p-ISSN 2460-0768 e-ISSN 2597-6044 *GeoEco, Vol. 10, No 2. July 2024 Page. 130-139*
https://doi.org/10.20961/ge.v10i2.74605 https://jurnal.uns.ac.id/GeoEco/article/view/74605

DEVELOPMENT OF SPATIAL THINKING BASED STUDENT WORKSHEET IN GEOGRAPHY SUBJECT AT SMA NEGERI 1 RANDANGAN

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ARTICLE INFO

Article History
Received : 06/06/23
Revised : 22/12/23
Accepted : 27/03/24

Citation:
Hubaib, N.M., Maryati, S., and Koem, S., (2024) Development Of Spatial Thinking Based Student Worksheet In Geography Subject At Sma Negeri 1 Randangan. GeoEco. Vol. 10, No. 2.

ABSTRACT

This research is based on the issue of the lack of teaching materials in the form of spatial thinking-based student worksheets to assist students' learning process. Another issue is that we have not yet implemented student worksheets based on spatial thinking in teaching. This research aims to develop spatial thinking-based student worksheets based on primary map knowledge material to make the learning process innovative and meet the demands of the independent curriculum, which was reviewed from the spatial thinking element for X Grade students at SMA Negeri 1 Randangan. This research uses the Steven J. McGriff version of the ADDIE development model (analysis, design, Development, implementation and evaluation). The research subjects are students from X Grade in Natural Science (IPA) 2 and Social Sciences (IPS) 2 classes. The data are collected through tests and questionnaires. The researcher uses effect size analysis to determine the learning effectiveness using the spatial thinking-based student worksheets based on basic map knowledge material. The study results show the student's responses to the spatial thinking-based student worksheet, which is suitable for use and interesting for students. The effectiveness of learning using the spatial thinking-based student worksheets get value of value 0,34 implies categorized as effective with a moderate classification level. This shows that spatial thinking-based student worksheets are declared effective in learning geography based on basic knowledge of maps.

Keywords: *ADDIE; student worksheets; spatial thinking*

INTRODUCTION

Modern education utilizes digital technology to adapt the teaching and learning process to the demands of the times, equipping students with relevant skills and knowledge for the future (Wijayanto et al., 2020). Modern education requires students to master science, understand and control their thinking process, and be skilled in critical thinking, creativity, communication, and collaboration (Wijayanto et al., 2020). With the guidance that exists in this era, geospatial literacy in measuring spatial

thinking skills must be applied in education.

Spatial thinking skills are needed to face the challenges of global competition in the 21st century. Gardner (2006: 45-46) asserts that in his theory of multiple intelligences, one of the Nine types of intelligence recognized is spatial intelligence. Gardner states that this intelligence is possessed by students or individuals who tend to learn better through visual presentations or objects that can be seen with the eyes. Spatial thinking ability is the core of visual-spatial intelligence (Kurniawan et al., 2022). Spatial intelligence can come from natural talent, but spatial thinking ability is a cognitive learning process (Kurniawan et al., 2022). Spatial thinking is often associated with spatial intelligence. Spatial thinking is simply the ability to analyze spatial relationships on Earth (Gersmehl & Gersmehl, 2007). Meanwhile, spatial intelligence is imagining, presenting ideas visually spatially, and orienting oneself accurately. This study focuses on students spatial thinking and summarizes it through student worksheets.

Student worksheets are a collection of sheets containing learner activities that allow learners to carry out actual activities with objects and problems studied (Novita et al., 2013). Student worksheets are one learning resource that teachers can develop as facilitators in learning activities. The Student worksheet can be designed and developed according to the conditions and situations of learning activities that will be faced (Novita et al., 2013). Based on this statement, developing student worksheet teaching materials based on spatial thinking is essential to understanding spatial thinking concepts in geography subjects. Geography emphasizes the relationship between humans and space, making this discipline considered the most appropriate for developing students spatial thinking abilities (Lutfianingsih, 2017). The opinion of Bonnet (2008) and Kersky (2015) suggests that geography emphasizes the integrated spatial relationship between physical phenomena and human activities.

Learning conditions that are effective enough do not necessarily meet the needs of students. Metoyer and Bednarz (2016) state that spatial thinking is one of the main characteristics of geography. Lambert & Morgan (2010) focus on geography as the science that studies the location and organization of human

activities on the Earth's surface in this case, measuring spatial thinking ability. Spatial thinking is a new thing for SMA Negeri 1 Randangan. The learning process, which includes models, strategies, and methods, is quite complex and by the demands of the Merdeka curriculum. Nevertheless, the learning process involving the ability to think spatially has not been perfectly realized. Awareness of its application exists, but the indicators measured are still poorly understood.

Spatial thinking consists of three components of concepts of space, using tools of representation and reasoning processes (Scholz et al., 2014). The three components of spatial thinking can be used to develop geography teaching materials, especially geographic information systems (Kamil et al., 2020). Learning activities must be supported by tools, technology, curriculum, and school policies to support the achievement of students' ability to think spatially (Bednarz et al., 2015). Competencies that must be possessed by students who pursue geography studies are the ability to think geographically, spatial thinking, and spatial intelligence (Bednarz et al., 2015). This research focuses on spatial thinking ability by developing spatial thinking student worksheets in geography subject matter of basic map knowledge.

The role of researchers is appropriate in researching the Development of spatial thinking-based student worksheets to improve students' geospatial literacy. This is supported by previous research, namely the ability to think spatially in 21st-century learning (Wijayanto et al., 2020), the effect of google earth learning media on spatial thinking skills of high school students (Santoso et al., 2022), the effect of project-based learning with google earth on spatial thinking skills (Oktavianto et al., 2017), the role of geographic information systems (GIS) in improving spatial thinking skills (Setiawan, 2016), Developing Spatial Thinking Skills of Students Through Geographic Information System Learning as Environmental Concern Reinforcement (Cholifah & Alfi, 2022), Development of Spatial Thinking Skills Test Instrument for High School Students (Aliman et al., 2020). These studies became the basis for researchers to develop spatial thinking-based student worksheets, this is new for researchers and schools as the research locations.

The research objective is to develop student worksheets based on spatial

thinking on the basic knowledge of maps to make the learning process innovative as the demands of the Merdeka curriculum in terms of the elements of spatial thinking in class X IPS students at SMA Negeri 1 Randangan.

MATERIALS AND METHODS

This study used the research and development method. The research design is the ADDIE model version (McGriff, 2000), which has five stages. The ADDIE research model has five stages, namely the analysis stage, which consists of analyzing student characters, curriculum and learning processes; the design stage, to design spatial thinking based on student worksheets; the development stage, which includes the validation process of instruments and student worksheets content; the implementation stage, that covers treatment to students and testing the effectiveness of student worksheets; and the evaluation stage, to assess the feasibility of student worksheet.

The data was obtained using a questionnaire, interviews with teachers and students, and tests to assess the results of using the product being developed. Fifty-five respondents are the research sample. The distribution of respondents was based on the test applied by the researcher, namely the limited test, general test, and validity test, with the location of this research at SMA Negeri 1 Randangan.

In this research, an analysis of practicality and effectiveness was carried out to measure the feasibility of student worksheets teaching material. The practicality analysis was carried out by paying attention to student assessments using a limited and general test scale. The effectiveness analysis is carried out by looking at the differences in test results before and after using student worksheets and teaching materials, considering the learning target achievement constants, and analyzing effect size.

Analysis of effect size obtained from the calculation of the total score of students, the number of participants, and the average score of student test results in categories d> 0.2 (small), 0.2 <d> 0.8 (medium), and d> 0.8 (tall) (Saregar, 2017).

RESULTS AND DISCUSSION

Analysis Stage

At the analysis stage, the researcher conducted a needs analysis, curriculum analysis, and analysis of student

characteristics. The needs analysis stage was carried out to analyze the extent to which geography learning in class X IPS at SMA Negeri 1 Randangan was carried out. At this stage, the researcher interviews geography teachers and observations in class X IPS 1, 2, and 3. At the curriculum analysis stage, the researcher analyzed the various curriculum tools that apply. The analysis aims to formulate indicators and learning objectives based on the elements of learning outcomes that apply in SMA Negeri 1 Randangan. Analysis of student characteristics is the stage used by researchers to find students' characteristics, which is the basis for researchers to compile student worksheets that will be developed.

Design Stage

At the design stage, the process of designing student worksheets will be developed by containing three indicators of spatial thinking. Student worksheets were made using the Canva application. There are two types of design: the content design and the student's worksheet appearance.

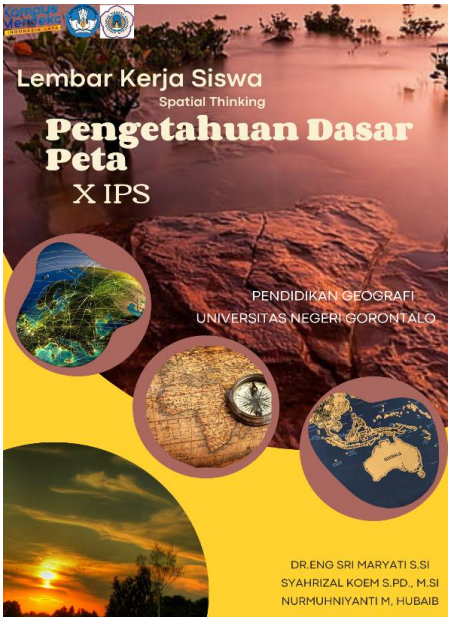

Figure 1. Front Cover of Spatial Thinking based Student Worksheet

Figure 2. Topic View Student Worksheet

Figure 3. View Task of Student Worksheet

Figure 1 shows the front cover of the worksheets for student-based spatial thinking. **Figure 2** shows the central part of the student worksheet discussion, which contains learning outcomes, learning objectives, Pancasila student profiles, achievement indicators, and self-identity (student worksheet users).

Figure 3 shows initial questions regarding student worksheets based on spatial thinking. This material is included in the odd semester in class X IPS subjects at the high school level. In addition, at the design stage, the researcher prepared the student worksheets validation instrument and the student response questionnaire.

Development Stage

At the development stages, researchers carried out several steps so that the availability of spatial thinking-based student worksheets certainly helps students at SMA Negeri 1 Randangan who still use printed books as their basis for learning. At this development stage, the researcher carried out several steps, namely writing the main points of the material to be conveyed through the contents of the student worksheets. At the writing stage, student worksheets are drafted by making learning objectives based on the applicable curriculum, namely the independent learning curriculum. In the product validation and revision stages, the researcher validates the product of teaching materials to

expert validators, material experts, linguists, and learning experts. The stage I and II validation comparison graph for each expert validator is presented in **Figure 4** and Figure 5.

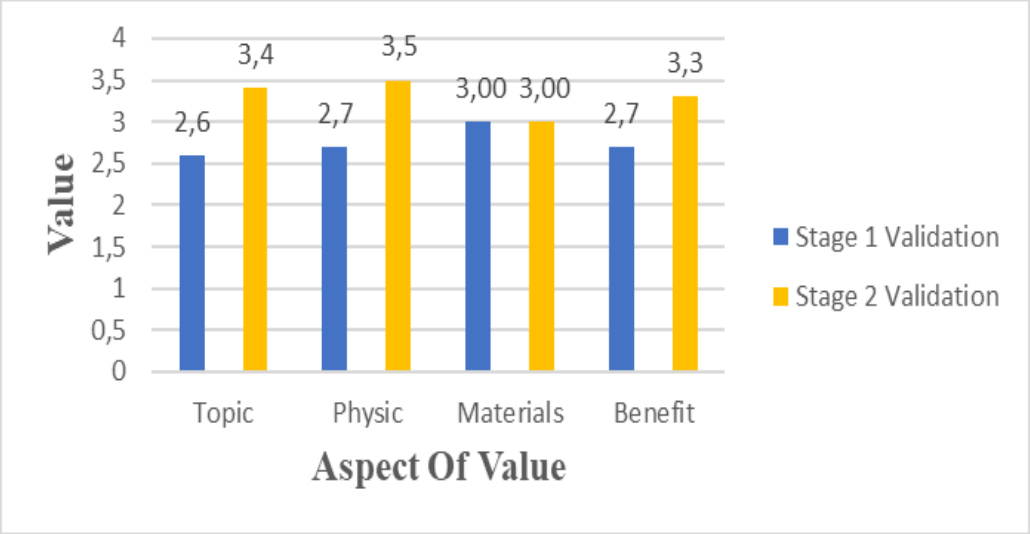

Figure 4. Graph of Average Results of Stage I and Stage II based on Material, Physical, Material and Utilization Aspects.

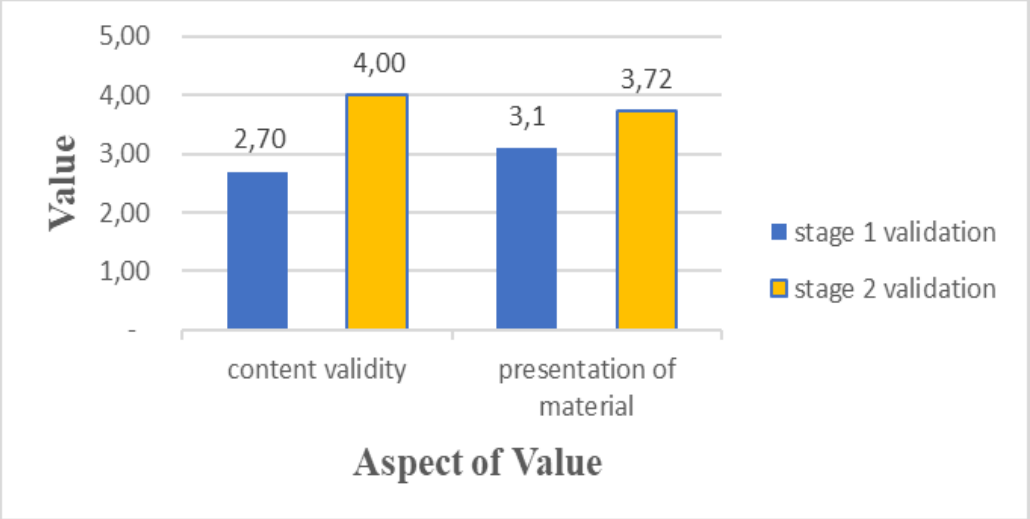

Figure 5. Graph of Average Validation Stage I and Stage II Based on the Feasibility Aspects of the Content and Presentation of the Material

Implementation Stage

At the implementation stages, the researcher applied prototype 3, spatial thinking-based student worksheets. Class X IPA 2 and X IPS 2 are appointed as the research samples. The classes were used as subject instrument validation tests, limited tests, and general tests of student worksheets.

Data from limited test results with high, medium, and low abilities concluded that the spatial thinking-based student worksheet was feasible, with an average value of 3.76, a category "valid/feasible" to use. The general test is focused on testing the attractiveness of student worksheets. The data from the general test results concluded that the student worksheets are suitable for use (prototype 3) with an average final score of 3.87, which has the category "valid/feasible". The effectiveness test of the development results includes validation tests, pre-tests, and post-tests.

Table 1. Recapitulation of Pre-test and Post-test scores

Value	N	Score Ideal	Score Minimum	Score Maximum	Average
Pre-test	20	100	50	72	61.50
Posttest	20	100	75	91	82.05

Table 1 shows the results of the pre-test and post-test. Results pre-test shows a minimum score of 50, a total score of 72, and an average of 61.50. The results post-test shows a minimum score of 75, a maximum score of 91, and an average of 82.05.

Evaluation Stage

At the evaluation stage, there are formative and summative evaluations. In this research, researchers focused more on formative evaluation. Formative assessments were made to analyze the information obtained from research results. Analysis of student needs, curriculum analysis, analysis of student character, product validity by the validator, and student response results. The results of the evaluation stage show that the spatial thinking-based student worksheet is suitable for use during learning.

CONCLUSIONS

The results of student responses on the limited test and general test show an average value of 3.87 (valid/suitable for use). The calculation effect size analysis results are interpreted to see the criteria for the effectiveness of the magnitude of d=0.34, which is in the range of $0.20 < d \leq 0.80$. Based on the category determined by the level of effectiveness, the learning process using spatial thinking-based student worksheets is categorized as efficient with the medium grouping category. The research results and discussions indicate that spatial thinking-based student worksheets are appropriate and effective for learning.

The results of student responses on the limited test and general test show an average value of 3.87. However, a more detailed analysis of the score distribution, such as a histogram or frequency table, would provide a clearer understanding of overall student performance. The interpretation of the effect size analysis could be expanded to provide a deeper understanding of the practical implications of the calculated effect size. Furthermore, including recommendations for further Development of spatial thinking-based worksheets, along with suggestions for adjustments or enhancements that may be necessary to improve their effectiveness in different learning contexts, would enhance the applicability of the research findings.

ACKNOWLEDGMENTS

We extend our heartfelt thanks to the Headmaster and Geography Teachers of SMA Negeri 1 Randangan for their invaluable support throughout this research.

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