Android-based tutorial: Improving students digital literacy in mathematics programming

R K Setyansah* and E Suprapto
Mathematics Education Study Program, Universitas PGRI Madiun, Indonesia

*Corresponding author’s e-mail: reza.mathedu@unipma.ac.id

Abstract. The purpose of this research is the development of making media tutorials based on Android mathematical applications (Wolfram Alpha, Geogebra, and Matlab). This tutorial media is stored online and displayed through Google Site pages. The development used the Plomp model that has four-phases, namely the initial investigation, the design, the realization/construction, the testing, evaluation, and revision. Before making a media tutorial, the media tutorial was validated by two material experts. This prototype was tried for students in a limited way to see the practicality of using media and to be an evaluation for researchers. The conclusion from the media tutorial is considered feasible if it meets 1) the element of validity with the average results obtained from the material validation sheet 88.5% and 83.5% media experts; 2) it seems that the effectiveness of complete material from limited tests is 88.17% and field tests are 82.81%; and 3) the results of the questionnaire responses were seen from students after using the tutorial media on a limited test showed 79.33%, and in the field, the test showed 78.23%, the achievement of reinforcement using digital literacy. The acquisition in this study, sharpening digital literacy using tutorial media, is 71.11% categorized.

1. Introduction
The impetus for the influence of the COVID-19 pandemic had a very extraordinary impact, which began the whole of conventional learning that changed drastically towards Distance Learning. The generation with the development of a new culture called digital natives was born from the penetration of aggressive digital technology and the rapid growth of technology that influenced their learning behavior habits. Consequently, the generation had unique ways of thinking and learning [1]. Expectations to be achieved in the development of education require breakthroughs in learning high-speed innovations. This view from the results of the study [2] the digital generation natively feels depressed and bored if the learning process is similar to the previous generation. The development required in the learning process requires a precise and fast process to reach the native digital generation. Humans need a part of communication through the process of visual information that is dominated by various learning sources derived from screens that require direction so that teachers and learners are directly involved with each other. See results from [3] The intent was to teach visual awareness in a way that increased the capacity for visual understanding and thinking. The intent was to teach visual attention in a way that increased the capacity for visual understanding and thinking. It also discusses the nature of mathematics, the perspective of what constitutes mathematics literacy, and the competencies that people need to acquire mathematical literacy [4]. E-
learning has become a necessity in higher education institutions and is being deployed in educational establishments throughout the world [5].

Universitas PGRI Madiun (UNIPMA) produces a generation of teacher candidates who need to prepare for this. Based on observations of lectures in the UNIPMA Mathematics Education Study Program, there are classic problems seen in the field during the practice of basic computer learning mathematics programs using video conferencing using ZOOM. It seems that the use of mathematical programming applications with computer software cannot cover all students. On top of this, multimedia technologies further offer students different forms of media to match their learning styles, leading to enhancements of their learning effectiveness [6].

The conducted study was initiated with the presupposition that SRL had a positive impact on the satisfaction and academic performance of students [7]. Teachers should help students to approach educational tasks with confidence. Teachers should help students how to seek information. Also, teachers should help students to engage the cognitive and metacognitive cycle activities flexibly and adaptable [8]. A similar thing was shown in the research [9]. The textbook that will be developed is equipped with a video simulation on how to do calculations using Matlab, so students can learn to do their calculations with computers. Previous studies concluded that utilizing technology in learning and the availability of devices in the form of an android smartphone that, on average, is owned by all students. It is hoped that this research will be able to hone digital literacy skills for students through media tutorials based on mathematics android-application.

From the description of the background, the problems in this study are as follows: 1) What is the procedure of developing an android application-based mathematics tutorial media program in mathematics computer programming courses? 2) Is the tutorial media mathematics program based on android applications, feasible to use to hone students’ digital literacy?

The objective to be achieved in this research is to create a tutorial media program based on an android application that can hone the digital literacy of students in mathematics programming.

2. Methods
This research is in the type of research and development (R&D). The model used is the Plomp model providing a model consisting of five phases: initial investigation phase, design phase, realization/construction phase, test phase, evaluation, and revision, and implementation phase [10]. However, the fifth phase requires a feedback process for the implementation of each phase and the time and level of in-depth evaluation work. So, the application of the solution in this implementation is feared not to be reached optimally. It allows researchers to proceed to further research. The operational stages of conducting this research are limited to the fourth phase, which can be seen in figure 1.

![Figure 1. Plomp flow chart.](image-url)
Field subjects in this study were class II A students of the Mathematics Education Study Program of UNIPMA who took classes in 22 students’ basic computer programming practice mathematics. The taking of subjects for the trial was limited to 6 students.

The research instrument consisted of an instrument validation sheet, a student response questionnaire related to the ease of operation of the tutorial media. The purpose of instrument validation is based on expert judgment. In this case, the experts in question are lecturers who have the ability in the field of multimedia and the field of computational programming. The results of the expert’s assessment are used as a reference for improvement.

To assess the feasibility of the tutorial media that have been made, a measurement scale using a Likert scale is used. The variables to be measured are translated into indicator variables, then referred to as benchmarks as compiling instrument items that use a Likert scale having levels from very positive to very negative. Likert scale with the criteria of rating very feasible (5), feasible (4), quite feasible (3), not feasible (2), and very improper (1) [11].

Validity analysis, in this study, developed a tutorial media-based mathematics program android, which involved more than one expert as a validator. To find out the overall percentage results then can be analyzed the calculation results with the average formula as in equation (1) [12]

$$V = \frac{V_1 + V_2 + \cdots + V_n}{n} = \cdots \%$$  

Web-based learning media is declared valid (good/good enough), if the combined validity results show more than 70% [12]. The valid formula as in equation 2

$$V = \frac{\text{Total Empirical Score}}{\text{Total Expectation}} \times 100\%$$  

Effectiveness analysis, tutorial media can be said to be effective if 80% of students fulfill mastery learning. Students are declared complete if the percentage of completeness of individuals has reached ≥ 80%, which classically obtains a minimum score of 75 from the overall score [10].

Practical Analysis, Data analyzed to determine the practicality of instructional media were obtained from the student response questionnaire. The list of media response criteria [13], namely: 1) Presentation of Information, 2) Material and Response, 3) Response Evaluation, 4) Response Feedback, 5) Repetition, and 6) Segment of Material Arrangement. Student questionnaire responses used a Likert scale with a checklist method. Likert scale is used to measure people’s attitudes, opinions, perceptions [14]. Media tutorials can meet the practicality criteria of the media if it gives criteria ≥ 70% of students classically provide a positive response [15]. If it is less than 70%, the researcher must make improvements to the learning media based on suggestions given by students.

### Table 1. Student digital literacy indicator.

| No. | Item Indicator            | Item Question                  | Total |
|-----|--------------------------|--------------------------------|-------|
| 1   | Use of Technology        | 1,2,3,4,5,6                    | 6     |
| 2   | Use of Smartphone / Mobile | 7,8,9,10,11,12,13,14,15,16,17,18 | 12    |
| 3   | Social networking        | 19,20,21,22                    | 4     |
| 4   | Privacy Settings         | 23,24,25,26                    | 4     |
| 5   | Online Safety            | 27,28                          | 2     |
| 6   | Positive Impact of Technology | 29,30                          | 2     |
|     | Total Questions          |                                | 30    |

From the results of the ability, media tutorial android-based math programs can strengthen the student’s digital literacy. Research instruments are needed to be identified that refer to the digital
literacy questionnaire grids that generally consist of 6 indicators with a total of 30 questions [14]. The details of the student digital literacy questionnaire can be seen in table 1.

The steps taken to make an android application-based math program tutorial to hone the independence of student learning are as follows: 1) Arrange storyboard video tutorials based on the composition of the material; 2) Validate the expert team (Multimedia Support Lecturer and Computing Programming Lecturer) and test the reliability level; 3) Revise the video tutorial following the direction of the expert team if needed; 4) Design the tutorial including practice instructions; 5) Make a prototype tutorial using Snapgit tools, Canva, and Filmora; 6) Make materials at Office 365 and upload video tutorials on Youtube; 7) Make a material page and video tutorial by using google site; 8) Make a QR Code and URL address to the research subjects and 9) Uploading material to the ELMA UNIPMA online learning page at the link address: http://elma.unipma.ac.id/.

3. Results and discussion
The implementation of this research, carried out with the arrangement of the Plomp model stages [10], namely the initial investigation phase, the design phase, the realization/construction phase, and the test phase, evaluation, and revision. Presentation on each implementation results in the study as follows:

3.1. Initial investigation phase
In this phase, the problem is determined. The problem is different between the ideal conditions obtained and the facts that occur in the field. There are some initial problems brought by the change. The problems are 1) Changes in the learning process initially with blended learning (face to face and online) then experience a change in online learning (Online as a whole) due to the Covid-19 pandemic. It affects the adaptation of learning for students; 2) Online learning with the use of the zoom platform, there are students having difficulty following and asking for repetition of the explanations conveyed by the instructor and requesting the results of the zoom record to be shared again. However, the results delivered in the form of record zoom are mixed with various discussion matters; and 3) If there are students who do not understand the material from the explanation on the zoom platform, then the zoom record will be asked to access the YouTube link. It becomes less effective, considering the material is not studied in advance by students.

Departing from this problem, researchers took the initiative to make an android application-based math program tutorial even in a simple form. Towards the stage of making an android application based tutorial, there are still several phases that must be passed. Before realizing/constructing a storyboard, a video tutorial is planned first, which will be explained in the next section.

3.2. Design phase
Design is the blueprint of the solution, so the process must be examined. The general problems described in the first phase must be limited so that the research direction is not too widespread. The design is given as follows: 1) Software used to make video tutorials including Canva and Filmora, the selection of software that is used because it is free and easy to operate; 2) Software used in basic computer lecture materials including Wolfram Alpha Mathematica, Geogebra, and MATLAB; 3) Storyboard Video Tutorial Design, as for the simple design in making the design in figure 2; 4) Questionnaire instruments validation of material experts and media experts, and 5) Student response questionnaire instruments.

In developing the video tutorial, some storyboard sections are prepared, including Appearance Display, Display Instructions, Content Display, and Evaluation Display.
3.3. Construction phase

At this stage, the video tutorial begins, while the first step is to make a screen record using Snapgit software from each use of GeoGebra software, Wolfram Alpha Mathematica, and MatLab. Figure 3 is the display of the Screen Record of the three programs.

![Figure 3. Snagit editor (a record).](image)

The second stage was then performed video editing with Filmora software following the sequence of material compiled by the RPS for introductory mathematics education courses. This editing process requires the insertion of images using Canva software. The appearance of the editing process with the Filmora program in figure 4 and figure 5.

![Figure 4. Video editor (Filmora).](image)  ![Figure 5. Picture editor (Canva).](image)
The next stage is uploading material in Office 365 with sway platform and video results to YouTube channel, while in arranging tutorial sequence according to the material. It can be seen in figure 6 and figure 7.

**Figure 6.** Sway editor (Office 365).  
**Figure 7.** YouTube studio.

The fourth stage continued the creation of a place to hold material and video tutorials on website pages at sites.google.com with content arranged in the order of material lectured on basic computer mathematics education followed by all displays that have been combined into one place at the university’s LMS (ELMA). The appearance of the tutorial material that has been packaged is displayed on the web. It can be seen in figure 8 and figure 9.

**Figure 8.** Editor Google Sites.  
**Figure 9.** Display LMSelMA.

3.4. Test, evaluation and revision investigation phase  
Products developed in the first stage are named prototype-I, and the revised product is called prototype-II, Prototype-III, and so on, depending on the improvements number. To see the complexity or practicality of the application, Prototype-I was retried on the teaching with limited students. Besides, the results of trials on this limited number of students also function as an evaluation tool. The results of testing the acquisition of improvements obtained some revisions and modifications in the display. The validator said that it took too long to load the content if the initial display was loaded via Wordpress with the address. Therefore, the 92-page was replaced by google site and become faster to load the content. It is also more user friendly. The validator gave suggestions to fixed some math type
errors. Also, there were no voice element instructions in the use process in the prototype-I. It has been added to the prototype-II.

From the results of the expert validation instrument, the percentage of expert approval can be seen in the following table 2 and table 3. Based on calculations, the results of the study show the acquisition of table 2 and table 3 elements of the validity of the android-application media tutorial to hone learning independence with the average results obtained from the media validation sheet from material experts by 88.5% and from media experts by 83.5%. According to the validator, it only fulfills parts of 1) Presentation of Information, 2) Material and Response, 3) Repetition and 4) Segment Settings.

### Table 2. Material validation results.

| Validator Team | Expert I | Expert II |
|----------------|----------|-----------|
| Empirical Total Score | 83 | 94 |
| Total Expectation Score | 100 | 100 |
| Percentage | 83% | 94% |
| Percentage of Final Validity | **88.5%** |

### Table 3. Media tutorial validation results.

| Validator Team | Expert I | Expert II |
|----------------|----------|-----------|
| Empirical Total Score | 82 | 85 |
| Total Expectation Score | 100 | 100 |
| Percentage | 82% | 85% |
| Percentage of Final Validity | **83.5%** |

The practicality of the tutorial media was obtained from the percentage of questionnaire responses that were filled in by the second-semester students during the pilot experiment and field experiment tests. Following the result of filling in the student, the response questionnaire can be calculated by Likert Scale formula [11]. From the result of filling out the limited questionnaire response, the percentage results in the pilot experiment amounted to 79.33% with total number score obtained is 476 from 600, and field experiment tests amounted to 78.23% with total number of score obtained is 1721 from 2200. Therefore, it was concluded that the tutorial media that was developed had fulfilled the practicality element because the percentage obtained was ≥ 70% and meant students classically gave positive responses [14]. Supported by research results, Student responses to the appeal of e-learning-based learning media blogs about global warming subjects in high school are stated to have been exciting interpretation criteria [16].

A follow-up of digital literacy to the media is given to know the result of student’s responses about media tutorials. It was obtained from the responses of student questionnaires about digital to the android based math tutorial program media, which can be seen in table 4.

The results of the acquisition of student responses in the use of media tutorials android-based math programs achieve digital literacy responses, showing an average percentage score of 71.11%. Achievement to hone digital literacy using categorized tutorial media is mainly on aspects of technology use, smartphone usage, online safety, and the positive impact of technology.

Achievement of digital literacy affects learning media, in line with research that new media (print, electronic and digital media) can function in terms of contributing to the development of literacy (new) and cultural techniques (new) [17]. In digital literacy, users easily make frameworks on existing or proposed programs or other educational measures [18].
Table 4. Student digital literacy response results.

| Item Indicator | Student Response | Achievements | Percentage of Response |
|----------------|------------------|--------------|------------------------|
| 1              | 495              | 528          | 82,5                   |
| 2              | 842              | 1056         | 70,42                  |
| 3              | 252              | 352          | 63                     |
| 4              | 249              | 352          | 62,25                  |
| 5              | 157              | 176          | 78,5                   |
| 6              | 140              | 176          | 70                     |
| Total          | 2138             | 2640         | 426,67                 |

Total Average Percentage of Digital Literacy Response 71,11

The effectiveness sheet of using tutorial media is seen from the value of the results of the post-test comprehension done by students after using the tutorial media in limited trials and main field tests. The following are the overall results of the post-test in the main field test. It can be concluded that the tutorial media fulfill the mastery of comprehension achievement of the material from the limited test of 88.17% with amount of score obtained is 529 from 600 and the field test of 82.81% with amount of score obtained is 1822 from 2200. From the results obtained, it is stated to meet the percentage of completeness.

See the results of obtaining validity, effectiveness, and practicality. It is in line with previous study [19] Internet Based Learning (IBL) in higher education institutions resulting in major changes in traditional teaching and learning processes throughout the world. Besides, our findings reveal that the platform offers a developer’s tool for coding and customizing templates to attain higher levels of usage and interactivity in which learners can create and control learning objects while they observe the results [20]. It was found that the application of interactive conceptual based Matlab simulation media in learning can improve students’ understanding of Linear Equation Systems [21]. The instructor can conduct more simulation studies following examples to enhances their ability of programming skills [22]. Besides, the numerical calculation method and statistics, the optimization module and software Matlab, the typical case study, combine to optimize the teaching effect, enhance students’ learning interest, produce good effects on the subsequent courses and the work [23].

4. Conclusion

Media tutorials for android-based math programs to hone digital literacy are fulfilled: 1) Presentation of Information, 2) Material and Response, 3) Repetition and 4) Segment Settings. The product developed is declared feasible as a learning medium if it meets valid, effective, and practical criteria. It can be seen from the validity element with the average results obtained from the material expert validation sheet at 88.5% and from the media expert at 83.5%. Achievement of the categorical effectiveness of complete material from the limited test was 88.17%, and the field test was 82.81%. The accomplishment of practicality is categorized as high, as seen from the results of limited trials of 79.33% and main field trials of 82.56%. As in this study, sharpening digital literacy using categorized tutorial media is 71.11%, mainly on aspects of technology use, smartphone usage, online safety, and the positive impact of technology.

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