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Development of Learning Media for Earthquake Disaster Through Physics Subjects to Improve Problem Solving Ability and Disaster Preparedness

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Abstract

Intensity of the earthquake disaster in Indonesia is quite high. The impact in the form of casualties and infrastructure damage was very severe. It is very important to teach disaster preparedness knowledge from an early age, including in the field of education. The learning being taught is still glued to the material that has not linked disaster knowledge. The purpose of this research is to produce learning media for earthquake disasters based on android through proper physics subjects to improve problem solving skills and disaster preparedness. The design of this research is R & D using the 4D model. The data collection instruments are in the form of expert validation sheets which include media experts and material experts. The research data were collected through observation sheets, questionnaire sheets, and inferential analysis. The results of the development of android-based disaster learning media met the very feasible criteria of 92.1 for media experts and 94.1 for material experts. The Manova test statistical results were 95% for problem-solving skills and 92.7% for disaster preparedness, so it was concluded that Android-based earthquake disaster learning media were used effectively to enhance problem solving skills and disaster preparedness.

Key words: earthquake, learning Media, preparedness, problem solving

INTRODUCTION

Indonesia is located between the meeting point of the three world plates, namely the Eurasian, Indo Australia and Pacific plates and is located in a series of volcanoes (ring of fire). Indonesia's location has the potential to cause natural disasters in the form of earthquakes, tsunamis and volcanic eruptions. Yogyakarta is an area that has the potential for V-VII MMI damage because it is located between two tectonic plates (Wibowo & Sembri, 2016). Data from Badan Meteorologi Klimatologi, Geofisika (BMKG) notes that an earthquake with a magnitude of 5.9 SR that rocked Yogyakarta in 2006 caused damage to the infrastructure severe and thousands of people died in the disaster. Possibility to minimize the impact of an earthquake disaster by educating preparedness knowledge and increasing public awareness about disaster knowledge (Savasci, 2011)

One of the key focuses of the architecture established by the United Nations is disaster preparedness. In this context, disaster risk mitigation 2015-2030 seeks to mitigate harm caused by natural disasters such as earthquakes, tsunamis, flooding, droughts, and hurricanes by promoting preventive ethics (UNISDR, 2015). Preparedness and mitigation are considered important to reduce the impact of disasters, therefore disaster preparedness knowledge needs to be taught from an early age either formally or informally (Setiawati, Rusilowati & Khumaedi,

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2013). The results of observations carried out in three high schools in the Bantul area which are prone areas earthquake in Yogyakarta concluded that there was no learning linking knowledge of disasters, especially earthquake disasters, to relevant materials and the disaster curriculum had not been fully applied to these schools. This is in line with the results of previous research which stated that education about disaster owned by the community is still low (Sagala, Situngkir & Wimbardana, 2013). The integration of science in schools associated with disaster knowledge can help awareness of the preparedness of students in dealing with natural disasters (Desfandi, 2014) and make students have a good understanding in dealing with disasters (Septikasari, & Ayriza, 2018).

Problem solving practice is an important factor in physics education (Docktor, Strand, Mestre & Ross, 2010; Docktor & Mestre, 2014). One of the problem solving skill is the decision to tackle the problem at hand (Hesse, 2015). This determination encompasses determining the best course of action after an earthquake crisis, as well as planning prior to an earthquake. Teachers use problem solving as a category of analytical skills so that students can quickly solve questions and combine their prior experience with new information (Rufaida & Sujiono, 2013). However, the introduction of learning in classrooms does not take into account students' problem-solving skills and remains focused on memorizing formulas. Training, according to previous studies, did not n According to previous studies, students' problem solving abilities were poor because instruction did not prioritize the improvement of problem solving skills (Aji, Hudha & Rismawati, 2017).

In the 21st century, along with the development of technology, learning models that are of interest to students are independent, interesting, interactive and innovative learning assisted by Android-based mobile devices (Hadi, 2015; Muliyati, Bakri & Ambarwulan, 2018). Android, which is open source, can be used as a learning medium to increase student motivation and learning outcomes because it is designed with attractive features and is easily accessible anywhere (Yektyastuti & Ikhsan, 2016). This is in line with the results of previous studies, namely the creation of media that utilizes Android-based technology to create a more attractive, interesting, and fun learning atmosphere (Nikensasi, Kuswardayan & Sunaryono, 2012). In addition, technology has the benefit of informing about the technology used to detect the occurrence of a disaster to produce the correct response and attitude. Social element plays a role in providing knowledge to students about adaptation in the pre, during, and post-disaster period (Atmojo, RusilowatI, Dwiningrum, & Skotnicka, 2018)

Based on the facts and problems that have been explained, this research aims to develop learning media for earthquake disasters based on Android through physics subjects to improve students' problem-solving skills and disaster preparedness knowledge.

METHOD

Type of research is design and development research using the 4D model which consists of four main stages, namely define, design, develop, and disseminate.

In the first stage, the instruments needed at this stage are interview instruments, student analysis, and analysis of learning material concepts. The survey research was conducted in a class XI MIPA at SMAN 1 Pundong. The second stage is design, at the stage This learning media is designed with create storyboards, media layouts, arrangement of material according to the applicable curriculum in schools, video collection and animation support the theme of learning media that. Earthquake disasters occur as a result two plates that collide with each other cause a vibration event on the surface the earth suddenly as a result release of creating energy seismic waves and results collapse of existing buildings on. Disaster insight and disaster mitigation, especially earthquakes can be integrated in the wave material found in basic competence 3.8 analyze wave characteristics mechanics and 4.8 doing the experiment about one of the characteristics of the wave mechanics.

Inferential methods for statistical analysis. Inferential statistics are used to assess if the use of learning media for earthquake disasters is effective for enhancing the ability to solve problems and plan for disasters by using the Manova test which previously carried out the normality test assisted by the SPSS application. In the Multivariate Test, there are several test statistics that can be used to make decisions on differences between groups of Hotelling's Trace, which are test statistics used when there are only two groups of independent variables. The higher the statistical value of Hotelling's Trace, the greater the effect of the model.

The third stage of development, the design that has been completed is then developed using Android Studio, Adobe Audition, Photoshop and imported with the extension .apk.

Before the earthquake learning media was used, the earthquake learning media were validated by expert lecturers (material experts and media experts), physics teachers and peers using a questionnaire assessment sheet. The instrument that was assessed was the earthquake disaster learning media with aspects of software engineering assessment, audio visual and learning materials in the media. The results of the assessment of each aspect are developed into indicators which are tabulated and analyzed. The assessment result data is analyzed in the following steps:

a. The average score for each of the assessed aspects is calculated using the formula:

$$\overline{X} = \frac{\sum X}{n} \quad (1)$$

b. The scores on each aspect of the assessment are converted to a scale of five with the following steps:
   1) Calculate the ideal average score using the equation:

$$X_i = \frac{1}{2} \text{ (max score + min score)} \quad (2)$$

   2) Determine the ideal standard deviation (SBi) with equation:

$$SB_i = \frac{1}{6} \text{ (max score + min score)} \quad (3)$$

   3) Determining the criteria Qualitative data in the form of media feasibility is obtained from the conversion of a value of each component, according to Table 1.

Table 1. Category of Rating Scale

Respondent Score	Criteria
$X \geq X_i + 1{,}8\,SB_i$	Very feasible
$X_i + 0{,}6\,SB_i < X \leq X_i + 1{,}8\,SB_i$	Eligible
$X_i - 0{,}6\,SB_i < X \leq X_i + 0{,}6\,SB_i$	Fairly feasible
$X_i - 1{,}8\,SB_i < X \leq X_i - 0{,}6\,SB_i$	Less feasible
$X \leq X_i - 1{,}8\,SB_i$	Very inadequate

Learning media that has been revised according to suggestions and validation assessment is tested limited to one class, namely class XII MIPA SMAN 1 Pundong which consists of 25 students who are randomly selected (random sampling) by filling out a media response questionnaire to see the readability of earthquake disaster learning media, operations, and the features available in the learning media.

In solving the problem, there are several problem-solving indicators, namely: Identify, understand and formulate problems, plan problem solving, conclusion and evaluating. Indicator to be used to assess preparedness society is derived from five parameters including: 1) Knowledge of disaster risks, 2) Preparedness policies and guidelines, 3) Disaster emergency planning, 4) System disaster warning, 5) Mobilization of sources power.

The Disseminate stage is the last stage in this research. Products developed that have been improved through a revision process will be disseminated or published on a large scale.

RESULT AND DISCUSSION

Development of learning media for earthquake disasters based on android is described based on the 4D development stages (Thiagarajan, Semmel & Semmel, 1974).

The define stage is the initial stage carried out in this study, which consists of a preliminary study, student analysis, analysis of the concept of learning materials. Preliminary study starts from

previous research and research results (Uno, 2010). Based on the results of a review of previous research, it is known that Indonesia is located in an area that is vulnerable to various natural disasters, one of which is earthquakes. The level of impact caused by the earthquake is due to several factors, including the knowledge of individual preparedness about disasters earthquake. Linking subjects and knowledge of disasters in schools makes students have good knowledge and understanding in dealing with disasters from an early age (Septikasari & Ayriza, 2018). Disaster knowledge is associated with physics because the application of physics concepts can solve problems that occur in everyday life and problem solving is an important factor in physics (Docktor, Strand, Mestre & Ross, 2010; Docktor & Mestre, 2014). Therefore, it is necessary to develop learning media for earthquake disasters based on android through physics subjects to improve problem solving and disaster preparedness skills.

The school used as the place for this research is Sekolah Siaga Bencana (SSB) which has an average student age of 16-17 years with a good level of cognitive development. In accordance with Piaget's theory of cognitive development, students aged 15-17 at the stage of cognitive development are able to predict very complex things (Asyhar, 2011)

The earthquake disaster was chosen as one of the applications of physics material application, because after the earthquake analysis applied some physics material. The material is analyzed and adapted to earthquake disasters, then relevant materials are selected to improve students' problem solving skills and earthquake disaster preparedness. Wave material and free fall motion were selected as examples of Android-based earthquake disaster learning media applications to be made.

Based on the results of preliminary studies, student analysis and analysis of the concept of learning materials, earthquake disaster learning media were designed. The compilation of the media begins with drawing a navigation flow description in operates disaster learning media to be developed (flowchart) and storyboards that describe in detail the media components in the form of structuring images, animated writing, music and videos contained in the media adapted to earthquake disasters and physics subject matter.

The development of earthquake disaster learning media using android studio software, adobe audition and photoshop imported in the extract (.apk). Learning media can be operated using mobile phones with the Android 4.0 platform with a minimum RAM of 512 Mb. Earthquake disaster learning media is designed based on a storyboard consisting of several components including: a start page that has a start button, the main menu page contains the main material for earthquake disasters, evaluation, instructions for use, developer information and exit pages. The results of learning media that have been developed are as in Figure 1.

(a) (b)

Figure 1. (a) The start page of the media; (b) Media main menu page

The second page of learning media developed is the main menu consisting of an introduction containing indicators of learning achievement, earthquake material menu starting from the causes, impacts and earthquake preparedness associated with wave material mechanics and free fall motion, the evaluation menu contains questions about mechanical wave material and free fall motion, developer info, instructions for use, volume buttons and exit buttons, as shown in Figure 2.

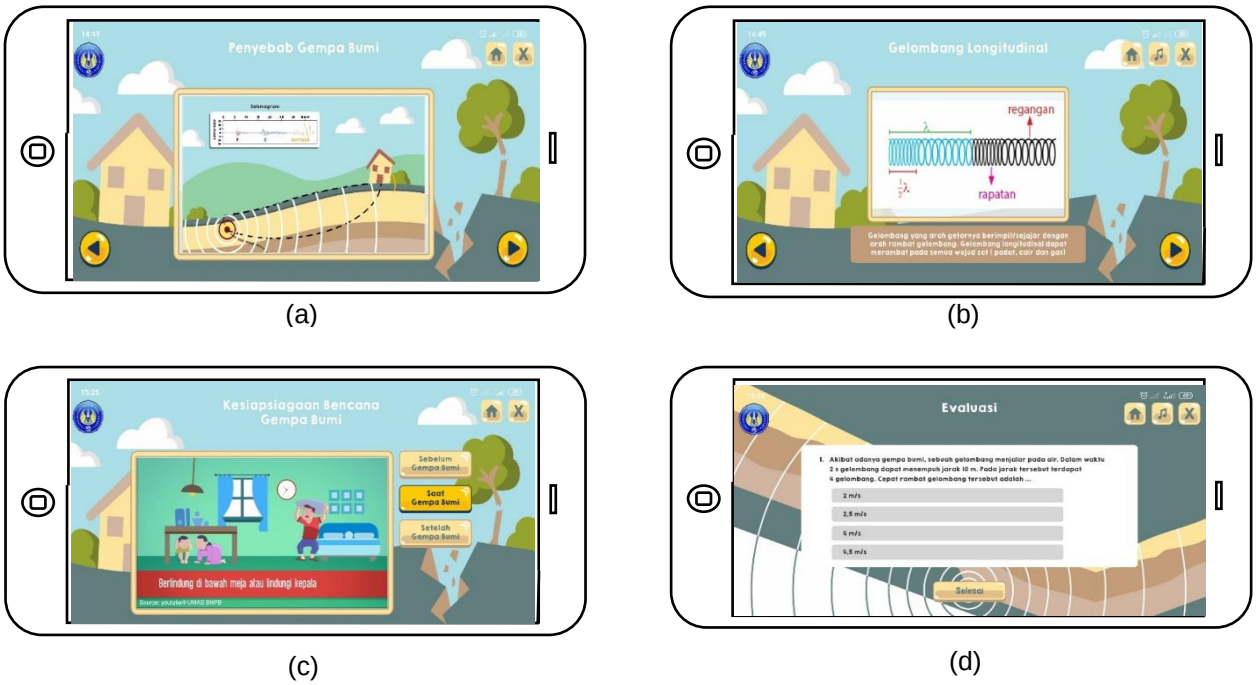

Figure 2. (a) Menu of earthquake disaster material; (b) physics material on the media; (c) Earthquake preparedness materials; and (d) evaluation menu.

Earthquake disaster learning media that have been developed must first be validated to obtain recognition and validation of the suitability of the media to the needs so that they are suitable for use in learning (Azwar, 2015). Assessment of media feasibility is assessed from two aspects, namely the media and material aspects in the product. Instructional media validity test results obtained earthquake after analyzing the data sheet media appraisal by 7 validator comprising one media expert lecturers, 1 lecturer matter experts, two teachers of physics, and three colleagues using Aiken analysis V.

Aspects assessed on Product feasibility by media experts is engineering software and audio visuals. The results of the product validity test by media experts can be seen in Table 2.

Table 2. Media Feasibility Assessment Results (Media Experts)

Aspect	Score	Category
Audio visual	90.7	Very feasible
Engineering Software	93.6	Very feasible
Average	92.1	Very feasible

Based on the results of the validity test conducted by media experts in Table 2, it shows that the product developed is in the category very valid with an average value of 92.1.

The aspects that are assessed in the product feasibility assessment for material experts are learning and materials. The results of the product feasibility validity by material experts can be seen in Table 3.

Table 3. Media Feasibility Assessment Results (Material Expert)

Aspect	Score	Category
Learning	95.5	Very feasible
Material	93.3	Very feasible
Average	94.4	Very feasible

Table 3 shows that the product developed has a very feasible category with an average rating of 94.4. The results of all assessments are in line with the expert opinion that a valid device contains compatibility between each component (Yusuf, 2005).

Before being used in learning media for earthquake disaster, a limited trial was carried out on 25 students of class XII MIPA to see the responses of students to the media developed using a questionnaire. Table 4 shows the results of the students' response assessments.

Table 4. Categories of Limited Trial Assessment Results

Aspect	Score	Category
Audio visual	90.4	Very feasible
Engineering Software	90.3	Very feasible
Average	90.3	Very feasible

Based on the assessment of earthquake disaster learning media through limited testing is said to be feasible to be used in the learning process.

Earthquake disaster learning media based on android developed through physics subjects are suitable for use in learning. Linking the material for earthquake disasters in physics subject matter makes learning more meaningful. The results of previous research also stated that the learning process would increase the motivation of students if they raised issues that were contextual and real in everyday life (Wahyuni, Ahmad & Syafriani, 2018). Learning arranged based on life or experience helps students build the knowledge learned (Jeng, Wu, Huang, Tan & Yang, 2010).

The development of earthquake disaster learning media through physics subjects explains that physics learning can be taken from the problems of everyday life or culture (Saputra & Kuswanto, 2018). This study produces learning media that has an attractive appearance and takes advantage of technological advances so as to make it easier for students to learn contextual learning (Mutlu & Kayabaş, 2015). In line with the results of the research which states that the provision of video and audio-visual media makes the level of readiness of students in the ready category and increases students' knowledge to be tough, agile, and responsive to earthquake disasters (Sari & Suciana, 2019; Wulandari, 2018).

This study aims to produce earthquake disaster learning media to improve problem solving and disaster preparedness skills. Problem solving skills are measured using five essay questions on the topic of mechanical waves and walking waves. Natural disaster preparedness can be measured using a five-question essay. The research instrument can be seen in Figure 3 and Figure 4.

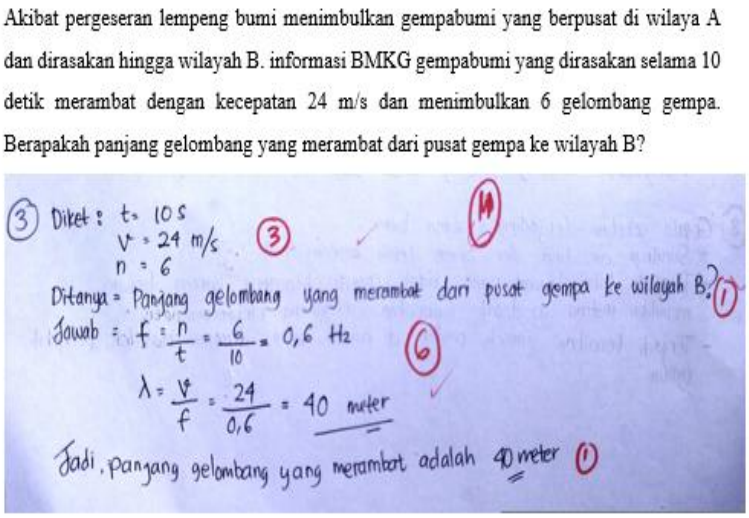

Figure 3. The Display of the Problem-Solving Skill Instrument

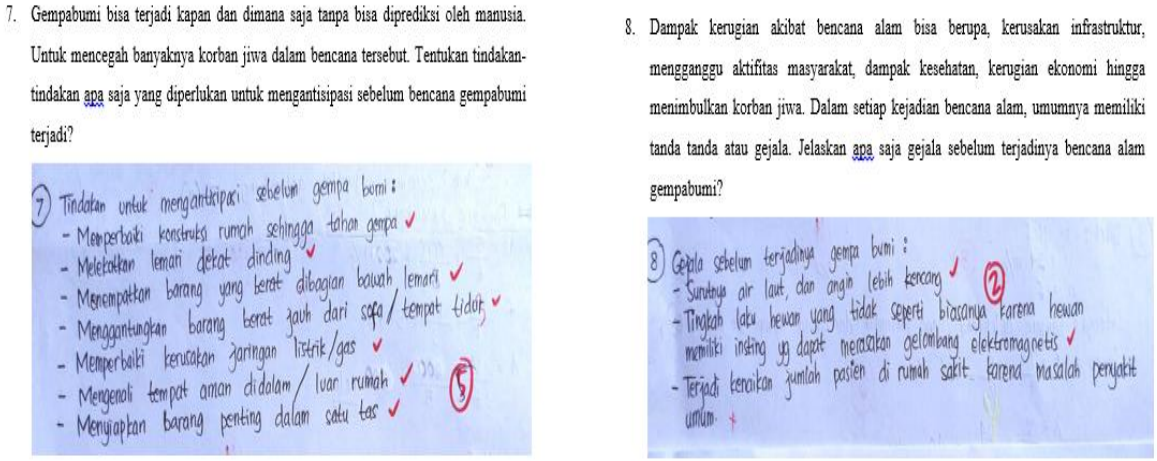

Figure 4. The Display of the earthquake Disaster Preparedness trument

Figure 3 explains that students can solve problems according to problem solving indicators (identify, understand and formulate problems, plan problem solving, implement settlement plans and make decisions or draw conclusions) which presented in the event of an earthquake disaster which is linked in the appropriate physics material. Figure 4 explains that students can plan disaster emergencies and know the earthquake warning system in accordance with the indicators of achieving earthquake disaster preparedness in this research.

Hotteling's Trace is the test statistic used since this research has two dependent variables that are typically distributed and have a homogeneous covariance matrix variant between classes, namely the experimental class and the control class. The findings of the test are provided in Table 5 by Hotteling's Trace.

Table 5. Results of Manova

Effect		Value	F	Sig.
Intercept	Hotelling's Trace	45.122	3226.215[b]	.000
Class	Hotelling's Trace	0.170	6.045	.000

By using the significance level alp=0.05, it can be inferred that there are substantial differences in problem-solving and planning skills between students in the experimental class who use earthquake disaster learning media and students in the control class who do not use media to understand earthquake disasters. Effective contribution to treatment in classroom learning Experimental and control classes on problem solving abilities and natural disaster preparedness are shown in Table 6.

Table 6. Univariate Test Results on Problem Solving Ability and Disaster Preparedness.

Variable	Class	F	Sig.	Partial Eta Squared
Problem Solving	Experiment	1736.740	0.000	0.950
	Control	1198.454	0.000	0.927
Disaster	Experiment	518.850	0.000	0.860
Preparedness	Control	354.581	0.000	0.847

Table 6 shows that the effective contribution to the class that uses learning media for earthquake disasters based on android to improve problem solving skills is 95.0% and to improve students' disaster preparedness is 92.7%. In the control class, using conventional learning in the form of PPT, gave an effective contribution to improve problem-solving abilities by 86.0% and disaster preparedness for students by 84.7%. Based on this comparison value, it can be concluded that the use of android-based earthquake disaster understanding media can provide a greater effective contribution in improving students' problem solving and disaster preparedness abilities compared to conventional learning with PPT.

The media for understanding earthquake disasters based on android is effective in improving students' problem solving and disaster preparedness abilities, because the media is prepared according to the indicators of problem-solving including identifying, understanding and formulating problems, planning problem solving, implementing settlement plans, making decisions or drawing conclusions. In addition, there is an element of disaster preparedness which is explained in detail in the form of videos and animations to make it easier for students to understand about earthquake disaster preparedness.

CONCLUSION

Based on the results of media development and research, it can be concluded that Android-based earthquake disaster learning media developed are feasible (valid) to be used to improve problem solving and disaster preparedness skills in learning with the excellent category.

REFERENCES

Aji, S., Hudha, M. N., & Rismawati, A. (2017). Pengembangan Modul Pembelajaran Fisika Berbasis Problem Based Learning untuk Meningkatkan Kemampuan Pemecahan Masalah Fisika. *Science Education Journal*, 1(1), 36-51. https://doi.org/10.21070/sej.v1i1.830.

Asyhar, R. (2011). *Kreatif Mengembangkan Media Pembelajaran.* Jakarta : Gaung Persada Press.

Atmojo, S. E., Rusilowati, A., Dwiningrum, S. I. A., & Skotnicka, M. (2018). The reconstruction of disaster knowledge through thematic learning of science, environment, technology, and society integrated with local wisdom. *Jurnal Pendidikan IPA Indonesia,* 7(2), 204-213. http://dx.doi.org/10.15294/jpii.v7i2.14273.

Azwar, S. (2015). *Penyusunan Skala Psikologi Edisi 2* . Yogyakarta : Pustaka Belajar.

Desfandi, M. (2014). Urgensi Kurikulum Pendidikan Kebencanaan Berbasis Kearifan Lokal di Indonesia. *Social Science Education Journal*. 201, 1(2), 191-198. http://dx.doi.org/10.15408/sd .v1i2.1261.

Docktor, J. L., Strand, N. E., Mestre, J. P., & Ross, B. H. (2010). A Conceptual Approach to Physics Problem Solving. *American Institute of Physics Conference Proceedings,* 1289(1), 137-140. Portland : American Institute of Physics.

Docktor, J.L., & Mestre, J.P. (2014). Synthesis of Dicipline Based Education Research in Physics. *Physical Review Special Topics Physics Education Research,* 10(2) 1-58.

Hadi, W. S. (2015). Pengembangan Komik Fisika Berbasis Android Sebagai Suplemen Pokok Bahasan Radioaktivitas untuk Sekolah Menengah Atas. *Unnes Physics Educaation Journal*, 4(2), 15-24. https://doi.org/10.15294/upe j.v4i2.7431.

Jeng, Y, L., Wu, T, T., Huang, Y, M., Tan, Q., and Yang, S, J. (2010). The Add-On Impact Of Mobile Applications In Learning Strategies: A Review Study. Educational Technology & Society: *Journal Educational Technology & Society*, 13(3), 3-11. Retrieved from https://eric.ed.gov/?id=EJ899857.

Hesse, F., Care, E., Buder, J., Sassenberg, K., & Griffin, P. (2015). A framework for teachable collaborative problem solving skills. In Assessment and Teaching of 21st Century Skills, 37–56. http://dx.doi.org/10.1007/978-94-017-9395-7_2.

Muliyati, D., Bakri, F., & Ambarwulan, D. (2018). Aplikasi Android Modul Fisika Berbasis Discovery Learning. *Jurnal Wahana Pendidikan Fisika*, 3(1), 74-79. https://doi.org/10.17509/wapfi.v3i1.10944.

Mutlu, M. E., Kayabaş, İ., Kayabaş, B. K., & Mutlu, A. P. (2015). Implementation of the lifelong learning experiences management approach Observations on the first experiences. *Procedia-Social and Behavioral Sciences*, 174, 849 - 861. http://dx.doi.org/10.1016/j.sbspro.2015.01.680.

Nikensasi, P., Kuswardayan, I., & Sunaryono, D. (2012). Rancang Bangun Permainan Edukasi Matematika dan Fisika dengan Memanfaatkan Accelerometer dan Physics Engine Box 2D pada Android. *Jurnal Teknik ITS*, 1(1), A255-A260. http://dx.doi.org/10.12962/j23373539.v1i1.648.

Rufaida, S., & Sujiono, E. H. (2013). Pengaruh model pembelajaran dan pengetahuan awalterha¬dap kemampuan memecahkan masalah fisika peserta didik kelas XI IPA MAN 2 Model Makassar. *Jurnal Pendidikan IPA Indonesia*, 2(2), 161-168. https://doi.org/10.15294/jpii.v2i2.2718.

Sagala, S. A. H., Situngkir, F., & Wimbardana, R. (2013). Interaksi Aktor Dalam Rekonstruksi Rumah Pasca Bencana Gempa Bumi. *MIMBAR: Jurnal Sosial dan Pembangunan*, 29(2), 217-226. https://doi.org/10.29313/mimbar.v29i2.397.

Saputra, R, Z., & Kuswanto, H. (2018). Development of Physics Mobile (Android) Learning Themed Indonesian Culture Hombo Batu on the Topic of Newton's Law and Parabolic Motion for Class X SMA/MA. *Journal Phys.Conf. Series.* 2018, 1097. http://dx.doi.org/10.1088/1742-6596/1097/1/0120 23.

Sari, D. P., & Suciana, F. (2019). Pengaruh Edukasi Audio Visual dan Role Play Terhadap Perilaku Siaga Bencana Pada Anak Sekolah Dasar. *Journal Of Holistic Nursing Science,* 6(2), 44-51.https://doi.org/10.31603/nursing.v6i2.2543.

Savasci, F. (2011). Make an Earthquake: Ground Shaking. *Journal Science Activities*, 48, 57–64. https://doi.org/10.1080/00368121.2010.523909.

Septikasari, Z., & Ayriza, Y. (2018). Strategi Integrasi Pendidikan Kebencanaan Dalam Optimalisasi Ketahanan Masyarakat Menghadapi Bencana Erupsi Gunung Merapi. *Jurnal Ketahanan Nasional*, 24(1), 47-59. https://doi.org/10.22146/j kn.33142.

Setiawati, I. K., Rusilowati, A., & Khumaedi. (2013). Pembuatan Buku Cerita IPA yang Mengintegrasikan Materi Kebencanaan Alam untuk Meningkatkan Literasi Membaca dan Pembentukan Karakter. *Jurnal Pendidikan IPA Indonesia,* 2(2), 129–135. https://doi.org/10.15294/jpii.v2i2.2713.

Thiagarajan, S., Semmel, D. S., & Semmel, M. L. (1974). *Instructional Development for Training Teachers of Exceptional Children.* Broomington: Indiana University.

UNISDR (2015). Sendai framework for disaster risk reduction 2015 – 2030. United Nations Publica-tion

Uno HB. (2010). Orientasi Baru dalam Psikologi Siswa yang memiliki gaya belajar. Jakarta : Bumi Aksara.

Wahyuni, T, A., Ahmad, F & Syafriani. (2018). Pengaruh LKPD Terintegrasi Materi Gelombang Gempa bumi Terhadap Kompetensi Fisika Peserta Didik di SMA. *Pillar of Physics Education,* 11**(**1), 169-176. http://dx.doi.org/10.24036/2724171074.

Wibowo, N. B., & Sembri, J. N. (2016). Analisis Peak Ground Acceleration (PGA) dan Intensitas Gempa bumi berdasarkan Data Gempa bumi Terasa Tahun 1981 - 2014 di Kabupaten Bantul Yogyakarta. *Indonesian Journal Of Applied Physics*, 6(1), 65–72.

Wulandari, F. (2018). Pengaruh Media Video Terhadap Kesiapsiagaan Siswa Dalam Menghadapi Bencana Gempa bumi di SMA Negeri 1 Gantiwarno, Klaten. *Jurnal Pendidikan Ilmu Pengetahuan Sosial Indonesia*, **3**(2), 18-20. https://dx.doi.org/10.26737/jpipsi.v3i2.712.

Yektyastuti, R., & Ikhsan, J. (2016). Pengembangan Media Pembelajaran Berbasis Android Pada Materi Kelarutan untuk Meningkatkan Performa Akademik Siswa SMA. *Jurnal Inovasi Pendidikan IPA*, 2(1), 88-99.

Yusuf AM. (2015). *Metodologi Penelitian (Dasar-Dasar Penyelidikan Ilmiah)* Padang: UNP Press.