JPSI 9(3):433-444, 2021
Jurnal Pendidikan Sains Indonesia
e-ISSN: 2615-840X p-ISSN: 2338-4379

Development of Chemistry Comics based on Android and Its Implementation to Improve Learning Outcomes

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DOI: 10.24815/jpsi.v9i3.20266

Article History: *Received: March 3, 2021* *Revised: May 31, 2021*
Accepted: June 14, 2021 *Published: June 24, 2021*

Abstract. Teachers often use printed book media in learning. Due to many reasons, rarely do they want to develop and vary learning media with the aim of making the learning process more interesting. The lack of student interest in learning results in low student learning outcomes. This study was aimed to develop chemistry comics based on android (chemondro) on the material for the reaction rate. The method used was research & development with ADDIE model, namely analysis, design, development, implementation, and evaluation. Collected data were included media validation, responses, suggestions for improvement from validators according to the BSNP eligibility standards and learning outcomes. The analysis stage was carried out by analyzing the needs in the forms of student characteristics and identifying learning media. The design stage included flowchart design and chemondro. The results of design were then developed and the application was given to the validators for a feasibility test. The implementation stage was carried out in class XI SMA N 1 Garoga. The sample was of two classes, namely class XI IPA 1 (experimental) and class XI IPA 2 (control), whereas each class was consisted of 34 students. Furthermore, student learning outcomes were measured at the evaluation stage using pre and post tests. The results found that eligibility of chemondro was of 3.6 with very well criteria. The learning outcomes were found to be 81.91 in the experimental class compared to 71.76 in the control class. This study concluded that chemondro was very suitable for use in chemistry learning, especially on the material of reaction rates and student learning outcomes were achieved with good criteria.
Keywords: Chemistry comics based on Android, Learning Outcomes, and Reaction Rate

Introduction

Freedom to learn is freedom to think creatively in seeking knowledge from various sources. Students are free to choose to learn from various learning sources and in a happy atmosphere. This strategy is able to realize the democratization process of learning which reflects that learning is the initiative of students according to their characteristics (Budiningsih, 2010). Thus, one of the roles of the teacher is to be able to make students have broad insight into all-sophisticated technology to face the millennial era and have a broad knowledge of the times (Dewantara, 2013; Makaryus & Sri, 2013).

Teaching is considered effective if students learn actively (Hamalik, 2013) and its aspects work in harmony between students, educators, and learning resources (Fawaidah

& Sukarmin, 2016). The rate of reaction is a chemical material that studies microscopic things, which makes students tend to only memorize theories because of difficulties in understanding them. Therefore, the media will be very helpful for the thinking process of students to understand the material correctly (Herawati, 2013; Daryanto, 2013).

Based on learning observation which was carried out on class XI IPA students of SMA Negeri 1 Garoga showed that the use of learning media used by the teacher was found o be minimal and limited. Teachers taught with conventional methods such as lectures, question and answer without being supported by media and other learning aids. In addition, the lack of student interest in reading textbooks was one of the causes of student learning outcomes not achieving learning completeness. The development of chemical comics based on android can be an alternative solution in this case.

The purpose of this study was to develop chemondro learning comics on chemical reaction rates to improve learning outcomes for high school students. Several previous studies have confirmed that comics can help improve student learning outcomes. Comics can be used in a two-way learning process (Saputro, 2015). Many comics are now in electronic form which are operated on smartphone devices with the Android operating system (Yektyastuti & Ikhsan, 2016). Android is designed primarily for touch screen mobile devices such as smartphones and tablets (Mukherjee, 2015).

Previously, the application of android-based comics got positive response from students. Comics can be used to improve students' critical thinking skills. Good verbal packaging with narration and directed flow makes comics more interesting (Damayanti and Kuswanti, 2020). In addition, chemistry learning media on solubility material has been successfully applied in learning chemistry of solubility material in class XI IPA at SMAN 10 Yogyakarta for the 2014/2015 academic year (Yektyastuti, 2015). Researchers Brouillette & Lubell, (2019) provided a motivational exercise to connect the science behind heavy-metal hero comic stories. Novianti & Putra, (2020) found that chemical comics on the material electrolyte and non-electrolyte could be used as an alternative learning.

In addition, Ntobuo, et al. (2018) found a positive student response to the use of gravity comics. Students' positive perceptions could be identified through comic-based practicum learning (Affeldt, et al., 2018). Learning that was oriented towards generic skills of colloid material science was also found that Android-based learning media was feasible to use (Wiguna, 2019). Research conducted by Sari, (2019) in measuring science process skills in thermodynamic experiments gave the results of high school students' science process skills that could be mapped. Android-based chemistry learning media developed were very suitable for use in learning (Isma, 2015; Anesia, 2018; Susanti, 2019; Hakim, 2018; Hayuwari and Rahmawati, 2016) and student learning outcomes were improved (Anesia, et al., 2018; Prasetyo, 2019; Hayati, 2017).

Methods

The method used in this research was research and development (R & D), with ADDIE model which consisted of five stages, namely, analysis, design, development, implementation, and evaluation. Samples were taken using a total sampling technique from two classes, whereas each class was consisted of 34 students. The research was conducted at SMA Negeri 1 Garoga class XI IPA in the odd semester of the 2020/2021 school year, from June to December 2020. Learning was carried out online using the google meet application, whatsapp group and google classroom.

Collected data were included media validation, in the form of responses and suggestions for improvement from validators, according to BSNP eligibility standards. In addition, learning outcomes were also collected using pre and post tests. These data were analyzed using predetermined assessment criteria. However, data of learning outcomes were analyzed statistically using the right-hand t-test after first being tested for normality, homogeneity, hypothesis and data gain test.

Results and Discussion

The process of developing the android chemistry comic (chemondro), has been developed using the ADDIE model development stages, as follows:

Analysis

Somethings that were analyzed include needs, such as material, characteristics of students and learning media. The curriculum used in SMA Negeri 1 Garoga was the k-13 curriculum. Reaction rate material includes material that was difficult for students to understand, besides this material used a lot of calculations and also has practical activities. The results of the analysis showed that a media that can lead students to be more active and able to visualize the subject matter was needed. Based on this, the learning media for chemical comics based on android were expected to help students understand the reaction rate more easily and interestingly.

The findings of this study were in line with Isma, (2015) and Anesia, (2018) which found that android-based mobile learning media could also increased student learning motivation. The implementation of learning using android-based comic media could be carried out well in accordance with the learning activities planned by the teacher, so that the media was included in the practical category as teaching material (Susanti, 2019).

Design

The design stage was included as a whole storyboarding, compiled material in the form of comics, questions and answers, making backgrounds, images, and in the application. In other hand, learning indicators were set which accordanced with the basic competencies as well. Flowchart design was carried out to determine how the flow and

process of Android-based comic chemistry learning media would be developed, so that it became an attractive, complete and structured application, as in Fig. 1.

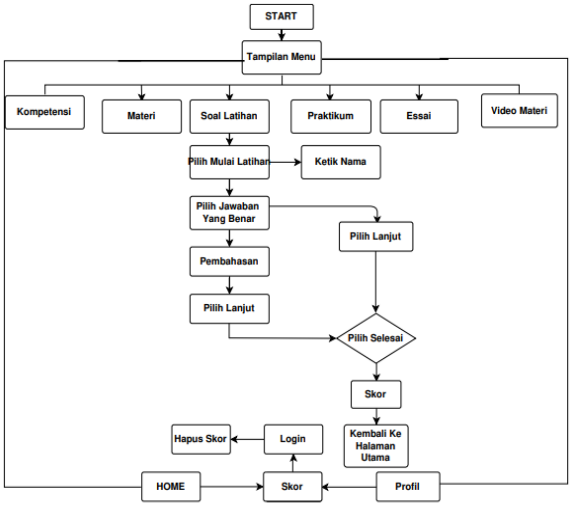


Figure 1. Flowhart Design

Physical display was adjusted to the information from the flowchart design. Media design consisted of comic content, logos, homelists, the type of font used, the size of the writing, and the creation of an application as an access point for chemondro. Several icons were downloaded from *flaticon.com*, namely the mentoring and training type. While the background is downloaded from *trianglify.io* where the width was 1440 with a height of 900. The colors used were *cyan 600#00acc1* and *Yellow 500#ffeb3b*. Fonts from *fonts.google* with type *dose designed* by *Impallari type* with *extra-bold 800*. The application development used *Android Studio* to display Android projects, as in Fig. 2.

(a) (b)

Figure 2. Application development: (a) printed comics, (b) android comics

Furthermore, the material that will be used as comic content was also designed as well as planning the form of the media by selecting the format. The evaluation in the form of a written test was designed with a multiple choice question type. The design stages carried out were in line with what has been done by previous researchers, such as (i) mapping basic competencies, (ii) learning objectives, (iii) determining assessment tools, (iv) preparing material, and (v) Learning Implementation Design (RPP), as well as (vi) program thinking flow model or flowchart (Hamdan, 2017; Rustandi, 2020; Rika, 2019; Yektyastuti, 2016; Saputra, 2020; Mujahadah, 2021).

Development

At this stage, everything that has been designed would be developed into android comics. The application features and program code were developed using android studio which displayed the project files in the android project. Furthermore, the tools on *Android Studio* use the *JAVA programming* language for the process that would be carried out next. The type of android studio can be seen in Fig. 3.

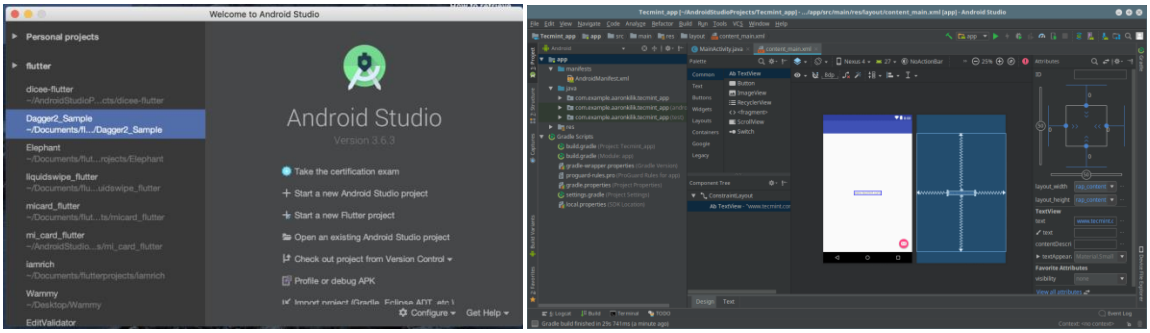


Figure 3. Type Android Studio

The JAVA programming language also managed the running of application features with translated code. After the display was created, then insert the comic into the application, but previously the comic was converted into PNG and then pasted it to the drawble. An Android-based comic application that has been built into an APK was then stored on a computer device and could be sent to the user, as Fig. 4.

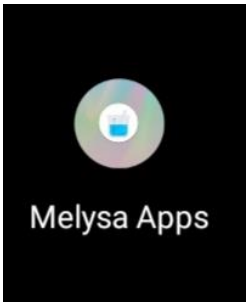


Figure 4. Shape of the Teaching Material Logo (Melysa Apps)

Chemondro that has been installed on by each student could be operated offline. This learning media has an initial appearance, which was in the form of the main menu as shown in Fig. 5.

Figure 5. Display Menu of Chemondro

Before the implementation stage, the feasibility assessment was carried out by a media and material expert validators. This assessment included several aspects, such as the feasibility of content, language, presentation and graphics. MelysaApps was validated by two expert media lecturers from Chemistry, Faculty of Mathematics and Natural Sciences, State University of Medan (UNIMED), and one chemistry teacher from SMA Negeri 1 Garoga. The results of the media validation can be seen in Fig. 6.

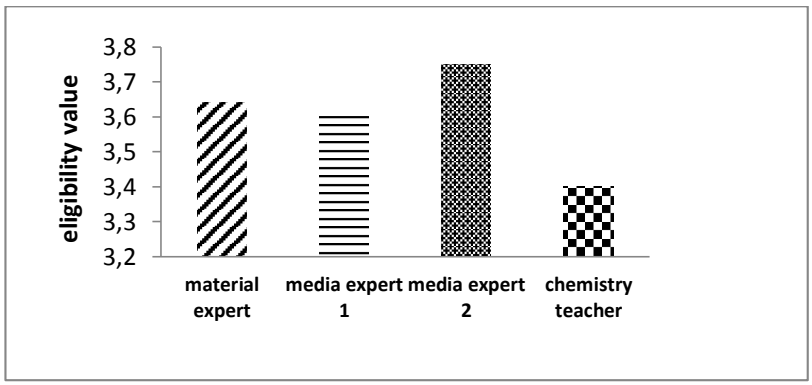
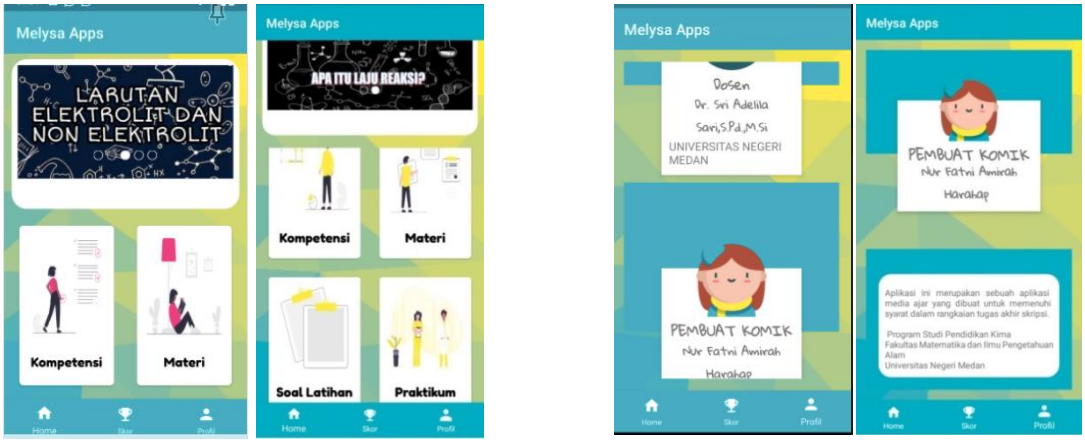


Figure 6. Media Feasibility Assessment

The average of validation results of the *MelysaApps* was found to be 3.46, and it stated to be very valid. So that they did not require significant revised and could be implemented in the learning process of reaction rate material. Minor revisions only need to be done in terms of display contrast, as in Fig. 7 (a) and (b). Overall, the assessment of the feasibility of chemistry comic instructional media from the chemistry teacher was good, the material presented was relevant and complete.



(a) (b)

Figure 7. Revisions of (a) initial display, and (b) profile

The activity of the feasibility validation was in accordance with the findings of previous researches. Whereas the android-based chemistry learning media developed were suitable for use in learning in terms of aspects of material assessment and testing (Isma, 2015; Anesia, 2018; Saputro, 2020; Mujahadah, 2021; and Alkodri & Ayu, 2019). The results of the experts' assessment of the media in the feasible category could be implemented (Hakim, 2018; Susanti, 2019). Findings put forward by Elfiana and Azhar, (2019) test the validity of the average value, with the average kappa moment was found to be 0.87 with a very high validity category.

Hayuwari and Rahmawati, (2016) obtained a score of 3.6 which was included in the very feasible category and Hamdan, (2017) obtained an assessment from reviewers, peer reviewers, and teachers with a score of 4.34 and a percentage of 86.67 which meant was very good. Novianti & Putra, (2020) found that the chemistry comic had a very high level of validity with a kappa moment value of 0.85.

MelysaApps that has been declared feasible by the validator were then used for teaching and learning process, as in Fig. 8.

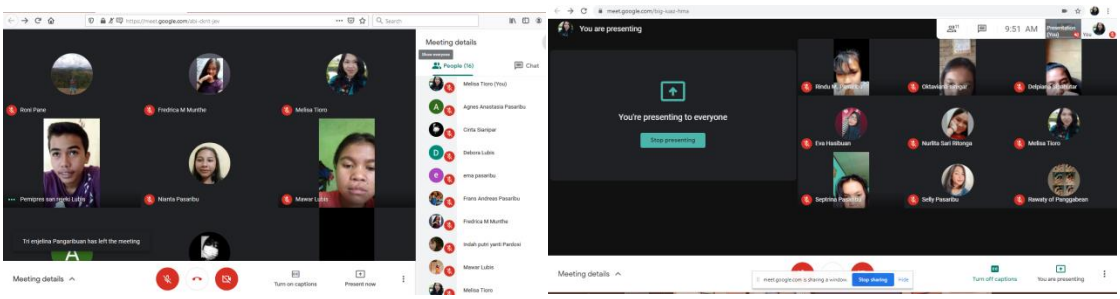


Figure 8. Implementation of *MelysaApps*

The application of learning media for chemical comics based on android lasts for 90 minutes with two meetings and was attended by 34 students. Students read the *MelysaApps* carefully and if there were material that were not clear yet, the students asked through the *WhatsApp group*. The learning process was taken place orderly and smoothly. After the use of *MelysaApps* was completed, then a discussion be held on the topic of applying the reaction rate in everyday life using *google meet*. After the short discussion, students were given a post test to measure learning outcomes after using chemondro.

Evaluation

At this stage the activities carried out were measuring student learning outcomes in learning using *MelysaApps*. The evaluation used multiple choice questions which were consisted of 20 questions. Student learning outcomes were obtained based on the results of the pre and post tests. The results of this study showed that the average student learning outcomes in the experimental class (using MelysaApps) were found to be 81.91 and the control class (using school handbooks without MelysaApps) was of 71.76. A recapitulation of the results of the expert validator's assessment can be seen in Fig. 9.

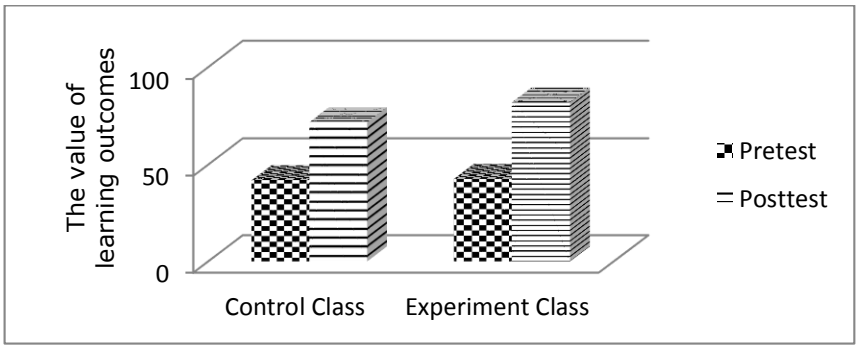


Figure 9. Learning Outcomes

Based on Fig. 9, it can be seen that the pre test scores obtained by students were still below the minimum completeness criteria of 75. After students learnt to *MelysaApps* and post test was completed, it was obtained the value of learning outcomes that have reached the minimum completeness criteria.

The normality test was carried out and the results showed that the pre and post test data were normally distributed. Data obtained from the Eeperiment class with $(X_2)_{count} <(X_2)_{table}$(5.45<11.07) and for the control class with $(X_2)_{count}<(X_2)_{table}$ (2.85<11.07). Based on these calculations it can be concluded that the learning outcomes in the experimental and control classes have been normally distributed at the significance level (α= 0.05).

The homogeneity test was obtained F_{count} 1.07<1.9, it can be concluded that the data was homogeneous because $F_{count}<F_{table}$. Based on hypothesis testing, obtained $t_{count}> t_{table}$ (6.67>1.67). Thus, it can be concluded that there were differences in the learning outcomes of students who were taught using *MelysaApps* and without. Based on the pre and post tests results were of 42.64 and 81.91, respectively in the experimental class, the

gain value was found to be 0.65. This means that the experimental class (XI IPA2) experienced an increase in learning outcomes in the moderate category, because 0.7>g≥0.3. Then, in the control class (XI IPA1) an average pre test was found to be 41.91 and post test was of 71.76, with a gain of 0.50. This means that the experimental class (XI IPA1) also experienced an increase in learning outcomes, but the increase was in the moderate category because 0.7>g≥ 0.3. These results are depicted in Fig. 10.

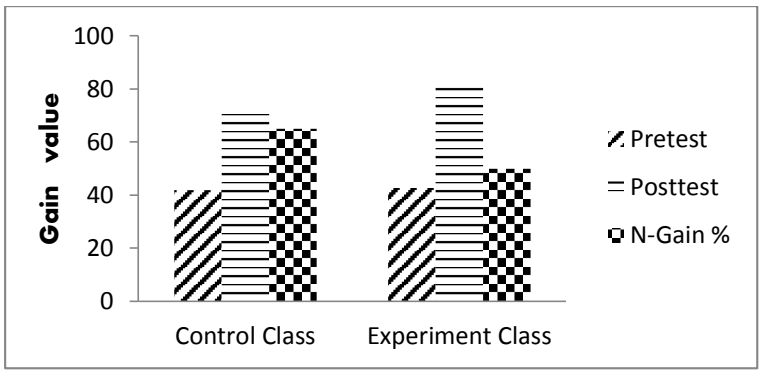


Figure 10. Gain Value Diagram

The findings of this study were in line with Situmorang, (2014); Silaban, (2018); and Yektyastuti, (2016) which stated that the average post test score of students was higher in the experimental class after using learning media. Furthermore, android-based mobile learning media could also be increase student motivation (Astuti, 2017; Astuti & Bhakti, 2018). Increased learning outcomes and student learning motivation were obtained significantly after using android-based learning media that had been tested for feasibility (Asti, 2019; Rustandi, 2020, Mujahadah, 2021). The characteristics of chemistry comic has a very high level of practicality so, it could be used as an alternative learning (Novianti & Putra, 2020).

Conclusion

Based on the results of the research that has been done, it can be concluded that android chemical comics, namely *MelysaApps* on reaction rate material could be developed with the ADDIE model. The average feasibility of the comic was found to be 3.6 with very feasible criteria. The learning outcomes were achieved by class XI IPA SMAN 1 Garoga have reached the minimum completeness criteria of 75, whereas score of post test was 81.91 with good criteria and a gain of 0.65. This means that the experimental class (XI IPA2) experienced an increase in learning outcomes in the moderate category because 0.7> g≥0.3. Thus, android chemistry comic *MelysaApps* was very suitable for use in chemistry learning, especially in the material reaction rate and student learning outcomes achieved in good criteria.

Acknowledgement

Thanks are conveyed to SMAN 1 Garoga for providing the facilities and infrastructure during this research.

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