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Geography Learning: How to Know the Students Spatial Thinking Ability?

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This research aims to develop an instrument for students' spatial thinking abilities in geography learning. This research uses the ADDIE Research and Development model method. The research subjects were 24 students of class XII IPS 2 at SMA Negeri 1 Kandanghaur, Indonesia. The instrument used is a multiples choice test consisting of six closed questions related to material on rural and urban spatial interactions in geography learning. The indicators developed in preparing the questions are related to spatial thinking skills, namely village and city spatial patterns linked to local regional space, case studies in one's own region, and forms of implementation of spatial interactions. The various questions are prepared first and then expert judgment is carried out. The next step is to test validity, reliability, difficulty index and distinguishing power index in this research. Validity test analysis shows that the six items in the instrument are valid and the reliability of the test instrument is categorized as sufficient. Meanwhile, the level of difficulty is categorized as easy and medium, and the ability to differentiate the questions is included in the good criteria. Thus, the six question items developed can be applied as instruments to measure spatial thinking abilities. Instrument usage is adjusted to various considerations including the characteristics of the students and the class being taught.

Keywords: Geography Learning, Spatial Thinking, Students Spatial Ability

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1. Introduction

Geography as a study of learning in schools always adapts to the demands of student learning needs and current developments (Chang & Kidman, 2019). The needs of each student from one individual to another will be different. Student needs are also related to what each student needs to support their future, such as work and others (Herdlein & Zurner, 2015). Geography in schools today and beyond always supports current developments, especially in 21st century geography learning and achieving sustainable development goals or SDGs (Meadows, 2020; Metoyer, Bednarz, & Bednarz, 2015; Silviariza, Sumarmi, & Handoyo, 2021). This requires several competencies that students must have related to soft skills, hard skills, and sustainable geographical scientific concepts.

Geography learning is a subject in the social sciences group that is studied and taught at senior high school level in Indonesia. Geography has actually been studied at the elementary school and junior high school levels where it is still integrated with social science subjects, so that geography learning does not stand alone as a special field of study. High school level has been studied independently and focused on a special subject, namely geography in the social sciences group. Geography is important to study in school as a provision for students to form integrated cognitive, affective and conative knowledge wisely and wisely regarding the environment in which humans live (Amelia, Ruja, & Susilo, 2018; Novrizal, Rushayati, & Wijayanto, 2019)

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The discipline of geography contains several concepts, principles, aspects and approaches that are part of a unified body of knowledge (Aksa, Utaya, & Bachri, 2019). This research will focus more on geographic approaches, including spatial approaches, environmental approaches, and regional approaches. These three geographic approaches are things that must be integrated in analyzing every geosphere phenomenon (Rahmanelli & Prarikeslan, 2019; Somantri, 2022), for example, when studying flood phenomena, they must be connected to where the flood is located (spatial approach), what causes the flood (environmental approach), and what impact the flood has on the community and surrounding area (regional approach), all three must be present in the analysis of a geosphere phenomenon.

The spatial approach is one of the approaches that is characteristic of geographical studies (Daldjoeni, 2014). Spatial studies are closely related to space and places on the earth's surface which have similarities and differences (Li, Li, Zhang, & Yang, 2017). Spatial assessment can be done directly through field surveys or indirectly using technology. Spatial studies cannot be separated from several tools in analyzing them, namely maps, remote sensing images and geographic information systems. The existence of spatial studies in geography can give rise to the term spatial thinking ability (Suharyono & Amien, 2013).

How important is spatial thinking skills in geography learning?. To answer this question, it can be emphasized on the definitive meaning related to geography as a science that provides studies on the earth and the systems within it which are studied in three approaches, one of which is the spatial approach. This approach is one of the typical approaches to geography that provides a view that the earth is a space. Students' understanding of space must be possessed by students in order to be able to study the earth and interactions with creatures in it. The ability to use a spatial approach will understand geography from a spatial perspective which generally forms spatial intelligence in students.

The spatial thinking ability is generally all scientific studies, such as mathematics, which also has an almost similar term, namely mathematical spatial ability (Hibatullah, Susanto, & Monalisa, 2020). Conceptually, the difference between this and spatial thinking ability in geography lies in the spatial dimension, geography places space in very broad dimensions (Maryani, 2022). Spatial thinking ability is one of the thinking abilities that must be possessed by students who have studied geography (Asiyah & Rosita, 2019). Spatial thinking is related to thinking abilities including science and engineering in an effort to understand several complex spatial elements of the earth's surface through geographic information technology and the like (Nazareth, Newcombe, Shipley, Velazquez, & Weisberg, 2019; Nugraha & Santosa, 2022). Spatial thinking does not have to use sophisticated technology, using little or no technology can also be done. A small example in the classroom of students who have good spatial thinking skills is being able to solve various geographic problems and questions such as location, distance, and others related to the physical and geographical conditions of a place (McLaughlin & Bailey, 2023; Peterson, Weinberger, Uttal, Kolvoord, & Green, 2020).

Much has happened recently regarding students' spatial thinking abilities being only measured using geographic tools such as maps, images and geographic information systems. Of course, the teacher will only focus and be limited to deepening the material on mapping, remote sensing and information systems, while on other geography material it will be difficult to measure students' spatial thinking abilities. Currently there is no measurement of spatial thinking other than using geographic tools. These limitations create this research which is used as a research gap that must be resolved, namely measuring students' spatial thinking abilities through the spatial shape of the earth's surface in urban and rural areas implemented in the area around where students live. This means that measuring spatial thinking can be done without using geographic tools, but can be done through students' local area knowledge. This measurement needs to be developed so that it can be used as an appropriate measuring tool to measure spatial thinking abilities that are relevant to the objectives of this research.

The measurement instrument needs to be in accordance with what will be measured, the meaning is that the purpose of preparing the instrument must be clear and detailed so that the preparation of the questions can measure something for the purpose (Bednarz & Lee, 2019). Based on the facts available in the field, several obstacles were found for geography teachers in developing students' spatial thinking abilities (Aliman, Halek, Lukman, Marni, & Alnursa, 2022). This is because teachers are still rarely able to formulate questions that can stimulate spatial thinking abilities, so far teachers are only limited to measuring students' abilities in learning concepts in each material. This is the reason why researchers are interested in preparing questions to measure spatial thinking abilities. Then the question arises, how do you prepare a multiples choice test instrument that is accurate and can be used to measure students' spatial thinking abilities in material other than mapping? This will be answered through the aim of this research to produce an accurate instrument for measuring students' spatial thinking abilities in high school geography subjects.

2. Method

The research method used in conducting this research is the Research and Development (R&D) method. This method was used by researchers to develop an instrument for measuring students' spatial thinking abilities.

Research and Development research method as a method for developing something that is carried out systematically (Hadi, 2016). This method does not only aim to develop one thing but can be adapted to the needs of what will be developed. This method is a scientific method used to carry out research, design, production and test the validity of the products that have been produced (Sugiyono, 2017). In the Research and Development Method, there are various types of models that differ based on the inventor, and their use is adjusted to the object to be developed, but in general each model has the same purpose and only differs in the syntax or development stages carried out.

One type of Research and Development is the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) development model which is used to produce instrument designs for measuring students' spatial thinking abilities (Creswell, 2019). This model consists of five stages that are arranged systematically and continuously, from before development to after development. The first stage in this model is analysis, examining various problems related to spatial thinking abilities which are still low and the spatial thinking instruments are only limited to mapping material. Calibration of the test question instruments is carried out by adjusting the indicators for measuring spatial thinking abilities on village and city spatial interaction material. The next stage is design, namely by preparing an instrument framework based on spatial thinking ability instruments, Bloom's taxonomy cognitive levels, and learning process indicators. The next stage is development, the instrument framework for measuring spatial thinking abilities that has been prepared is then assessed by geography learning experts (judgment experts) regarding the appropriate material domain, the domain of good question construction, and the linguistic domain that is in accordance with applicable rules. The next stage is implementation, the results of the experts' judgment that has been carried out are then carried out to improve and test the instrument on third grade students at senior high school level with the aim of finding out the extent of students' understanding and ability in working on the question instrument. Next, the researchers tested the validity of the questions, the reliability of the questions, the difficulty level of the questions, and the differentiating power of the questions in measuring students' spatial thinking abilities (Putri, Pertiwi, Arrum, Nurhanifa, & Yuliyanto, 2021). The next stage is evaluation, this stage is the final stage in developing the instrument, namely by considering the instrument that has been prepared by making improvements and improvements if possibles to the instrument before it is distributed by teachers or other researchers in the field of spatial thinking skills.

The subjects of this research were 24 students in class XII IPS 3 at SMA Negeri 1 Kandanghaur, Indramayu Regency. The subjects were determined based on purposive sampling technique. The reasons for selecting samples were based on considerations of development objectives in rural schools between village (Indramayu Regency) and city (Cirebon City) studies, time, research permits, and costs. The class requirements set for the trial are classes that have received village and city spatial interaction material. Consideration: The sample used in this research also met the minimum threshold of 20 students regarding normal distribution.

The characteristics of students used in this research subject are students who have a school and home domicile in the village, so the instrument is arranged based on students' abilities related to students' abilities in understanding the interaction between villages and cities, how students in villages are able to see the spatial interaction of both so that they can improve students' spatial thinking. Students involved in the study were students in grade XII who had studied material related to the interaction of villages and cities as a theme discussed in measuring spatial thinking. Students were given material related to villages and cities as spaces so that their increased abilities in intelligence could be measured.

The limitations in selecting the subjects of this study certainly have some biases that will occur, including the subjects cannot represent all students with heterogeneous characteristics, the instrument can be modified and adjusted to the characteristics of students that will be used to assess spatial thinking skills. outside the limitations of the study, the benefits for use on students who are in rural areas, especially in rural areas that are at the same cover point as the city core area. But further development must be carried out continuously, because the character of the subject will be very easy to change.

This research uses a multiples choice question instrument which includes closed questions which are then adapted to several indicators of success in measuring spatial thinking skills which include rural and urban spatial patterns linked to local area space, case studies in their own area, and forms of implementation of spatial interactions integrated in the material. The lesson is the spatial interaction of villages and cities. The nature of the work or filling of the test instrument is individual. In general, the scoring system specified in the questions is closed or multiple choice, that is, there are only right and wrong answers, the correct answer is given a score of 1 and the wrong answer is given a score of 0, several questions are included as distractors that are quite selective in order to create a variety of student answers that can measure spatial thinking abilities.

A series of tests were carried out systematically to measure the validity of the instrument, the reliability of the instrument, the level of difficulty of the instrument, and the differentiating power of the instrument. Pearson Product Moment correlation coefficient analysis is used in testing the validity of instruments (Utsman, 2015), in testing the reliability of multiples choice questions by paying attention and comparing Cronbach's Alpha values. The difficulty level of the instrument is determined by testing students' correct answers with the total number of students who answered the instrument. Meanwhile, the distinguishing power of the questions is aimed at knowing the quality of the questions in which category. The validity value is based on a predetermined benchmark, namely the Guilford correlation coefficient in this study which has a categorization range from invalid to very high (Putri, et. al., 2021), depicted in Table 1 as follows.

Table 1.

Guilford Correlation Coefficient Classification Related to Instrument Validity Test

No	R Value	Classification
1	0,90 – 1,00	Very High
2	0,70 – 0,89	High
3	0,40 – 0,69	Intermediate
4	0,20 – 0,39	Low
5	0,00 – 0,19	Very Low
6	Less than 0,00	Invalid

The reliability test is based on the reference value of the relevant Guilford coefficient from the validity test specified in the table. If the value of 0.90-1.00 in the validity coefficient is considered very high, then the r value of 0.90-1.00 for the Guilford reliability test is interpreted as very high too. However, the difference in the reliability coefficient lies in the lowest r value which is determined not starting from 0.00 but using a reference of less than 0.20, so it does not need to be illustrated again through a table. The next step after knowing the validity coefficient and reliability coefficient is the level of difficulty of the question instrument which has been prepared with parameters using the following percentages (Susetyo, 2017).

Table 2.

Classification of Correlation Coefficients for Instrument Difficulty Levels

No	Percentage	Classification
1	100% - 86%	Very Easy
2	71% - 85%	Easy
3	31% - 70%	Intermediate
4	16% - 30%	Difficult
5	0% - 15%	Very Difficult

The final test in a series of tests on the suitability of the instrument for use in measuring spatial thinking abilities is testing the discriminating power of the questions. Discriminating power is also called another term, discrimination index, which is a question item that differentiates between students who have spatial thinking abilities and those who do not yet have spatial thinking abilities. The larger the coefficient number, the better the instrument's distinguishing power. Table 3 below describes in detail the differentiating power coefficients of the instruments (Fatimah & Alfath, 2019).

Table 3.

Classification of Instrument Discrimination Correlation Coefficients

No	Coefficients	Classification
1	0,70 – 1,00	Very Good
2	0,40 – 0,69	Good
3	0,20 – 0,39	Intermediate
4	< 0,20	Bad
5	Negative	Very Bad

Several coefficient values are used as the main reference in this research which are then adjusted to the calculation results that have been produced. The final result will be a table of test results on the spatial thinking ability instrument and its classification in the research results. If testing the validity of the instrument, the reliability of the instrument, the level of difficulty of the instrument, and the overall distinguishing power of the instrument meet the requirements, the instrument can be used to measure the spatial thinking abilities of high school students.

3. Results & Discussion

Findings

Based on the research carried out, the research results were obtained, namely a test instrument measuring students' spatial thinking ability. The indicators that researchers have compiled can be described in detail in the following table.

Table 4.

Indicators of Spatial Thinking Ability

Aspects of spatial thinking abilities	Indicator
Rural and urban spatial patterns are associated with local regional space	1.1. A description of the meaning of village spatial patterns is presented in relation to the student's local area of residence. 1.2. A description of the city's development phases is presented.
Case studies in your own region	2.1. The characteristics of village spatial patterns are presented in relation to the students' local area of residence. 2.2. The implementation of urban spatial theory based on city characteristics in students' environments is presented.
A form of implementation of spatial interaction	3.1. The implementation of village and city interactions is presented in case studies of regional development in Indramayu Regency and Cirebon City. 3.2. A discussion is presented regarding the implementation of rural-urban interaction on regional economic development.

The table provides an explanation of several indicators of students' spatial thinking which are generally divided into three aspects, namely rural and urban spatial patterns related to local regional space, case studies of their own region, and forms of implementation of spatial interactions. Each aspect has two indicators, then from these indicators questions are prepared that measure students' spatial thinking abilities. The instrument framework for measuring spatial thinking abilities that was developed in this research was applied to material on village and city spatial interactions in the first semester of the twelfth grade of high school. In order to see more detail, it can be seen in the following table.

Table 5.

Spatial Thinking Ability Instrument Development Design

Based Competence	Subject Matter	Question Indicator	Cognitive Level	Question Number	Question Form	Answer Key
Analyzing distribution patterns and spatial interactions between villages and cities for regional economic development.	Rural spatial patterns	A description of the meaning of village spatial patterns is presented	C2	1	PG	B
		The characteristics of village spatial patterns are presented	C2	2	PG	C
	Urban spatial patterns	A description of urban spatial theory is presented	C1	3	PG	A
		The implementation of urban spatial theory based on the characteristics of cities in students' environments is presented	C3	4	PG	D
	Interaction of villages	A description of the interaction of villages and	C2	5	PG	C

	with cities in regional development	cities in regional development is presented				
		The implementation of village and city interactions is presented in case studies of regional development in Indramayu Regency and Cirebon City	C3	6	PG	A
	Urban development and land conversion	A description of the city's development phases is presented	C2	7	PG	D
		Presented in a case study of land conversion in a nearby city area	C3	8	PG	B
	Rural-urban interaction is related to the distribution of goods and people as well as regional economic development.	An example of the relationship between village-city interaction and the distribution of goods and people in Indramayu Regency and Cirebon City is presented	C2	9	PG	C
		A discussion is presented regarding the implementation of rural-urban interaction on regional economic development	C3	10	PG	A

Based on the results of the assessment carried out by experts (judgment experts) and based on the results of testing the validity, reliability, level of difficulty and distinguishing power of the questions, a decision was made that the spatial thinking ability instrument could be used by teachers and researchers. Some of the suggestions given were that it would be better to sort the questions from low to difficult levels of difficulty, it would be better to use a concept strategy, and embed images on questions that require it. After receiving advice from experts, the researchers made improvements and distributed the instruments back to students.

Validity testing in this research was carried out four times. The large number of tests carried out was due to several tests resulting in several invalid instruments. Researchers here divide the validity of this instrument into four stages as complementary information. Table 6: Initial validity measurements with ten questions distributed in class XII IPS 1 as follows.

Table 6.
Results of Validity Coefficient of Improvement Trial 1

Question Item Number	Correlation Value	Significance
1	0,395	Invalid
2	0,640	Valid
3	0,000	Invalid
4	0,375	Invalid
5	0,000	Invalid
6	0,412	Valid
7	0,326	Invalid
8	0,486	Valid
9	0,401	Invalid
10	0,443	Valid

The first validity test measurement resulted in 60% of the total instruments being declared invalid and another 40% being declared valid with moderate significance because it was above the r table value. The researcher then carried out analysis, evaluation and correction of the invalid question structure. The next stage that was carried out was to distribute the test questions in different classes from the classes that had been tested previously, namely the researcher focused on class XII IPS 2 which can be seen in the following table.

Table 7.

Validity Coefficient Results of Improvement Trial 2

Question Item Number	Correlation Value	Significance
1	0,494	Valid
2	0,653	Valid
3	0,138	Invalid
4	0,405	Valid
5	-0,185	Invalid
6	0,558	Valid
7	0,506	Valid
8	0,232	Invalid
9	0,412	Valid
10	0,491	Valid

Testing the validity of the second instrument has increased the results of valid question items to 70% of all question items, while 30% were declared invalid. Invalid question items were decided not to be included in the instrument, so 7 questions remained. The 7 question items were tested for validity again to obtain a good instrument. The results are listed in Table 8 as follows.

Table 8.

Results of the Validity Coefficient of Improvement Trial 3

Question Item Number	Correlation Value	Significance
1	0,484	Valid
2	0,615	Valid
3	0,544	Valid
4	0,560	Valid
5	0,570	Valid
6	0,373	Invalid
7	0,502	Valid

The results of the seven questions that were tested for validity resulted in one question item being declared invalid, while the other six items were declared valid because they met the r table value. The researcher deleted the invalid question item again. The results of the final and determined validity testing of the instrument can be seen through the visualization in Table 9 as follows.

Table 9.

Validity Test Results on the Spatial Thinking Ability Instrument

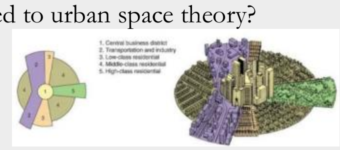
Question Item Number	Correlation Value	Significance
1	0,418	Medium Significance
2	0,599	Medium Significance
3	0,585	Medium Significance
4	0,623	Medium Significance
5	0,588	Medium Significance
6	0,511	Medium Significance
Total correlation of all question items	0,55	

Total of subject	24	
Question Item	6	

Based on the table, information is obtained that there are six multiple choice questions that have been declared valid with a total correlation value for all items of 0.55. Some of the questions set in measuring spatial thinking abilities include numbers 1, 2, 4, 6, 7, and 10. The following table illustrates several questions used in measuring students' spatial thinking because six questions have been declared valid.

Table 10.

Instrument for measuring students' spatial thinking abilities

Indicator of Spatial Thinking Ability	Learning Indicator	Cognitive Level	Question	Question Item
Rural and urban spatial patterns are associated with local regional space	A description of the meaning of village spatial patterns is presented in relation to the local area where students live.	Understanding	Choose the correct statement below related to village spatial patterns! A. Village space is a spatial pattern that forms residential areas and offices that are densely packed with daily activities. B. Village space is a form of spatial appearance such as settlement and land use that is geographically unique. C. The village space is an artificial appearance. D. The village area is a densely populated area.	1
Case studies in your own region	The characteristics of village spatial patterns are presented in relation to the local area of residence of students.	Implementation	After understanding statement number 1, now you must be able to understand the characteristics or characteristics of village spatial patterns. What are the characteristics of village spatial patterns? A. Village spatial patterns are characterized by complex land use. B. The characteristics of the village spatial pattern are dense settlements and narrow open land. C. The spatial pattern of a village is characterized by having settlements close to agricultural land or plantations. D. The spatial pattern of the village is characterized by the existence of individual communities.	2
Case studies in your own region	The implementation of urban spatial theory based on the characteristics of cities in students' environments is presented.	Analysis	The way you study urban space is that you understand what urban space looks like in the area closest to you. Cirebon City is a city located on the seashore or shaped like in the picture. The spatial shape of Cirebon City is related to urban space theory?  A. The spatial form of Cirebon City is an implementation of sectoral theory. B. The spatial form of Cirebon City is very unique and unlike other cities. C. The spatial pattern of Cirebon City is shaped like the multiple core theory. D. The spatial pattern of Cirebon City is shaped like the concentric theory.	3
A form of	The	Implementation	The interaction of villages and cities will	4

implementation of spatial interaction	implementation of village and city interactions is presented in case studies of regional development in Indramayu Regency and Cirebon City.		influence regional development. In the case study of Cirebon City which influences the progress of Indramayu Regency, what is the form of implementation of the interaction between the two? A. Cirebon City as the center of the Ciayumajakuning region coordinates the development of the surrounding areas, including Indramayu Regency. B. Cirebon City, being the central capital of West Java Province, coordinates through Bappeda regarding the development of the surrounding area. C. Cirebon City has the ability to supply natural resources to the surrounding area. D. Indramayu Regency has quality human resources so that it is able to meet the needs of Cirebon City.	
Rural and urban spatial patterns are associated with local regional space	A description of the city's development phases is presented.	Understanding	The current city was not formed quickly. Big cities have also undergone long changes since they were still agricultural cities. The following are the phases of city development according to Lewis Munford which start from the birth of a city to the destruction of the city, choose the right answer! A. Necropolis, Tryanopolis, Polis, Neopolis, and Biopolis. B. Megapolis, Polis, Eopolis, Necropolis, and Tryanopolis. C. Nekropolis, Tryanopolis, Polis, Eopolis, Megapolis, Metropolis, and Biopori. D. Eopolis, Polis, Metropolis, Megapolis, Tryanopolis, and Necropolis.	5
A form of implementation of spatial interaction	A discussion is presented regarding the implementation of rural-urban interaction on regional economic development.	Analysis	The interaction of villages and cities can also make regional economic development more rapid. Which of the following is a manifestation of regional economic development as a result of the interaction of villages and cities? A. Villages have many investors coming in, while the city's needs regarding natural resources are met. B. Urban areas influence the social conditions of rural communities. C. Rural areas that have a strong culture will be able to weaken the culture in urban areas. D. Only the urban economic sector will develop rapidly as a result of the interaction of villages and cities.	6

As for the results of the six question items, moderate validity was found, namely in the correlation range of 0.40 to 0.70, so that the instrument could be suitable for continuing to test its reliability. The next stage of testing was reliability testing using the SPSS 23 tool with a total of six valid questions. The instrument reliability results can be seen in Table 11 below.

Table 11.

Reliability Test Results of the Spatial Thinking Ability Instrument

Subject Number	Subject Initial	1	2	3	4	5	6	Total Score
1	MP	1	0	0	0	0	0	1
2	GA	1	1	1	0	0	0	3
3	HS	0	0	0	0	0	0	0
4	AS	1	1	0	0	1	0	3
5	Ay	1	1	1	1	1	1	6
6	AS	1	0	1	1	0	1	4
7	Is	0	1	0	0	1	1	3
8	Ls	1	1	0	0	1	1	4
9	SRN	0	1	1	1	1	0	4
10	Ar	1	1	1	0	1	0	4
11	Re	0	1	0	0	1	1	3
12	We	0	1	1	0	1	1	4
13	ZM	1	1	1	0	1	0	4
14	IE	1	1	1	1	1	1	6
15	Na	1	1	0	1	1	0	4
16	GD	1	1	1	1	1	1	6
17	Wi	1	1	1	1	1	1	6
18	DA	1	1	1	1	1	0	5
19	AA	1	1	1	1	1	1	6
20	FS	1	1	0	1	1	1	5
21	Pu	1	1	1	0	1	0	4
22	PR	1	1	0	1	0	0	3
23	SH	1	1	1	1	0	0	4
24	AA	1	1	1	0	1	0	4
Standard Deviation	1,504 ; 4,00	Mean:						
Instrument Reliability	0,538							

Based on this table, it can be concluded that the results of the reliability test on the six items on the spatial thinking instrument show 0.538 > the table value of 0.404. Even though it is declared reliable, the Cronbach's Alpha value shows the medium category with an alpha range of 0.40-0.70, while the standard deviation is 1.504. The test results for the question difficulty index can be shown in Table 12 as follows.

Table 12.

Instrument Difficulty Index Test Results

Question Item Number	Level of Difficulty (%)	Interpretation
1	79%	Easy
2	91%	Very Easy
3	62%	Medium
4	50%	Medium
5	75%	Easy
6	46%	Medium

Based on this table, the results show that the instrument difficulty index varies from medium difficulty, easy, and very easy. Of course, if it is related to the preparation of question items in the future, if teachers use them to measure students' spatial thinking abilities, they can be prepared independently by the teacher according to the indicators that researchers have developed.

Table 13.

Instrument Discrimination Power Test Results

Question Item Number	Discrimination Index	Interpretation
1	0,155	Bad
2	0,424	Good
3	0,301	Intermediate
4	0,340	Intermediate
5	0,342	Intermediate
6	0,197	Bad

Based on this table, it was found that the test of differentiating power of questions was only 30% of the total instrument items which could not differentiate abilities between students. Meanwhile, the other 70% were able to differentiate each student's spatial thinking abilities or categorized them as good and moderate. As for other instrument development research that has relevance to the research conducted, namely the results of the analysis found that 70% of instruments can differentiate spatial thinking abilities, there are even instrument developments that are lower than 50% (Aliman, et. al., 2020). This instrument is only a tool for measuring students' spatial thinking abilities. If it is used to improve students' spatial thinking abilities, this instrument will be further improved so that the distinguishing power of questions can be spread across easy, medium and difficult question categories.

Discussion

The instrument for measuring spatial thinking abilities of high school level students in geography subjects was carried out in stages using Research and Development, the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model (Nurulhasni, Nurbaiti, Nabila, & Jumadi, 2023), preceded by the preparation of spatial thinking question items which were applied in the spatial interaction material. villages and cities. The preparation of the question grid or instrument design is carried out by paying attention to indicators of spatial thinking and learning subject matter. Each question item is then reviewed by an expert (judgment expert), and then the results of the expert review are revised and improved on the question item based on expert advice (Brownstein, Louis, O'Hagan, & Pendergast, 2019). After that, the instrument was tested with 24 students in class.

After testing the instrument, a series of tests were carried out, namely testing the validity of the instrument, reliability of the instrument, level of difficulty of the instrument, and testing the differentiating power of the instrument. The first process of testing the validity of the instrument resulted in 60% or 6 question items out of a total of 10 instrument question items being declared invalid. This requires researchers to re-analyze invalid instruments based on suggestions from expert judgment results. The second process was carried out in a second trial in a different class, namely class XII IPS 2 with the same number of 24 students. The results of the validity test in the second trial increased the validity value by 70% or 7 question items out of a total of 10 question items were declared valid. The researcher decided that 30% or 3 question items from the total 10 instrument items that were invalid were declared deleted or eliminated, so that only 7 instrument items were used. Based on this, the research subject determined in this study was class 6 question items which as a whole represent all indicators of spatial thinking. A total of six instrument items have been declared as a whole to meet the validity of the instrument. The r_{xy} value on this 6 questions instrument was found to be 0.55 with a value range of 0.418-0.623, so that reliability testing could be carried out.

Instrument reliability testing was carried out after knowing several instrument question items which were declared valid (Bolarinwa, 2015). This is the main reference in testing reliability, so the long process lies in testing validity, because the instrument must be truly valid and then reliability testing can be carried out. Previous researchers tried to test reliability with the majority of answers being invalid which turned out to have an impact on low or even very low reliability figures. Testing the reliability of the instrument for measuring spatial thinking ability, the figure was 0.538, greater than the value in the table of 0.404. This means that the entire instrument is declared reliable because it meets the reliability requirements of an instrument. The Cronbach's Alpha figure is in the alpha range of 0.40-0.70, which is included in the moderate reliability category.

The next step is to test the difficulty level of the items on the spatial thinking ability instrument to determine the ease and difficulty of an instrument when done by students (Soeharto & Csapó, 2021). Based on the instrument measuring spatial thinking ability, the results of testing the instrument's complexity index were 45% to 91%, which means that the question items were in the easy to medium category with a balanced composition, but the researchers had not found any questions in the difficult category. Even though there are no difficult questions, it is hoped that teachers who will use this instrument can improve it a little so that the complexity of the questions can be spread out and ideally range from low, medium to high levels of difficulty. Specifically, each item of the instrument can be described, namely in question item 1 it is obtained 79% or if in another version it is 0.79, question item 2 is obtained 91% or 0.91, a very high number, meaning the question is very easy to do, question item 3 is obtained 62% or 0.61, item number 4 got 50% or 0.50, meaning half of the students answered right and wrong, question item number 5 got 75% or 0.75, and finally question item 6 got 46% or 0.46 which has the most difficult question items on this instrument but is still in the medium difficulty range.

The final testing stage is testing the differences in spatial thinking skills instruments. Based on the spatial thinking instrument in this research, the results showed that 70% of the items from the entire instrument were declared good. However, 30% of the question items from the entire instrument have low differences. In terms of percentages, this instrument does not overall have good differentiating power, and this is a point of improvement in future research. However, if you pay attention to the development of other spatial thinking instruments carried out by other researchers, it was found that 70% of the question items met good differentiation power (Aliman, Mutia, Halek, Hasanah, & Muhammad, 2020), even other instruments also had under 50% of the question items meeting good differentiation. In future research, this imperfect instrument will be refined to measure the instrument for measuring students' spatial thinking abilities.

4. Conclusion

The instrument for measuring students' spatial thinking abilities has been stated to be able to be used as a whole, consisting of 6 question items, and 5 indicators of spatial thinking at the high school level in geography learning. This is based on the results of a review from an expert (judgment expert) along with a series of tests, namely instrument validity test, instrument reliability test, instrument difficulty index test, and instrument discrimination test which are declared to have met the requirements for further use by teachers and other researchers. will use an instrument to measure spatial thinking abilities. It is recommended that the question difficulty index be spread from easy, medium and difficult, and the question discrimination power is very good if we are trying to improve students' spatial thinking abilities.

5. Reference

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