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DEVELOPMENT AND VALIDITY OF MATHEMATICAL LEARNING ASSESSMENT INSTRUMENTS BASED ON MULTIPLE INTELLIGENCE

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Abstract

This study was aimed to develop and produce an assessment instrument of mathematical learning results based on multiple intelligence. The methods in this study used Borg & Gall-Research and Development approach (Research & Development). The subject of research was 289 students. The results of research: (1) Result of Aiken Analysis showed 58 valid items were between 0,714 to 0,952. (2) Result of the Exploratory on factor analysis indicated the instrument consist of three factors i.e. mathematical logical intelligence-spatial intelligence-and linguistic intelligence. KMO value was 0.661 df 0.780 sig. 0.000 with valid category. This research succeeded to developing the assessment instrument of mathematical learning results based on multiple intelligence of second grade in elementary school with characteristics of logical intelligence of mathematics, spatial intelligence, and linguistic intelligence.

Keywords: *multiple intelligence, logical intelligence mathematics, spatial intelligence, and linguistic intelligence, assessment, mathematics*

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Introduction

The results of field study show that in the three surveyed schools, they have implemented learning process with multiple intelligence approach, but in assessment of learning results, they still use conventional modeling examination. There is a gap between learning and assessment process. The results of field study in detail as follows. (1) Teacher prepares Learning Implementation Plan (RPP) with Teaching and Learning Activities (KBM) using multiple intelligence approach; (2) Teachers teach using multiple-intelligence approach; (3) Students receive learning materials through multiple-intelligence approach; (4) assessment of learning results uses traditional-assessment instrument; (5) learning results reach minimum passing grade (KKM) at least (7) there is a gap between the learning process and the instrument used to assess learning results. (8) Teachers have not been introduced to instruments which are based on multiple intelligences specifically; (9) from the Education Authority, it requires instrument use made by the Local Education Authority with using traditional instrument which is consisting only of sentences and numbers (10) the issue from students is when they have to work on traditional instruments that are not relevant to the learning process. (11) Teachers argue: traditional test has weakness if applied to the learning process with multiple-intelligence approach. Some weaknesses include (a) the instrument does not accommodate the multiple intelligence that is in accordance with the learning process, (b) The form of examination is in sentences and numbers, without any elements of multiple intelligences such as pictures, puzzle, riddle box. (C) on the instrument there is no color therefore it is less attractive.

To overcome these problems, it is offered a solution in which a model of learning-result assessment that considers multiple intelligences. This model of assessment will accommodate the characteristics of multiple intelligences that teachers use as an approach in the learning process.

In the development of assessment instrument, the mathematics lesson for second grade of elementary school is selected. Some of the reasons are mathematics is a subject that is closely related to life, mathematics is the basis to study other subjects. In certain classes students assume that mathematics lesson is tiresome.

Douglas, Smith, & Reese (2008) carried out research on impacts of multiple-intelligences learning model towards the achievement of eight-grade students on mathematics subject in Turkey. Samples consisted of two classes, one class as experimental class receiving mathematics with teaching-activity model, one class as control class to receive mathematics with Direct Instruction (DI) model. The learning results of both classes showed the difference. The experimental class had average point at 25.48, while the control class at 17.25 point. Based on this study, it is concluded that learning model with multiple intelligences increase learning result of students.

The problems in this research are: (1) What is the characteristic of assessment instrument on intelligence-based mathematics learning results? (2) What are the criteria of the assessment instrument on intelligence-based mathematics learning results? The purpose of this study is to describe: (1). Characteristics of the assessment instrument of multiple intelligence-based mathematics learning results. (2). Criteria of quality in instrument assessment of multiple intelligence-based mathematics learning results.

The purposes of the study are: The development of assessment instrument is expected to ease the teacher in implementing assessment towards the learning process with multiple intelligence approach. Teachers are expected to broaden their insights to be able to teach with high creativity whose orientation resides to the needs of students. Teachers should view students as individuals whose intelligence can develop according to the theory of multiple intelligences.

The result of the research on the development of assessment instrument of

multiple intelligence is helpful for the students because the assessment is designed by the teacher that considers the multiple intelligences of the students. The assessment instrument of multiple intelligences can create a fun learning atmosphere, and students can absorb the learning materials more easily.

Students feel happy, because the content of the examination contains material related to real life. The assessment instrument of multiple intelligences is directly related to the environment and the experience of students. The assessment instrument of multiple intelligence assessment also creates a pleasant atmosphere for students, because the examination has form in colorful images, graphics, riddles, and puzzle. The way to answer is also varied, not only in multiple choices, but students can answer by coloring the images, or filling in the blank boxes in the riddle.

Armstrong (2003, pp. 2-4) outlined eight of Gardner's theoretical intelligences as follows. (1) Linguistic Intelligence: The ability to use words effectively, Logical Intelligence: the ability to use numbers well. Spatial intelligence: The ability to perceive the spatial-visual world accurately. (2) Kinesthetic Intelligence: The skill to use whole body in expressing ideas. (3) Musical Intelligence: Ability to handle musical forms, (4) Interpersonal Intelligence: Ability to perceive and differentiate mood. (5) Intra-personal Intelligence: Self-understanding (6) Naturalist Intelligence: Skill to recognize and categorize species.

(7) Logical-Mathematical Intelligence: Campbell, Campbell & Dickinson (2002, p.: 41) described some conditions that enable one's logical-mathematical intelligence to thrive well as follows: feeling their goals and functions within their environment, recognizing concepts with properties of quantity, time, and causal relationships; using abstract symbols to demonstrate in concrete way, both objects and also concepts; showing logical problem solving skills.

Armstrong (2003, p. 26) explains that a person with high mathematical logical intelligence expresses the following features: being able to calculate numbers off the head easily, being fond of mathematics, enjoying games or solving puzzles that require logical reasoning, being eager to look for patterns, regularities, or logical sequences, believing everything with rational explanation.

Someone with strong mathematical logical intelligence tends to be fond of following activities such as science, mathematics, accounting, detective work, law and computer programming. One who makes use of mathematical logical intelligence in daily life will be easier to apply mathematical concepts. When dealing with problems and in assuming or arguing, he or she will use mathematical calculations frequently. Professions that can be developed from logical mathematical intelligence include accountants, statisticians, computer programmers, scientists, and researchers.

Spatial Intelligence (Visual-Spatial)

Space intelligence (visual-spatial) is an intelligence that can be developed for students. Students with spatial intelligence have several features, including as the following: being able to read maps easily, charts, graphs, being eager to work on puzzles, can build three dimensional constructions, and being more easily to learn through images than text. Armstrong (2003, p. 48) describes a person who is strong in spatial intelligence or space usually shows an interest in color, photo or video camera, images, reading materials that have many illustrations.

In line with those disclosed by Campbell et al (2002) on visual-spatial intelligence, it is revealed that a person with spatial intelligence exhibits several observable features such as: being fond of learning by seeing and observing, being fond of thinking in pictures, reading graphs, maps, diagrams or in visual method; enjoying three-dimensional shapes, origami, composing patterns, being fond of art, cards, pictured stories, being fond of drawing and painting.

Linguistic Intelligence

Gardner (1983) revealed that language is the most important example of human

intelligence that is indispensable to society. Gardner (1983) explains the important meaning of language-rhetoric aspect, or the ability to convince others from the series of actions, the potential for language recalling, or the ability to use language (Campbell et al, 2002, p. 10).

The ability possessed by a person in utilizing language intelligence can bring a student's confidence in learning to maintain a position in a forum and discussion. Utilization the ability in understanding the language in the lesson brings the opportunity to be able in discussion or teaching friends with what has been learned. In the scope of learning, a teacher must provide an opportunity for students to convey their arguments and provide opportunities for students to learn together with their friends.

A person who possesses linguistic intelligence exhibits characteristics as described (Amstrong, 2003) being fond of reading, writing, telling stories; being able to remember name, date; being fond of the word-guessing game; being fond of reading poetry, rhymes; being able to communicate well. Campbell et al (2002) describes the characteristics of linguistic intelligence such as: learning through listening, reading, writing, and discussion, effectively listening, understanding, deciphering and remembering the spoken words; being effective in writing, understanding language rules, spelling, being fond of learning other languages.

Assessment of Mathematics Learning

Assessment is the process of collecting and processing information to measure the achievement of student's learning results. Assessments that is made by teachers to students can be interpreted as a process of collecting various informations that can provide a true picture of student's learning progress. It means, if there are signs of students experiencing barriers in learning, teachers can take the right steps immediately. The taken steps in the process of handling students in the learning process can provide an overview towards the progress of learning. The learning progress of students is required throughout the learning process through assessment effort. Assessment is not only implemented at the end of the period (semester) in the learning process but during the learning process as well as the formative assessment (Stiggins & Chappuis 2011, p. 15). "The assessment is one of the main tasks of teachers ..." (Kartowagiran, 2012). Each teacher is required to possess assessment techniques to support the main task. According to Mardapi, (2007, p. 5) ".... assessment includes all the means used to assess individual performance ...". Performance appraisal allows students to demonstrate skills and attitudes that they have in addition to knowledge. Assessment in the learning process serves to determine the condition of students.

Assessment can be used as a method to motivate students in learning, not as a threat to students, in accordance with the theory presented by Nitko & Brookhart, (2007, p. 11) that:

> *Assessment may also motivate student to study. unfortunately, some teacher use this form of accountability as a weapon rather than as a constructive force. Teachers may hope that using an assessment as a possible threat will encourage their student to take studying seriously. Sometime teacher use the surprise quiz or pop quiz in this manner to encourage more frequent studying and less cramming (Nitko & Brookhart, 2007, p. 11)*

Teachers can use assessment as a way to motivate students in learning. Assessment is not intended to make students depressed, fearful or tense. Assessment if implemented properly can improve the quality of learning, an assessment supported by opinion of Nitko & Brookhart (2007):

> *How making your own assessments improve your teaching: (1) knowing how to choose or to craft quality assessments increases the quality of your teaching decisions; (2) what and how you assess communicated in a powerful way what you really value in your students learning; (3) when you carefully define assessment tasks, you are clarifying what you want*

> *students to learn; (4) you use your knowledge of how to craft quality assessment tasks when you evaluate assessment materials available from other source; (5) learning to craft assessment tasks increases your freedom to design lesson; 6) you will improve the validity of your interpretations and uses of assessment result. (Nitko. & Brookhart, 2007, p. 107)*

Theory of Nitko & Brookhart explains that assessment can improve the quality of teacher in teaching. Assessment can explain what students need. Assessment also functions in designing the next lesson. Assessment results can improve the validity of teacher interpretation towards the students. The preparation of examination items for assessment does require knowledge and high creativity, there is an influence of the assessment on improving the quality of learning.

Mardapi (2007, p. 6) described a principle to be considered in the assessment that: The essential principles of assessment are accurate, economical, and encourage the improvement on the quality of learning. Therefore, the assessment system used in each educational institution should be able to: (1) provide accurate information, (2) encourage students to learn, (3) motivate teachers, (4) improve institutional performance, and (5) improve education quality

A teacher must be able to design an assessment that fulfills the function in the learning process. The result of the assessment is expected to be helpful, both for the students and for the teachers themselves. Assessment on learning results of students at primary and secondary education levels is based on the following principles according to the Regulation of Education and Culture Minister of Indonesia No 23 Year 2016: Art 12 (2), assessment procedures undertaken by educators: Assessment of knowledge aspects is carried out through stages of: (a) preparing assessment plan ; (b) developing assessment instruments; (c) carrying out an assessment; (d) making use of the assessment results; and (e) reporting the assessment results in the form of numbers on a scale of 0-100 and description. Art 13 (1) while the process of assessing the learning process and results by educators is carried out by the following rules: (a) establishing an assessment objective with reference to the RPP that has been prepared; (b) developing an assessment points; (c) establishing an assessment instrument its guidelines; (d) conducting quality analysis of the instrument; (e) preparing assessment; (f) processing, analyzing, and interpreting the results of the assessment; (g) reporting the results of the assessment; and (h) utilizing the assessment report.

In Regulation of Education and Culture Minister of Indonesia Number 23 Year of 2016, it was clearly described how the assessment procedures should be done by the educators. An explanation of assessment both regarding assessment in the process and also the assessment in the learning results for the knowledge aspect has been detailed. Teachers only follow and carry out them. The steps to be taken to assess the knowledge aspect, from the plan to the report on the results of the assessment.

Model of Assessment in Learning Mathematics

In preparing assessment examination in mathematics, it is necessary to pay attention towards several matters related to the material, as the following opinion Schoenfeld (2002, p. 9) :

> *The "interwoven and interdependent" components of mathematics proficiency advanced by the NRC Committee are: Understanding: Comprehending mathematical concepts,...; Computing: Carrying out mathematical procedures,...; Applying: Being able to formulate problems mathematically ...; Reasoning: Using logic to explain and justify a solution to a problem ...; Engaging: Seeing mathematics as sensible, useful and doable....*

Schoenfeld explaines that the skill components in mathematics include: understanding, implementing procedures, formulating math problems, reasoning, using mathematics as a logical thing. Assessment should be designed in such a way to meet the purpose of the assessment, the mathematical as-

sessment is able to explore what is mastered and what has not been mastered by the students from the teaching materials, therefore the teacher can plan the next lesson. According to Schoenfeld (2002, p. 94) states:

> *Designing and developing good assessment tasks, which have meaning to students and demand mathematics that is important for them. The tasks must enable students to show what they know, understand and can do without the help from teachers that classroom activities can provide. Task design is usually subject to too-tight constraints of time and form. Starting with a good mathematics problem is necessary..*

Schoenfeld's opinion lays out that teachers should be able to design good, detailed, clear assessments therefore students are able to carry it out independently. A good assessment is designed to meet the actual assessment function in education.

Learning Assessment Model with Multiple Intelligence Approach

In carrying out the assessment of mathematics subject for elementary school with Multiple Intelligence approach will be able to implement with the examination. The research that will be carried out is to developing a focus towards the three development intelligences i.e. logical, mathematical, spatial, and linguistic intelligence. Assessment instruments used in research are conducted in the form of riddle, guess words, graphics, puzzle, drawings, stories, poems. Each test item is developed by associating three multiple intelligences i.e. logical mathematics-intelligence, spatial intelligence, and linguistics intelligence. Instrument of assessment that is conducted in the study was in accordance with the model of learning pursued by students, therefore between the process and the assessment there is sustainability in approach.

The tests in the development of instruments of assessment, it is used to assess mathematics learning for elementary school. The developed instrument aims to provide a sense of pleasure in students as the tests run, reducing students' anxiety during the test, while being in test students feel happy, and being able to relate test materials with real life.

Mathematical appraisal with mathematical logical approach, spatial intelligence and linguistic intelligence will be carried out by presenting the spatial drawings to the students in which in them, there are various images, such as ball, can, triangle, rectangle etc. Students are required to observe the pictures to answer the questions. The test items are in the form of puzzle inside, the students look for the empty puzzle pair. Furthermore, the students are presented with natural picture, in which there are animals, plants in it, students are asked to count the number of animals, plants present in the picture. Further, students are presented with pictures of unit-hundred-thousand blocks. Students are required to count the number. The test is in the form of story, students are required to observe the number of goods, and the price of goods.

The result of the Ellis's (2011) research "highlight generalization as a dynamic, socially situated process that can evolve through collaborative acts". The conclusion of the research is that the dynamic learning process and social process can be improved through collaborative action. Amy's research illustrates that the role of the learning process in mathematics affects the learning outcomes greatly. It is necessary for teachers to develop innovative and creative learning. Learning can be created by the approach of multiple intelligences.

According to the research of Duskri, Kumaidi, & Suryanto (2014) that the learning process can be effective and successful when individual differences get attention. The difference will affect the level of understanding of students. The teacher must know the individual differences that has form in students' difficulties in understanding the subject matter, the factors that cause difficulties and other factors. As a result, the diagnostic test is a solution therefore the teacher can design the learning process in accordance with the needs of students.

Method of Research

The research that was used is the research and development, According to Borg & Gall (1983, pp. 771-794) research & development was conducted in ten stages as follows: (1) Research and Information Collection. The first step relates with preliminary study towards the product development plan. (2) Planning. The second step, after the preliminary study, it is carried out planning preparation. In the planning of this study, it includes: identification of competency standards and basic competencies of mathematics for elementary school of grade V, demanding the prerequisite materials (learning continum), preparing concept maps, preparing material clues, defining the objectives, determining the steps of the development activity, determining the place, time, research sample and required funding, determining the experts that are involved in the FGD or expert judgment, and determining the product trial samples on small scale.

(3) Developing Preliminary Form of Product. The third step is to developing the initial shape of the product. (4) Preliminary Field Testing. In this fourth step it is carried out to test the product design on a limited basis. (5) Main Product Revision. The main product revision step aims to improve product design based on limited trials. Based on information and inputs from experts on the initial test, improvement was made towards the developed product. (6) Main Field Testing. Products that have been refined, tested more widely to potential users. Based on the second test, it will be obtained empirical information, whether the developed product has met the empirical validity or not, both in terms of substance and also of effectiveness of the product. (7) Operational Product Revision. Based on field trials more broadly and based on empirical results obtained, an improvement to the product developed. Product improvement is a second improvement. Unqualified items must be discarded or repaired.

(8) Operational Field Testing. Based on the second improvement of the developed product, it is followed with the feasibility test on the user more extensively than the previous field test. From the feasibility test, it will be obtained information both in terms of substance and also methodology towards the product design developed to be applied in the field. (9) Final Product Revision. Based on the information obtained during the feasibility trial, it is continued with a revision to complete the resulting product. (10) Dissemination and Implementation. After implementing improvements to the resulting product, the final step is dissemination and introduce product results either through workshops, scientific meetings or in the form of scientific journals. The findings of the product can be used or implemented by both the teachers in the field and for the concerned parties to advance the education world.

In conducting the research and development of the assessment instrument of multiple intelligence-learning results of mathematics was started from February 2014 to March 2017. The places of study were: SD Mutiara Ilmu pandaan Pasuruan East Java, SD YIMMI Gresik East Java, SD Muhammadiyah I Samarinda, SD Muhammadiyah IV Samarinda East Kalimantan. Preliminary study for Grade-2 students was 11 classes, teachers for grade 2 were 17 people for Small Trial: Grade-2 students were 89 people with teachers of 7 people. The trial was expanded: Grade-2 student were 200 people, teachers amounted to 9 people.

Preliminary research aimed to deepen about the learning process by applying the approach of multiple intelligences. In Indonesia, the application of multiple intelligences in learning was driven by Chatib (2009). Schools that have conducted the learning process with multiple intelligences of Howard Garner are in SD Plus Mutiara Ilmu in Pandaan Pasuruan East Java. Gresik Sekolah YIMI (Malik Ibrahim Islamic Foundation) that is located on Jalan JA Suprapto and SD Muhammadiyah 1 Samarinda.

Model Development: (1) Preparation of characteristics of multiple intelligence (2) Preparation of Curriculum-2013 clues (3)

Writing examination items. (4) Instrument seminar (5) FGD to obtain assessment of experts towards the examination items that have been already in the form of test equipment. (6) User Validation.

Small-scale trial with subject of 89 grade-2 students of SD Muhammadiyah IV Samarinda. Based on the results of experiments, it was conducted item analysis using computer assistance such as EFA with SPSS, then the next item would be revised in accordance with the results of computer analysis. After the test items were revised, the second test would be conducted with larger number of sample. The second test subject was also the same as the first trial, SD Muhammadiyah I Samarinda with total of 200 students.

From the result of second test, then it was reanalyzed, further revision was made to the test items that needed to be revised. The next step of the implementation phase. In the implementation phase of the instrument product, it could be applied to the actual situation. The results of the implementation of this instrument were analyzed to identify the achievement of the learning process for one semester with multiple intelligences approach. Revised point: from the results of analysis of instrument implementation, then the final revision was made.

For the quantitative data in the form of mathematics-learning achievement can be reviewed from the developed assessment instruments. For qualitative data, it was used interview/observation/questionnaire. Descriptive ana-lysis in research is used to describe stages of development and application of assessment instruments and the results as well. Descriptive analysis to illustrate the quality of assessment models ranging from early prototypes, seminar of prototype 1, FGDs, small-scale trials, expanded trials, to model trials. Quantitative analysis was performed on the data to determine the validity, model test and reliability of the multiple intelligence assessment model based on the empirical data obtained in the field.

Content validity is a test to examine validity of instrument items. Content validity test aims to determine if the item has already included the material to be measured. If the item is in accordance with the prepared indicators. Validity test is carried out by experts (expert judgement), as well as by the user (teacher). Results of validity test of expert and user were analyzed using aiken analysis with formula:

$$V = \frac{\sum s}{n(c-1)}$$

The value criteria of V aiken less than 0.600 is included in less good category, between 0.600 - 0.88 is included in good category, while greater V than 0.800 is included in very good category.

Exploratory Factor Analysis: factor analysis is carried out to determine the variable-forming factors. A common criterion of EFA is the KMO MSA value> of 0.5. The sig. value i.e. <0.5. Loading factor >0.3, eigen value >1. Qualitative analysis, qualitative analysis is carried out on the readability. Assessment regards to the use of language, writing techniques, the use of punctuation, the use of fonts, the use of pictures, the length of the sentence. Assessment technique with questionnaire instrument, containing statement with four answer choices, 4 for excellent, 3 for good, 2 for less good, 1 for not good.

Results of Research and Development

Instrument Development

Instruments in the form of initial drafts should be validated. The purpose of validation is to obtaining feedback, criticism, suggestions on model improvement according to the area of expertise of each validator. Expert validation aims to provide an assessment to the items in the instrument.

Assessment relates to the point suitability towards indicator, the suitability of point to the psychology of primary school children, the suitability of point towards mathematics for elementary school, graphs, suitability of choice answers. Other things are assessed to the type and size of the letters, the number of words.

Table 1. Recapitulation on Results of Aiken Instrument Validity Instrument by Expert

Validator (initial)	Area of Expertise	Valid item	V Aiken
FH	Psychology		0.714–0.952
DM	Measurement		
BK	Evaluation		
YA	Psychology		
JA	Mathematics		
FAS	Psychology		
MAR	Phil. of maths		

Table 1 shows that the analysis results of instruments provided by the experts indicate that all items are eligibly valid. The resulting V aiken values are between 0.714 and 0.952.

Validity of Instrument Item of Assessment of Multiple Intelligence

Instrument items were validated by 7 experts as well as by 9 teachers, the data was analyzed with the V Aiken formula. Here is the result of Aiken's validity on each developed multiple intelligence.

Validity of Logical Mathematical Intelligence Item

Table 2. Results of Validation of LM Intelligence Item

Instrument Item	V Aiken (Expert)	V Aiken (Teacher)
1	0,857	0,833
2	0,762	0,866
3	0,905	0,833
4	0,810	0,733
5	0,762	0,833
6	0,762	0,866
7	0,714	0,866
8	0,810	0,766
9	0,762	0,866
10	0,857	0,766
11	0,952	0,833

Table 2 shows that the validation results of experts as well as of teachers towards the items of logical mathematical intelligence can be concluded that the whole instrument items of mathematical logical intelligence has good-level validity. 13 items that represent logical intelligence of mathematics have expert-validity results ranging from 0.619 to 0.952. The validation results by teachers as practitioners ranging between 0.733 to 0.866. Based on the achievement of V Aiken result value, all items are declared valid and are in medium and good category.

Validity of Spatial Intelligence Items

From Table 3 shows that 12 points for spatial intelligence have good validity, both validation results of expert and also teacher. This conclusion is based on the value of Aiken Validity, in which the results of V aiken by experts are between 0.714 to 0.952. The validation results of teacher are between 0.733 and 0.90

Table 3. Validation Results of Spatial Intelligence Items

Instrument Item	V Aiken (Expert)	V Aiken (Teacher)
1	0,810	0,733
2	0,857	0,833
3	0,952	0,900
4	0,857	0,833
5	0,762	0,800
6	0,810	0,866
7	0,810	0,833
8	0,714	0,800
9	0,905	0,833
10	0,667	0,833
11	0,714	0,866
12	0,857	0,833
13	0,857	0,833
14	0,857	0,833

Source: Excel, Analysis of V Aiken

Table 3 shows that the validation results of experts as well as of teachers towards the items of logical mathematical intelligence can be concluded that the whole instrument items of mathematical logical intelligence has good-level validity. 14 items that represent logical intelligence of mathematics have expert-validity results ranging from 0.714 to 0.952. The validation

results by teachers as practitioners ranging between 0.733 to 0.900. Based on the achievement of V Aiken result value, all items are declared valid and are in medium and good category.

Validity of Items of Linguistic Intelligence

Table 4. Validation Results of Linguistic Intelligence Items

Instrument Item	V Aiken (Expert)	V Aiken (Teacher)
1	0,762	0,733
2	0,857	0,833
3	0,714	0,900
4	0,762	0,833
5	0,857	0,833
6	0,667	0,866
7	0,714	0,833
8	0,762	0,733
9	0,810	0,800
10	0,762	0,900
11	0,619	0,866
12	0,762	0,733

Source: Excel, Analysis of V Aiken

From Table 4 it shows the validation results of expert as well as teacher after being analyzed with V Aiken, it can be concluded that the whole items of linguistic intelligence have good validity, therefore it is worthy to use. This conclusion is supported by Aiken Validation result data by experts between 0.667 to 0.810 while validation by teachers were between 0.733 to 0.90.

Small-Scale Trial

The results of small-scale trials were analyzed by EFA (exploratory factor analysis.) The purpose of EFA was to investigate the factors contained in the observational variables. All measurable variables were associated with each factor in an estimation of loading factor. In this EFA analysis, we want to learn the items that are included in the developed factors i.e. factors of mathematical logical intelligence, spatial intelligence, and linguistic intelligence.

Table 5. KMO and Bartlett's Tes

KMO	0.661
Df	0,780
Sig.	0,000

Source: Output of SPSS

Based on the analysis of SPSS, it shows that KMO MSA (Kaiser-Meyer Olkin Measure of Adecuasy sampling) has a value of 0.661. The value of KMO MSA is included in good category for further analysis, since it is greater than 0.5.

Table 6. Analysis of Total Variance Explained

Componen	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	13.342	33.356	33.356
2	10.300	25.749	59.105
3	8.103	20.257	79.362

Source: Output SPSS Total Variance Explained

Table 6 shows that 40 variables that were analyzed consist of three factors. This is observed from the value of eigenvalue that is located ≥ 1with a cumulative value of 79.362%. Three factors are formed in accordance to the theory developed in the assessment instrument of multiple intelligences.

Conclusions

From the results of data analysis can be concluded as follows. Fisrt, Instrument of assessment of learning results in mathematics is based on multiple intelligences has forms of: a. each item of instrument accommodate the characteristics of multiple intelligences. b. Instrument has form of drawings, graphics, number squares, puzzles, poems, short stories, tables, and color maps. c. The answer options are on the number square, on the animal image, on the fruit drawing, and on the puzzle image. Second, The multiple-intelligences based criteria of assessment instrument of mathematics has good validity. It has a moderate and good difficulty level of items.

Suggestion

Some suggestions need to be delivered for further refinement and development towards the results of research and development of multiple intelligence-based mathematics learning assessment instrument: (1) Teachers may develop a multiple-intelligence-based learning appraisal instrument on other types of multiple intelligences, or other subjects; (2) Researchers and teachers can develop this multiple intelligence assessment instrument into a computer-based test assessment with various softwares; (3) The education authority can develop an assessment research of multiple intelligence in junior or senior high school level

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