development

Learning media was created using Articul Storyline 3 software. In this stage, the learning media that had been created was expanded to adapt the HTML5-based learning media format. The product validation process involved evaluations from lecturers and mathematics teachers from several schools. The prototype of the learning media that had been created was revised to suit the learning media format expected by expert lecturers and mathematics teachers.

1) The Intro Pages

The intro page is the initial display that automatically appears after this learning media is run and stops on the start page. This page contains the UIN Malang logo and the Merdeka curriculum as seen in Figure 2.


**Figure 2. The Intro Pages**

2) The Start Pages

The start page is the page used to continue the application and enter the application instructions menu. This page contains the application logo, text box name and school of origin, and the "login" button to continue the media. The name and school of origin text box must be filled in by the user to activate the login button on the page. This page automatically opens after the user has been on the intro page for a while as seen in Figure 3.


**Figure 3. The Start Page**

3) The Main Menu Page

The main menu page (home) is a page that contains the menus available in the media, such as the CP-ATP menu, apperception menu, material menu, game menu, practice menu, and quiz menu. This page is equipped with illustrations of endemic animals of Kalimantan as elements of the theme of fauna conservation in the region. The illustrations are none other than an effort to introduce students to the attached fauna as seen in Figure 4.


**Figure 4. Main Menu Page**

4) Applications Instruction Page

The media usage instructions menu page is a page that contains explanations of the buttons and symbols contained in the media. This menu automatically opens when the user presses the "login" button on the start page as seen in Figure 5.


**Figure 5. Application Instructions Page**

5) CP-TP Page

The CP-TP menu page is a page that contains the achievements and objectives of learning in the application. This menu consists of two pages, the first page contains CP along with the learning model used in this application, then the second page contains TP along with the learning model used in it. The CP-ATP menu can be seen in Figure 6.


**Figure 6. CP-TP Page**

6) Apperception Page

The apperception menu page is an introductory page of the material that will be given to students. Consisting of one page, this menu contains an introduction for students and examples of the application of number sense in everyday life as seen in Figure 7.


**Figure 7. Apperception Page**

7) Material Page

When entering the material menu, students can choose three types of learning styles they want. Each learning style has a different approach, but the details of the material provided remain similar. The material menu page consists of 5 sub-materials, namely (a) flexibility with numbers, (b) understanding mathematical concepts, (c) mental calculations, (d) understanding the relationship of numbers, (e) the ability to estimate and round. In each sub-material there are questions at the end to test students' understanding. The material menu can be seen in Figure 8 and Figure 9.

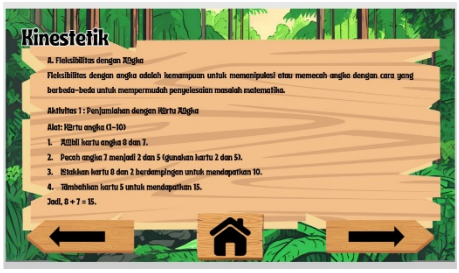


**Figure 8. Material page**


**Figure 9. Material page**

8) Assessment Page

The assessment menu page consists of five multiple-choice questions, where at the end of the work, the results of the answers that have been submitted will be displayed. In this assessment menu, there is also a solution to the questions at the end of the page. The assessment menu can be seen in Figure 9.


**Figure 10. Assesment Page**


**Figure 11. Assesment Page**

9) Game Page

On the game menu, it will display two games with number sense content in it. in the first game "Pola Kartu" is a number puzzle that must be completed by the user, where this aims to hone the ability to reason numbers. The "Keuangan" game requires users to be able to estimate the shopping money needed, where this trains the ability to round and estimate numbers.


**Figure 12. Game page**

10) Quiz Page

The quiz menu page is a menu that automatically directs students to the wordwall to work on quizzes (questions) when students press the "Quiz" menu on the main menu page. This menu is a link that can be modified by the creator, so that it can be expanded, either by expanding the questions in it or adding other things related to learning as seen in Figure 13.

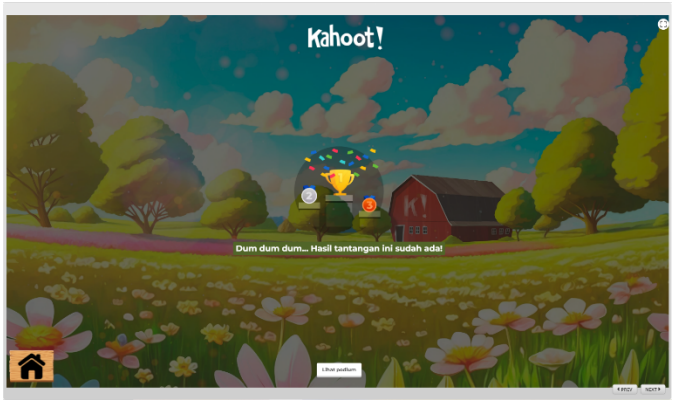


**Figure 13. Quiz page**

d) Implementation

At this stage, the product that has been completed after revisions from expert lecturers in material, media, and mathematics teachers, is implemented at MTs Sunan Kalijogo. This implementation is carried out together with the principal and mathematics teachers who teach in grade VII. Then the application is introduced to students at MTs Sunan Kalijogo. After implementing the implementation, this product will be used at the school as an effort to implement the merdeka curriculum.

**Figure 14. Implementation of Media at MTs Sunan Kalijogo**

e) Evaluation

During the implementation stage, several media deficiencies were found that were felt by students. At the evaluation stage, revisions were made again based on suggestions and input from students at the implementation stage. The revisions included fixing buttons that did not work, explanations related to shortcuts for discussing questions in the material menu, and adding explanations on the media usage instructions page. Then the researcher also received input from students to add more fauna that would be the researcher's notes for further media development. One of the additional pages created can be seen in Figure 15.


**Figure 15. Media Instructions Page on the Material Menu**

**Data Analysis**

The developed Learning Media was validated by media experts and material experts. Validation was carried out by two validators, where one media and material expert was a lecturer in mathematics education at Muhammadiyah University of Sampit and one mathematics teacher from MTs Sunan Kalijogo Malang. The validation sheet given to the validator also contained suggestions and criticisms for further improvement of the learning media.

Meanwhile, validation by media experts on learning media based on Articulate Storyline 3 on number sense material received the lowest percentage in the material aspect, which was 94%, this was due to the abstractness of the material that had not been written well to make it easier for students to master the material. While the aspect that received the highest percentage was the language aspect, which was 96%.

**Table 3. Media Validation Results**

| No | Aspect | Validator | Percentage | | Category |
|---|---|---|---|---|---|
| | | | $\Sigma p$ | $p(\%)$ | |
| 1. | ICT | 1 | 100% | 94% | very feasible |
| | | 2 | 88% | | |
| 2. | Language | 1 | 96% | 96% | very feasible |
| | | 2 | 96% | | |
| 3. | Number Sense Material | 1 | 100% | 94% | very feasible |
| | | 2 | 88% | | |

The ICT aspect is the uniqueness of the learning media developed by researchers. Integration of learning with ICT is a novelty in 21st century education. The pandemic some time ago, where distance learning was implemented, made the role of ICT-integrated learning media crucial (Supinah & Soebagyo, 2022). The learning media developed by researchers is not only Android-based which can be accessed via smartphone, but is also connected to the internet so that students and teachers can connect online.

The suitability of the language listed in the learning media received the highest score of the other two aspects with a score of 96%. The use of standard and communicative language is important in making learning media so that it can be delivered to students well. Designing materials with communicative language in stimulating students in learning activities (Amzaludin et al., 2023).
The Number Sense material designed and created by the researcher received the same value as the ICT aspect. The preparation of the Number Sense material carried out by the researcher refers to the needs of basic mathematical skills of students at the junior high school level. Loss Learning material is a basic ability that must be mastered by students in reading a number or numeracy without traditional solution methods. The use of learning media can help develop students' number sense skills, especially with games that carry number sense content (Fahlevi, 2022).

The assessment of the validation of questions on the developed learning media received the highest percentage from the teacher validator, which was 92%. Meanwhile, lecturer validators gave the lowest percentage of 90% due to confusion in the question sentences in the questions.

**Table 4. Assessment Validation Results**

| No. | Aspect | Validator | Percentage | | Category |
|---|---|---|---|---|---|
| | | | $\Sigma p$ | $p(\%)$ | |
| 1 | Assessment | 1 | 90% | 91% | Very feasible |
| | | 2 | 92% | | |

After the learning media was validated by media experts and questions from lecturers and teachers, then dissemination was carried out in class VIIA and VIIC MTs Sunan Kalijogo Malang and a questionnaire was given on the attractiveness of the learning media to students in that class. From the questionnaire given to 36 students who attended, the highest percentage was obtained in the aspect of the attractiveness of the application for learning at 88.3%. The aspects of the helpability and completeness of the application obtained the same value, which was 83.8%, the aspect of ease obtained a value of 82.2% and the lowest percentage in the aspect of ease of access obtained a value of 81.1%.

**Table 5. Media Practicality Questionnaire Results**

| No. | Aspect | Percentage $p(\%)$ | Category |
|---|---|---|---|
| 1 | Ease of Accessing Applications | 81,1% | Very feasible |
| 2 | Ease of Running Applications | 82,2% | Very feasible |
| 3 | The Attractiveness of Applications for Learning | 88,3% | Very feasible |
| 4 | Application Completeness for Learning | 83,8% | Very feasible |
| 5 | Application Assistance in Helping Learning | 83,8% | Very feasible |

The aspect of application assistance in helping learning and ease of access obtained the highest percentage of the practicality questionnaire. The learning media developed makes it easy for students to absorb learning material information briefly, coupled with an interface that attracts students' attention. This is in line with other studies that say that practical learning media is media that clarifies information to make it easier for students to understand learning (Irawan & Hakim, 2021). The learning media developed based on Android has the advantage that it can be accessed anytime and anywhere, making it compatible and flexible. In line with other studies that the aspect of ease of access to learning media is the main thing for the success of the media (Fridayanti et al., 2022).

The results of the media validation obtained a "very feasible" rating in all aspects, as well as the validation of questions obtained a "very feasible" rating. The ease of learning media based on the questionnaire given to students also obtained a "very feasible" rating in all aspects. As for the total value of media validation of 94.6%, question validation of 91%, and practicality with a total of 83.34%. So the learning media created can be said to be "very feasible" to be implemented in the learning process.

The learning media designed in this study is focused on grade VII students with the subject of number sense, and refers to technology-integrated learning. The uniqueness of this learning media lies in the attractiveness such as illustrations and programmed interactions in the application. In line with research conducted by Muyaroah and Fajarti, that Android-based learning media has advantages in the attractive interface display, including graphics, text, use of color, and animation (Muyaroah & Fajartia, 2017). This is none other than to attract the attention of students and increase their interest in learning mathematics. Adapting from other studies, where the use of learning media can increase students' interest and motivation to learn (Febrita & Ulfah, 2019). Interesting media is also able to stimulate student's concentration in learning so that it influences the efficiency of learning activities (Nurrita, 2018). Thus, the development of Android-based mathematics learning media using articulate storylines for number sense material is expected to have a positive impact on students and teachers in learning the material.

## D. CONCLUSION

Based on the results and discussion of the study, it can be concluded that the android-based mathematics learning media with articulate storyline 3 on the number sense material is a very feasible and very practical learning media. The results of the review by media experts and students indicates that this media is included in the very feasible category. The developed media contains three learning styles to meet differentiated learning needs, namely visual, audio, and kinesthetic. The developed media can be operated as a teacher's teaching module with the content of Learning Achievements, Apperception, and Evaluation. The game created contains number sense content that indirectly trains students' abilities.. Thus, the learning media developed is very worthy and very practical to use. Based on the results of the assessment, this learning media is considered suitable for implementation in learning.

Suggestions from further research are to expand the development of learning materials, covering broader and more comprehensive topics or concepts. Improve the design of learning media to be more interesting, attractive, and interactive, so that it can be more effective in maintaining students' interest in learning. Make periodic improvements and developments to the media to ensure that this media is always compatible with the latest devices, so that it can be accessed and used effectively and efficiently.

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