

ADVENTURE MATH GAME BASED ON STEM PROJECT-BASED LEARNING TO IMPROVE STUDENTS' CREATIVE THINKING

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ABSTRACT

This research aims to determine the validity of Android-based adventure media, determine the feasibility of Android-based adventure media, and measure the increase in students' creative thinking. Creative thinking is measured based on aspects of fluency, flexibility and originality. The method in this research is the ADDIE development model, with the research subjects being students in classes VIII A and VIIIB of Al Inayah Purwosari Middle School. Based on the research results, it was found that 1) Based on the recapitulation of the values from the validators, the average result for the three validators was 3.6%. Based on the media validity score table, the Android-based adventure media is declared valid. 2) Based on the questionnaire recapitulation table of student responses in the wide field test, the average result was 3.41%. Based on the media feasibility score table, the Android-based media adventure is declared feasible. 3) Based on the test results to measure students' creative thinking abilities, it can be concluded that there has been an increase in creative thinking from limited field tests to wide field tests.

Keywords: author guidelines; mathematics education; article template

1. Introduction

Currently, Indonesia is entering the era of Industrial Revolution 4.0 where its development relies on cyber-physical systems which are a combination of digital, physical, mathematical and biological developments which are also in the field of education. (Sadikin & Hakim, 2019). Education in the Industrial Revolution 4.0 is education whose implementation is characterized by digital learning (Sanusi, 2016). This learning allows the learning process to continue using digital without space and time limits (Ferdiani et al., 2022). Therefore, learning in the era of Industrial Revolution 4.0 not only demands the use of digital learning but also demands a more innovative learning process so that it is more interesting and efficient. (Sumaryanta & Wibawa, 2020).

In the era of Industrial Revolution 4.0 learning, students have unlimited access to information (Lase, 2019). Of course, this will be a challenge in the field of education. Challenges in the field of education include changes in students' thinking patterns, ways of learning, and ways of acting in developing creative thinking. (Surani, 2019). Changes in the field of education are certainly a

big challenge this century. Therefore, to overcome these challenges various competencies and abilities are needed, one of which is the ability to think critically and creatively (Sudjana & Rachmatin, 2019). However, the reality on the ground is that students in Indonesia's ability to think creatively is still relatively low. Based on the analysis results from the 2015 Global Creativity Index, Indonesia was ranked 86th out of 93 countries, with a score of 7.95 in the creative class (Florida et al, 2015). Meanwhile, in 2018, Indonesia's PISA score for mathematics was ranked 72nd out of 79 participating countries. Meanwhile, based on the UNBK results from 2014/2015 to 2017/2018, mathematics is in the poor category (Umar & Ahmad, 2019). Based on the results of the analysis, it can be concluded that the cause of the decline in UNBK results is due to the HOTS questions which require creative thinking skills to solve them (Gradini, 2018). Based on these studies, it can be concluded that students' creative thinking abilities are still low. The current learning process requires learning media to help optimize the use of technology so that it can produce output that keeps up with the times (Muhardono et al., 2022). Computers as a

technology product can be used as a learning tool and have quite a large potential for their use in the learning process (Astuti et al., 2018). Teachers in operating computers can be very helpful to use as a technology-based learning tool, namely online learning to improve students' creative thinking.

The use of learning models is the main key to implementing learning in the classroom. One learning model that can improve students' creative thinking is S TEM PROJECT Based Learning (Ferdiani, 2022, Capraro 2013). STEM project-based Learning encourages students to think critically so that they can improve their creative thinking abilities (Ferdiani, 2022). STEM Project Based Learning encourages students to design, make patterns and realize the design or pattern in a project into a product. In learning with the STEM project-based learning model, students work in a group to solve complex problems in a large project (Capraro et al., 2016). But in reality, teachers rarely apply the STEM Project Based Learning model in class, especially in mathematics classes (Ferdiani, 2017, Ferdiani 2022).

Based on researchers' observations at three schools in Pasuruan district, namely SMP Al Inayah Purwosari, Pasuruan, SMP N 1 Purwosari, and SMP N 1 Purwodadi, the results were that Students' creative thinking abilities need to be improved, especially in Algebra material. This was proven when students were given open-ended questions that required creative thinking skills, students still had difficulty answering them. The learning carried out has not maximized the use of learning media that can improve students' creative thinking abilities.

Based on the problems found during observation, learning media innovation is needed to improve students' creative thinking. One of them is an Adventure math game based on STEM Project Based Learning. Adventure Math Game based on STEM Project-Based Learning is a project-based adventure game that collects keys to open a magic door that leads students to learn Algebraic Operations which students must do in groups. A math game adventure can be developed using Construct 2 software which is easy because it does not require mastery of a fairly difficult programming language (Rohman, 2019).

This research has been researched by previous researchers, including (Nurbani & Puspitasari, 2022), (Niswah & Nisa', 2022), (Septiyani & Apriyanto, 2019). The difference between this research and previous research is that this research

is focused on improving students' creative thinking using the STEM Project Based Learning model. The aim of using the STEM Project Based Learning Model is so that students can work on projects to solve mathematical problems related to Algebra material. Meanwhile, creative thinking means different thinking (Ferdiani et al., 2021). A student's ability to present new ideas or solutions to problems in mathematics is considered an indicator of creativity. Creativity involves divergent thinking contributing to high-level reasoning, which highlights three indicators of fluency, flexibility and originality (Siswono, 2016). Mathematical creative thinking plays an important role in solving problems both at school and even in college (Ferdiani et al., 2019).

2. Research Methods

The development model in this research is ADDIE. This model has 5 main phases or stages, namely Analysis, Design, Development, Implementation and Evaluation. The selection of this model was based on the consideration that the model was easy to understand and developed systematically.

The analysis stage (Analysis) includes two process activities, namely: 1) analysis of existing problems, namely the absence of media that can support the learning process, so media is needed to attract students' attention. 2) Learning Component Analysis, namely the preparation of learning media referring to the 2013 curriculum, so that achievement indicators can be met according to existing competencies and by Algebra Operations material.

The next stage is the design or product design stage which includes the following stages: 1) Reference collection includes a collection of images suitable for the STEM Project Based Learning Adventure math game, character design in the STEM Project Based Learning Adventure math game, and design reference collection menu. 2) Designing the content of the material in the form of apperception, discussion of the material, example questions, practice questions and evaluation in learning media. 3) The storyboard consists of the main design and material presented in the Adventure math game based on STEM Project Based Learning.

At the development stage, an Adventure math game based on STEM Project Based Learning was created, using software construct 2 which includes: 1) Writing text material. 2) Installing the initial menu image, and character design 3)

Creating character animations 4) Determining the placement of the game stages 5) Adapting the game characters to the storyline (storyboard) 6) Providing background sound, background and animation 7) Installing Algebra Operations questions tailored to the stages -his. After the Adventure math game based on STEM Project Learning is completed as expected, the next step is a validation of material experts, media experts and learning experts or practitioners/teachers. Validity tests are used to determine the validity of media which is then corrected or revised. The following is the Media Analysis Validity Score.

Table 1. Media Analysis Validity Score

Score	Category
$3.25 < PK \leq 4.00$	Very worthy
$2.50 < PK \leq 3.25$	worthy
$1.75 < PK \leq 2.50$	Decent enough
$1.00 < PK \leq 1.75$	Not worth it

The implementation stage is the stage of implementing the Adventure questionnaire media that has been created. Before the media can be used by students, a validity test is carried out by media experts, material experts and learning experts. Researchers provide a validity questionnaire to determine the percentage of media validity. If there is a revision, the researcher revises the media, then the Adventure math game is based on STEM Project Learning This can be tested on students. testing Adventure math game based on STEM Project Based Learning It was tested by mathematics teachers at SMP Al Inayah, SMP N 1 Purwosari, and SMP N 1 Purwodadi before being tested on students. The implementation of the trial in this research is as follows: 1) Prepare a room with each student having an Android cellphone for the trial process. 2) Install the Adventure math game application based on STEM Project Based Learning on each cellphone. 3) Letting students learn using media, researchers accompany students in learning and help students if there are technical problems with the media. 4) Distribute questionnaire response sheets for learning media and ask students to fill them out to determine the suitability of the media in limited field tests and wide field tests. The following is the media suitability score which is measured based on student responses.

Table 2. Feasibility Score for Adventure math game based on STEM Project Based Learning

Score	Category
$3.25 < PK \leq 4.00$	Very worthy
$2.50 < PK \leq 3.25$	worthy
$1.75 < PK \leq 2.50$	Decent enough
$1.00 < PK \leq 1.75$	Not worth it

Adaptation: Widyoko (2014: 112)(modified).

The evaluation stage is the result of an evaluation that is at the development and implementation stage. This stage includes media revisions carried out by experts and obstacles found during the research. The revisions from the experts are: 1) Eliminating images that confuse students. 2) Added a help icon to help students while playing. 3) Correct writing that is too small. After revising according to the suggestions received, the Adventure math game is based on STEM Project Based Learning worth trying.

The advantages of Adventure math games based on STEM Project Based Learning among others; 1) Media work can be offline. 2) Applications for converting applications are easy to find, download and install for free on mobile phones. 3) The application capacity is light enough to be loaded on a smartphone. 4) Media can be accessed offline, anytime and anywhere.

To determine students' achievements in creative mathematical thinking, from the results of students' work in working on test questions. The following is the level of achievement of students' creative thinking abilities.

Table 3. Achievement of Students' Creative Thinking Abilities

Action Success (%)	Criteria
$95 \leq PK \leq 100$	Very creative
$80 \leq PK < 95$	Creative
$65 \leq PK < 80$	Quite Creative
$55 \leq PK < 65$	Less Creative
$PK < 55$	Not Creative

3. Results and Discussion

The final results of the development of the Adventure math game based on STEM Project Based Learning at the beginning of the lesson contain the title Adventure learning and its contents, the display theme taken by researchers in

compiling the developed Adventure math game based on STEM Project Based Learning, namely directing students' thinking patterns towards solving problems in projects in an integrated manner. sequentially to improve students' creative thinking. Researchers took an adventure theme because in applying Algebra Operations material, students play and go on adventures to solve problems in the project. By asking this question, researchers can measure students' creative thinking abilities.

The validation results from media experts show the validity of the Adventure math game based on STEM Project Based Learning which consists of 18 assessment items, the total score obtained from media expert validation is 60. The validation results from material experts show the validity of the Adventure math game based on STEM Project Based Learning where there are 12 assessment items, the total value obtained from material expert validation is 46. The total validation results from learning experts show the validity of the STEM Project Based Learning-based Adventure math game obtained from 12 assessment items, the total score from the learning expert validation is 42. The results obtained from validation by media experts, material experts and learning experts can be seen in Table 4.

Table 4. Recapitulation of validators

Expert	Average value (%)
Media	3.56
Material	3.76
Learning	3.44

Based on the validator recapitulation table, the average result for the three validators was 3.6%. Based on the media validity score table, the Adventure math game based on STEM Project Based Learning is declared valid.

The results of student responses to the Adventure math game based on STEM Project Based Learning for classes VIIA and VIIB SMP Al Inayah, SMPN 1 Purwosari, and SMPN 1 Purwodadi show the feasibility value of the Adventure math game based on STEM Project Based Learning obtained from 36 student response questionnaires with assessment criteria very worthy. This questionnaire was distributed to 6 students in classes VII A and VII B in the three

schools. These six students are representatives in each class with different academic abilities (2 students with low abilities, 2 students with medium abilities, and 2 students with high abilities). The recapitulation results of the class VIIA and VIIB questionnaire assessments at Al Inayah Middle School are shown in Table 5.

Table 5. Limited Field Recapitulation

Class VII A subject	Average value	Class VII B Subjects	Average value
1	3.45	1	3.46
2	3.45	2	3.56
3	3.54	3	3.50
4	3.45	4	3.65
5	3.63	5	3.48
6	3.54	6	3.59

Based on The results of the total student response questionnaire score of 489 for class VIIB obtained a very adequate criteria assessment. The recapitulation results of the class VIIB questionnaire assessment can be seen in Table 6.

Table 6. Recapitulation of Large Fields

Subject	Average value
1	3.18
2	3.36
3	3.54
4	3.18
5	3.63
6	3.45
7	3.27
8	3.36
9	3.63
10	3.18
11	3.54
12	3.45
13	3.63

Based on the recapitulation table of the student response questionnaire, the average result was 3.41%. Based on the media feasibility score table, the Android-based media adventure is declared feasible.

Based on the validation results and student response questionnaires, it can be

concluded that Adventure media is very valid and suitable for use in learning algebra material.

Based on the test results to measure creative thinking abilities, the following results were obtained.

Table 7. Results of Students' Creative Thinking Ability in Limited Field Tests

Criteria Aspect	Criteria					
	n	TK	KK	CK	K	SK
Fluency	2	12%	24%	12%	18%	34%
Flexibility	3	24%	18%	17%	11%	30%
Novelty	1	20%	20%	16%	15%	29%

Table 8. Results of Students' Creative Thinking Abilities in Wide Field Tests

Criteria Aspect	Criteria					
	n	TK	KK	CK	K	SK
Fluency	3	0	0	14%	24%	62%
Flexibility	4	0	0	15%	30%	55%
Novelty	5	0	0	13%	29%	58%

Based on the test results to measure students' creative thinking abilities, it can be concluded that there was an increase in creative thinking from limited field tests to wide field tests.

4. Conclusions

Based on research on the development of Android-based adventure media to improve students' creative thinking, the results obtained are:

- Based on the recapitulation of the values from the validators, the average result for the three validators was 3.6%. Based on the media validity score table, the Android-based adventure media is declared valid.
- Based on the questionnaire recapitulation table of student responses in the wide field test, the average result was 3.41%. Based on the media feasibility score table, the Android-based media adventure is declared feasible.
- Based on the test results to measure students' creative thinking abilities, it can be concluded that there has been an increase in creative

thinking from limited field tests to wide field tests.

Suggestions for advanced researchers are that research can be developed using Android-based adventure media to improve other thinking skills, for example critical thinking. Apart from that, this media can be used using learning models, for example project based learning, problem-based learning, or inquiry.

5. References

- Asmuni, A. (2020). Online Learning Problems during the Covid-19 Pandemic and Solutions to Solve Them. *Journal of Pedagogy*, 7 (4), 281. <https://doi.org/10.33394/jp.v7i4.2941>
- Astuti, IAD, Dasmo, D., & Sumarni, RA (2018). Development of Android-Based Learning Media Using the Appypie Application at Bina Mandiri Vocational School, Depok. *Journal of Community Service*, 24 (2), 695. <https://doi.org/10.24114/jpkm.v24i2.10525>
- Ferdiani, RD, Farida, N., & Murniasih, TR (2019). Analysis of junior high school students' creative thinking abilities through open ended questions on tube building material. *MUST: Journal of Mathematics Education, Science and Technology*, 4 (1), 35. <https://doi.org/10.30651/must.v4i1.2595>
- Ferdiani, RD, Manuharawati, M., & Khabibah, S. (2021). Geometry material: Profile of creative thinking process of prospective teachers with reflector learning style in proposing and solving problems. *Journal of Physics: Conference Series*, 1869 (1), 012118. <https://doi.org/10.1088/1742-6596/1869/1/012118>
- Ferdiani, RD, Manuharawati*, M., & Khabibah, S. (2022). Activist Learners' Creative Thinking Processes in Posing and Solving Geometry Problems. *European Journal of Educational Research*, 11 (1), 117–126. <https://doi.org/10.12973/eu-jer.11.1.117>
- Muhardono, A., Chalimah, C., Diazwara, M., & Mar'ah, M. (2022). The Role of Information Technology User Capabilities towards Transforming Human Resources in the Era of Industrial Revolution 4.0. *FIRM Journal of Management Studies*, 7 (1), 81. <https://doi.org/10.33021/firm.v7i1.1544>

Niswah, F., & Nisa', R. (2022). Development of Android-Based Mathematics Learning Media on Trigonometry Material. *Sigma* , 7 (2).
<https://doi.org/10.36513/sigma.v7i2.1405>

Indonesian Digital Journal of Mathematics and Education , 7 (1), 11–25.
<https://doi.org/10.53717/idealmathedu.v7i1.135>

Nurbani, N., & Puspitasari, H. (2022). Analysis of the Need for Development of Android-Based Learning Media in Mathematics Subjects in High School. *Educative: Journal of Educational Sciences* , 4 (2), 1908–1913.
<https://doi.org/10.31004/edukatif.v4i2.2357>

Rohman, H. (2019). Development of Media Construct 2 in Qira'ah Learning at Madrasah Tsanawiyah Negeri 1 Yogyakarta. *EDULAB: Educational Laboratory Scientific Magazine* , 4 (1), 25–46.
<https://doi.org/10.14421/edulab.2019.41-03>

Sadikin, A., & Hakim, N. (2019). Development of Interactive E-Learning Media in Welcoming Industrial Revolution 4.0 on Ecosystem Material for High School Students: Interactive Media Development of E-Learning in Welcoming 4.0 Industrial Revolution on Ecosystem Material for High School Students. *BIODIC* , 5 (2), 131–138.
<https://doi.org/10.22437/bio.v5i2.7590>

Sanusi, S. (2016). Implementation of Information Technology Based Learning Media Development at STAIN Kudus. *Elementary: Islamic Teacher Journal* , 4 (2).
<https://doi.org/10.21043/elementary.v4i2.3008>

Septiyani, E., & Apriyanto, MT (2019). Development of Android-Based Mathematics Learning Media for Middle School Level. *JKPM (Journal of Mathematics Education Studies)* , 5 (1), 153. <https://doi.org/10.30998/jkpm.v5i1.5230>

Siswono, TYE (2016). Students' creative thinking process in solving and posing mathematical problems. *Journal of Educational Sciences* , 15 (1). <https://doi.org/10.17977/jip.v15i1.13>

Sourial, N., Longo, C., Vedel, I., & Schuster, T. (2018). Online to draw causal claims from non-randomized studies of primary care interventions. *Family Practice* , 35 (5), 639–643.
<https://doi.org/10.1093/fampra/cmy005>

Sumaryanta, S., & Wibawa, AD (2020). Reconstruction of Mathematics Learning in the Era of Industrial Revolution 4.0. *Idealmathedu:*