

Design of *PISA*-liked problem which used *jember fashion carnival* context to train students' analytical thinking

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Abstract. This study aims to develop PISA-liked problem which used Jember Fashion Carnival as it is context to support students' analytical thinking. The PISA-liked problem then tested to 15 junior high school students at grade 8. This research is designed based on Ploomp model that satisfied validity, practicality, and effectiveness. Our analysis shows that PISAliked problem with JFC context was valid because the expert said that those items were valid with the score of 0.77. It's also supported by the analysis of validity test which shows 0.63. Secondly, the problem was practical, because the students' response was positive with 0.85 students answered so. Thirdly, the design also called effective, because it was reliable about 0.57. Meanwhile, around 0.73 among the students can use their analytical thinking and give reasons when they have to find the correct answer. Their strategies were connecting the problem to their prior knowledge and predict the solution.

1. Introduction

Mathematics is learning concepts, so learning mathematics requires special ways of learning and teaching. Indonesia government has standardized (measured) the mathematical abilities of students at all levels stated in the National Examination (UN). The benchmarks of the achievement of Indonesian students internationally can be seen from their participation in the tests that held internationally which are commonly known as the *PISA (Programme for International Student Assessment)*. This raises a question that is addressed to the questions used in the two measurements of achievement. Because there are significant differences related to student achievement nationally as measured by the NE and international student achievement measured through PISA [1]. The percentage of scores of Indonesian students is very low compared to other countries in solving high level questions at PISA [2].

According to Dewi Astuti this was influenced by the low ability of students to solve problems at high level PISA questions which were closely related to the thinking abilities of Indonesian students [3]. The ability to think of students is closely related to the thought process that is born from a curiosity about something and the desire to obtain a provision, which then grows into a specific problem[4]. One of the important thinking skills mastered by students is the ability to think analytically. Bloom states that the ability to think analytically emphasizes the breakdown of matter into specific or small parts and detects the relationships of the parts and organizes it [5]. The ability of analytical thinking can make it easier for students to think logically, about the relationship between concepts and situations they face. The ability of this analysis can be trained by practicing to solve question/problem, because by giving questions, students can train their problem solving ability. One of the questions that can be used here is the PISA question, a question that requires a lot of analysis from the students who are working on it. Mostly, PISA-liked problem is represented in a daily life problems.

Freudenthal argues that mathematics must be related to reality, close to children, and relevant to people's lives in order to have human values [6]. This value makes mathematics not a subject but more a human activities. One context that can be built is to use local wisdom [7]. Local wisdom is quite unique to be used and introduced in the school institutions, including local wisdom of Jember [8]. There are various local wisdoms in the Jember region such as JFC (Jember Fashion Carnival), Lahbako Dance,



suwar-suwir food, stilts, tak buta'an, can macanan kadduk, petik laut, etc. Local wisdom can be inserted and utilized in training students' abilities through PISA questions. Based on that description, by knowing the low achievements of the Indonesian students in PISA and the unique local wisdom of Jember, researchers are interested in researching the development of PISA model question based on local wisdom of Jember to train student's analytical thinking skill.

PISA is an international standard test that assesses three literacy abilities, namely reading (literacy), mathematics (mathematical literacy), and science (scientific literacy). PISA measures the ability of students at the age of 15 years or the end of the age of compulsory education to determine the readiness of students to face the society. The assessment carried out in PISA is future-oriented, namely testing the ability of young people to use their skills and knowledge in dealing with real-life challenges, not merely measuring the abilities included in the school curriculum [9].

In PISA 2015, the observed mathematical content is divided into four parts, namely: change and relationship, space and shape, quantity and uncertainty and data. Furthermore, the mathematical literacy assessment framework states that the ability of the process involves three important things as follows: 1) Formulating mathematical problems. 2) Using mathematical concepts, facts, procedures, and reasoning. 3) Interpret, apply and evaluate mathematical results. PISA establishes and uses four context categories to classify assessment items developed for the PISA survey as personal, educational and occupational, social and scientific [2]. The existence of context categories in mathematical literacy can show various uses of mathematics both for personal and global problem solving.

The PISA type math problem format must include three components, namely: the component content, process, context and must also be adjusted to the level of mathematical ability in PISA. According to Shiel, the PISA type question format is divided into five different question forms, namely: 1) Traditional multiple-choice items, i.e. multiple choice question in which students choose alternative simple answers (20% of the total items). 2) Complex multiple-choice items, i.e. the form of multiple choice questions in which students choose alternative answers rather complex (13% of the total items). 3) Closed constructed response items, i.e. the form of questions that require students to answer in the form of numbers or other forms that are closed (15% of the total items). 4) Shortresponse items, i.e. questions that require a short answer (27% of the total items). 5) Open-constructed response item, i.e. the questions that must be answered with an open description (25% of the total items) [10]. Every types of question has their own characteristics in fascilitating some one's thinking ability.

Formally, Siswono believe there are several types of thinking. The first level of thinking is recall, which is a reminder that includes thinking skills that are almost automatic and reflexive, such as remembering basic mathematical operations [11]. This level is a level in thinking that does not require reasoning. While the next level is the level of thinking that requires reasoning. The level above recall is basic, that is understanding and recognition of mathematical concepts. Critical thinking is at the third level while creative thinking is at the highest level. Creative thinking is original, reflective thinking and produces complex concepts. Local wisdom is the wisdom or noble values contained in the wealth of local culture in the form of traditions and life motto. Local wisdom embraced by the local community stems from an entrenched tradition. The present and future cannot be separated from what the community did in the past. Then culture as a legacy of the past must be maintained, respected, and preserved. Setiawan explained that there are a variety of arts and culture and local wisdom of Jember including jaranan art, canadian kadud, patrol music, batik sumber jambe, cage kneeling handicraft, suwar-suwir food, tobacco farming, batik with Tobacco motif (Batik Labako) and also Carnaval which is well known Internationally named JFC (Jember Fashion Carnival) [12].

Jember Fashion Carnival is a moment held by JFC foundation. JFC Foundation as a manager has a 4E concept in its activities, namely education, entertainment, exhibition, and economic benefits [13]. The concept of education or participants' education is by giving the knowledge about fashion design, fashion run way, fashion dance, presenters, and make up. With this ability, participants are expected to be able to make new creative ideas and entrepreneurial spirit. As an exclusive event, the concept of

entertainment is also a priority in organizing JFC. This entertainment is expected to be felt by the public as a whole from all profession, age, education, economic background and so on

2. Methodology

The type of research that will be carried out is research and development (R&D) because the researcher develops the PISA model question based on local wisdom of Jember. In this question research development, researchers modified the development of the Plomp model into 4 phases, including: (1) the initial investigation phase, (2) the design phase, (3) the realization / construction phase, and (4) the test, evaluation, and revision phase [14]. The implementation phase in terms of implementing solutions that developed in the problem situation is not carried out in this study. This is based on the reason that this research is a development research whose orientation is to produce the products according to the established criteria. To achieve these criteria can be done with trials, evaluations, and revisions. In addition, this study does not aim to make generalizations so that the implementation phase is not carried out. Researchers used several techniques including test techniques carried out by testing / giving PISA model questions to designated students. This technique is used by researchers to find out the achievements of MTs students on solving PISA model problems. In addition, this technique will be used to test the validity of the question development construct which will be analyzed quantitatively, as well as the reliability of the PISA model questions that have been developed. This test technique aims to obtain data that used in the analysis of the instrument's effectiveness. The documentation technique is done by looking at students' written answers to the PISA model problems that are tested. Interviews were conducted to obtain in-depth data related to tests and documentation that conducted by researchers. The questionnaire technique was used by the researchers. It was consist of two forms, namely the PISA model questions' development validity questionnaire and the student response questionnaire towards the development of the PISA model questions. The subjects in this study are 64 students of MTs Negeri 1 Jember

3. Result and Discussion

This development research was conducted to produce PISA model mathematical problems using local wisdom of Jember Region as a context for class VIII MTs that fulfill the valid, practical, and effective categories. Therefore, it was conducted one trial on this study. Researcher found several things from this research, based on the steps of Ploom development process, those are

3.1. Preliminary Investigation Phase

In this phase, identification and review of the mathematics 2013 curriculum, student analysis, material analysis, and possible wisdom analysis of the context of Jember Fashion Carnival were done. The results of the initial investigation are as follows..

3.1.1 Curriculum Analysis

The curriculum used in developing the PISA model mathematical problems using local wisdom in Jember Region refers to the 2013 curriculum. Based on Permendikbud No. 37 of 2018 it is stated that in the 2013 curriculum, learning is designed to follow four core competencies. The four core competencies cover spiritual, social, knowledge and skills aspects. The 2013 curriculum also uses a scientific approach which includes observing, questioning, gathering information (Experimenting), associating/processing information, and communicating. Based on the demands of the 2013 curriculum which have been stated previously it is known that in the 2013 curriculum students are expected to master skills such as observing, asking, reasoning, trying, making hypotheses and proving it, as well as the ability to write coherently based on facts or phenomenon. So that it takes math problems that facilitate students to think critically and creatively, especially in solving daily problems.

3.1.2 Student Analysis

Student analysis aims to examine the students' achievements related to the curriculum and content that has been obtained by students in class VII. The results from interviews with several teachers obtained the following findings.

- a. Students' knowledge of the local wisdom of Jember Region, after conducting interviews with several students, they did not know much about Jember's local wisdom. Some even feel unfamiliar with the term or type of local wisdom in Jember. However, there are also some students who know the local wisdom only by name, and do not know the exact characteristics of the local wisdom tersebut.
- b. Background knowledge of students, students have received all the basic competencies and core competencies in mathematics according to 2013 curriculum well. This is shown from the scores obtained by students at the end of semester assessment that has reached the specified competency standards.
- c. Students' cognitive development, grade VII and VIII students of MTs Negeri 1 Jember have an age between 12-14 years. Piaget assumed that at that age a child had entered the formal operations stage so that students had been considered capable enough to use logic and reason. At that stage, students have been able to think abstractly, they no longer depend on things that are direct or real. Therefore, it is very possible that students at this stage are able to complete more abstract tasks systematically. Based on the students' cognitive development level, it is possible that they can complete the series of tasks well [15].
- d. Implementation of 2013 curriculum, so far the teacher has implemented the 2013 curriculum well. This started from 2015 until now, using the 2013 curriculum. In addition, based on the teacher's information, the teacher has also implemented competencies that have been mandated by the curriculum, namely creating a 5M atmosphere (observing, asking, gathering information, associating / processing information, and communicating). However, in solving problems and learning, the teacher rarely starts by using the real context as a starting point for learning mathematics. The teachers more often use classic ways, namely explaining by using example non-example way to explain a mathematical concept. This is contrary to the main goal of mathematics, which is to solve real-world problems.

3.1.3. Jember Local Wisdom Analysis (Jember Fashion Carnival)

Jember Fashion Carnival is a moment held by JFC foundation. JFC Foundation as a manager has a 4E concept in its activities, namely education, entertainment, exhibition, and economic benefits. The concept of education or participants' education is by giving the knowledge about fashion design, fashion run way, fashion dance, presenters, and make up. With this ability, participants are expected to be able to make new creative ideas and entrepreneurial spirit. As an exclusive event, the concept of entertainment is also a priority in organizing JFC. This entertainment is expected to be felt by the public as a whole from all profession, age, education, economic background and so on.



Figure 1. Jember Fashion Carnival Moment

JFC is also used as an exhibition or as a display media for all activities related to costume design art, sound system art, and tourism promotion in Jember Region. This concept also makes JFC as a center for the study of Fashion Carnaval which is a trendsetter of several other cities in Indonesia. Based on the fact of how big the JFC moment is, there are some aspects that are used as context in the development of the PISA model mathematical problem. The aspects used as context can be seen in table 1 below.

Table 1. Cultural Aspect as Specific Context in Jember Fashion Carnival (JFC)

Aspect	Specific Context
Re-setting the Traffic Way in Jember	Finding an optimal path to go to certain place as the impact of JFC event
Booked Hotel	The impact of hotel existence for JFC moment
Economic Field	Local income gotten by the Jember Affected Governemt from the Event of JFC

3.2. Designing and Realisation Phase

In this phase researcher designed the prototype based on the theory. Then, tried to implemented it in to a piece of paper which consist of several question of PISA-liked question using *Jember Fashion Carnival Context*. In addition, instruments that needed in the activity (validation sheet) were designed. Prototype 1 and research instruments were discussed with the research team to be repaired until a prototype was ready to be tested. The fixed model are illustrated at Figure 2, 3 and 4 below and then followed by the questions:

Question Number 1

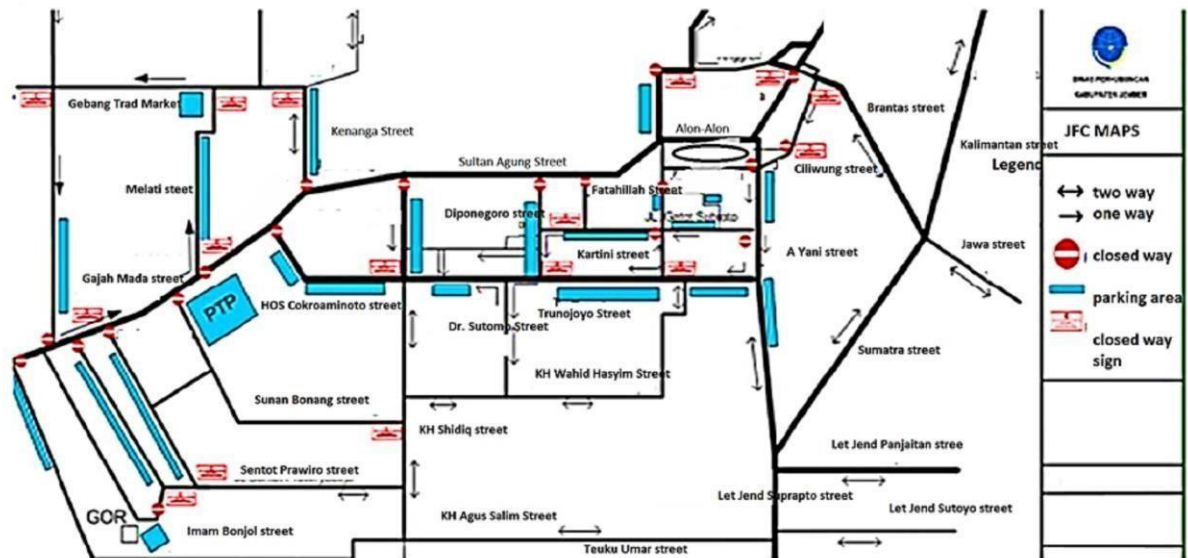


Figure 2. PISA-like Problem at Re-setting of Traffic Way in Jember context (Question Number 1)

The blue color shows the parking area provided by the committee of JFC for all audience (non-tribune session). Andi lives in the corner of the junction of Dr. Sutomo street and KH. Wachid Hasyim street. Where should Andi park his motorcycle to get the best view and the most appropriate place whne he has to consider about the distance of his home, the distance of the track, and the parking area? Explain your conclusion!

Question number 2

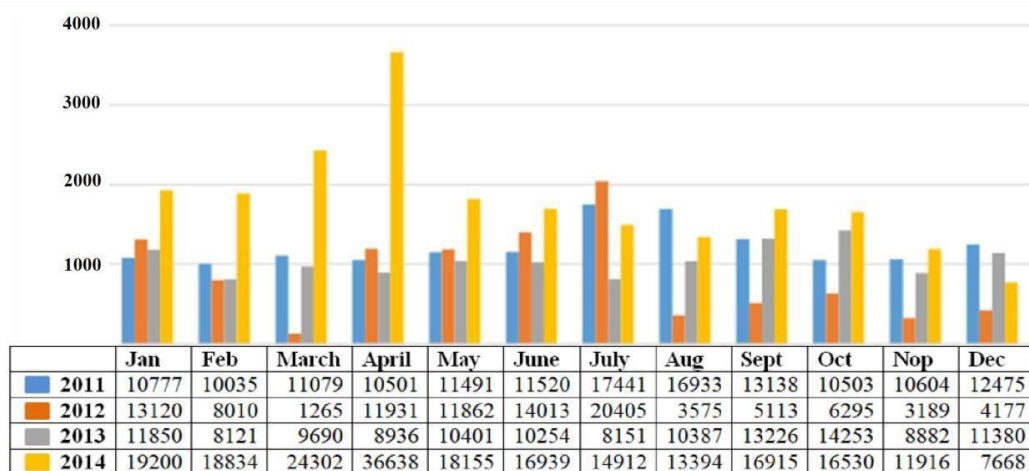


Figure 3. PISA-like Problem at Impact of Hotel Existance to JFC Moment (Question Number 2)

Those data shows the visiting time of guesses from several hotel in Jember. January, July and December are the *peak season* because in that period is holiday session.

1. How many people who are visiting the hotel in Jember when JFC moment is happening on August and September based on that data from 2011 to 2014? Explain it!
2. In what month the decreasing of moment happen in 2011 to 2014? What is the number of decrease from the visitors? Explain it!

Question Number 3

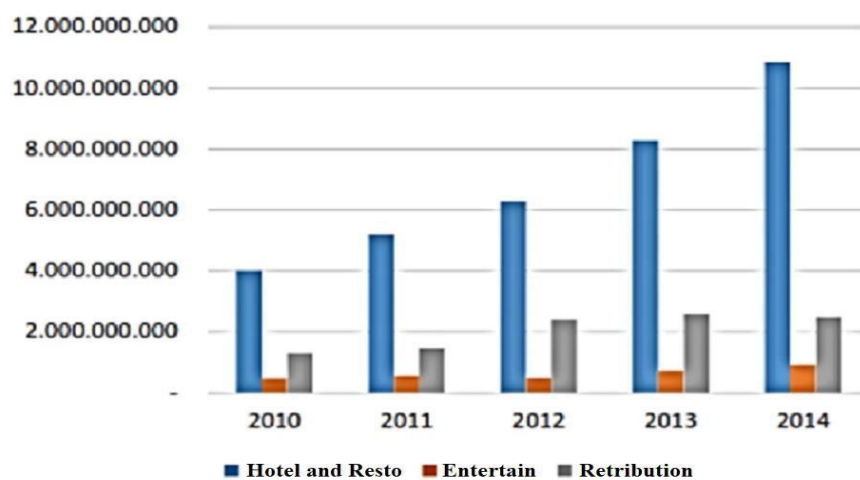


Figure 4. PISA-like Problem at Affected Economic Field in Jember context (Question Number 3)

Look at the chart above. The data is about Jember regional income from 3 sectors as the effect of JFC moment.

1. How much of Jember's income at the sector of retribution in 2015? Explain your solution!
2. In which sector the rise is significantly happen from 2010 to 2014? Explain it!

3.3. Test, Evaluation, and Revision Phase

3.3.1. Expert Review

Expert review is a prototype 1 validation stage qualitatively that is in terms of content, construct and language. The question set was consulted with experts and colleagues who had experience in mathematics education as validators. The prototype I validation process is done through face-to-face review [14]. Following are the names of experts as validators involved in the expert review stage.

Table 2. Expert Review Result and Identity

Name	Academic Status	Institution	Expertise	Score of Expert Validity
M. Faizal Amir, M.Pd.	Doctoral Students on	The State University of	Mathematics education (Cognitive	0.81
	Mathematics education	Malang	Analysis)	
Dr. Umi Farihah, M.Pd., M.M.	Mathematics Lecturer	The State Institute for Islamic Studies of Jember	Mathematics Education (Sources of Learning)	0.75
Anas Makruf Anizar, M.Pd.	Mathematics Lecturer	The State Institute for Islamic Studies of Jember	Mathematics Education (Learning Design)	0.74
Pipit Firmanti, M.Pd.	Mathematics Lecturer	The State Institute for Islamic Studies of Batusangkar, Padang	Mathematics Education (Realistic Mathematics Education)	0.78
		Average		0.77

From those score, it can be seen that all of the expert said that the validity is over of 0.75 and got the average score of 0.77. From the criteria of Arikunto, it shows that the mathematics PISA-like problem which use JFC context is valid and can be used [14]. However, some expert also said that there must be a minor revision to make it fixed.

Implementation at Some Students to analyze students' analytical thinking researchers generate indicators in measuring their analytical thinking. Those indicators then convert into scales which represents every ability. This scale consist of 0 – 4 scale which has specific ability of analytical thinking. These abilities then used in several activities like validity test and reliability test. The indicators to value students' analytical thinking can be seen in the table 4. below

Table 3. The Indicators on Analytical Thinking

Scale	Ability
• 0	<ul style="list-style-type: none"> Students write the given information correctly Students failed to determinethe solution using logical reasoning and without any explanation for the correct answer.

- Students write the given information and success to categorised the relevant and 1 irrelevant information to solve the problem
Students answer the question partly correct (correct in certain part), however they
- cannot give any clear-reason for their answer.
- Students write what is given, and separate what is needed and not-needed to solve the problem
- Students write the correct answer by giving ambiguous and unclear reason (only 2 based on their insight)
- Students write the answer using some mathematical facts outside the given information to connect with the given information to solve the problem
- Students give structured/unstructured answer, however it cannot be tracked the validity of the answer authentically

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- | | |
|---|--|
| 3 | <ul style="list-style-type: none"> • Students write what is given, and separate what is needed and not-needed to solve the problem • Students write the correct answer by giving reason, however they cannot exactly explain where it comes from (only based on their insight) • Students write the answer using some mathematical facts, concept, principle, and other mathematical object outside the given information to connect with the given information to solve the problem even there is minor mistakes • Students give structured/unstructured answer, and it can be tracked the validity of the answer authentically • Students write what is given, and separate what is needed and not-needed to solve the problem • Students write the correct answer by giving reason, however they cannot exactly explain where it comes from (only based on their insight) |
| 4 | <ul style="list-style-type: none"> • Students write the answer using some mathematical facts, concept, principle, and other mathematical object outside the given information to connect with the given information to solve the problem correctly • Students give structured answer, and it can be tracked the validity of the answer authentically |
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There are some students participate in this research as the subject. Actually there are 64 students, which consist of 31 grade 7th and 33 from grade 8th, while there are 32 male students in total and the other are female. Students ability in solving PISA-liked problem using Jember Fashion Carnival Context can be seen in the table 4 below.

Table 4. The Data of Students as Research Subject who Passed the Criteria

Grade	Sex		Total (N/%)
	Male (N/%)	Female (N/%)	
Grade 7th	13/0.20	9/0.14	22/0.34
Grade 8th	12/0.19	13/0.20	25/0.39
Total (N/%)	25/0.39	46/0.73	47/0.73

It can be seen from the table that there are 22 students at grade 7th (around 0.34) and 25 students at grade 8th (around 0.39) who passed the criteria. The criteria in this research means those who can give analytical thinking in solving PISA-like problem.

3.3.2. Validity test

Data obtained through the tests to students are analyzed, and compared with the validity and reliability criteria that have been made. The validity calculation result of each question and its average can be seen below:

Table 5. The results of the validity analysis of the PISA model questions with JFC context.

Number	Validity coefficient	Validity category
1	0.48	Enough
2	0.63	High
3	0.78	So High
Average	0.63	So High

Based on the validity criteria of items that have been determined, an item is said to be valid if the validity coefficient is more than 0.4 or at least in the moderate or sufficient category. The analysis shows that the validity of items included in the category is **sufficient, high or very high** so that the PISA model using Jember Fashion Carnival context can be said to be **valid** with a score of 0.63.

3.3.3. Reliability test

In accordance with the test's reliability coefficient calculation procedure, the result of the reliability coefficient calculation of the items is 0.57. Based on the reliability criteria of items that have been set, the test results are said to be reliable if the reliability coefficient is more than equal to 0.40 or at least in the medium category. The results of the analysis show that the item reliability is included in the high category so that the PISA model mathematical problems using the context of Jember Fashion Carnival can be said to be reliable and can be used.

3.3.4. Students' Response

The results of giving questionnaires to students at the end of the application of PISA model questions with the context of Jember Fashion Carnival, showed that the average percentage of students who responded positively was 0.85. Based on the established criteria it can be said that students' responses to the learning were positive.

3.3.5. The achievement of Developed PISA-liked Problem by Using Jember Fashion Carnival as the Context

The success of developing PISA-liked problem using Jember Fashion Carnival context can be seen from the path of development model by Ploomp which satisfy validity, practicality, and effectiveness. Those achievement can be seen from the table 6 below

Table 6. The Achievement of validity, practicality, and effectiveness

No	Category	Official Statement
1	Students analytical thinking	Good
2	Expert validity	Valid
3	Validity test	Valid
4	Students response (practicality)	Prositive
5	Reliability (Effectiveness)	Reliable

It can be seen from the table 7 above that PISA-liked problem with JFC context was valid because the expert said that those items were valid with the score of 0.77. It's also supported by the analysis of validity test which shows $r_{xy} = 0.63$. Secondly, the problem was practical, because the students' response was positive with 0.85 students answered so. Thirdly, the design also called effective, because it was reliable because can reach $\alpha = 0.57$. Meanwhile, around 0.73 among the students can use their analytical thinking and give reasons when they have to find the correct answer. Their strategies were connecting the problem to their prior knowledge and predict the solution. Based on those result in can be said that the development of PISA-liked problem by using Jember Fashion Carnival as the context to facilitate students' analytical thinking is good.

4. Discussion

Based on the analysis data, the number of students who can solve the problems is higher than those who cannot solve the problem. Those students actually can give their reason well and they relate several mathematical objects to solve the problem. This inline with the research of Putra's research which said that in solving the problem, students who passed the criteria, are able to conect their previously knowledge to solve the problem [1]. It shows that they can used their analitycal thinking.it shows that PISA problem can be used to train analytical thinking of students in solving mathematics problem. Beside they were good in solving the problems; they were also good in their score. It can be seen from the post-test after researchers implemented the problems.

The potential effect also faced by students when they solve the problem. They felt that using context especially jember fashion carnival, is really helpful to them. They felt that mathematics actually close to their daily life. This shows that the development of PISA-liked problem using JFC context generate students' interest, and motivation so that they are challenged to solve the question [16]. In this research, this data can be seen from students' response about development of PISA-liked problem.

The result of this research also supported by Martani who stated that PISA-liked problem can be used to train students' logical reasoning [3]. Students' were forced to use their own idea in solving the problem. For more, they can use their unstructured way or even structured way. Her research was developing PISA-liked problem as well to train reasoning ability in solving mathematics. Even though

some of developed problem cannot be solved well, her analysis of the data showed that it still could be said that the instrument can be used to train students' reasoning ability.

5. Conclusion

Based on data analysis results and results' discussion of PISA model mathematical problem development research with the context of Jember Fashion Carnival (JFC), the following conclusions are obtained: 1. The PISA model mathematical problem development with the context of Jember Fashion Carnival

(JFC) in this study adapted the Plomp development model which consisted of five phases. But in this study only limited until the fourth phase. The four phases are as follows.. a. Initial Investigation Phase

In this phase, identification and study of the mathematics curriculum, student analysis, the context of the Jember fashion carnival and the analysis of mathematical material are done for identifying, detailing and systematically compiling the main parts of the PISA model mathematical problems with the context of Jember Fashion Carnival (JFC)

b. Design and Realization Phase

In this phase, the PISA model mathematical problems is designed with the context of Jember Fashion Carnival (JFC) as well as instruments' research that include expert validation sheets and student response questionnaires. After that, it was continued with the realization in the form of a paper and pencil about the PISA model mathematical problems with the context of Jember Fashion Carnival (JFC)

c. Test, Evaluation and Revision Phase

In this phase, the validation, revision, and prototype trials of PISA model mathematical problems with the context of Jember Fashion Carnival (JFC) are done to produce the good PISA model mathematical problems with the context of Jember Fashion Carnival (JFC), that fulfill the valid, practical, and effective categories..

2. PISA-liked problem with JFC context was valid because the expert said that those items were valid with the score of 0.77. It's also supported by the analysis of validity test which shows $r_{xy} = 0.63$. Secondly, the problem was practical, because the students' response was positive with 0.85 students answered so. Thirdly, the design also called effective, because it was reliable because can reach $\alpha = 0.57$. Meanwhile, around 0.73 among the students can use their analytical thinking and give reasons when they have to find the correct answer.

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