The design of student mathematical representation instrument on problem solving reviewed from introvert-extrovert personality

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Abstract. This study aims to determine whether the instrument to be used is feasible or not to obtain research data. The research instrument used is the introvert-extrovert personality test and math-type problem-solving test. The introvert-extrovert personality test consists of 17 questions, and the math-type problem-solving consists of 2 types of questions, that is TPM I and II. The feasibility test of the introvert-extrovert personality instrument includes content validity, internal consistency, and reliability. While the feasibility test of the mathematical problem solving test instrument only used the validity of the content. For the validity of the contents of each test, conducted through expert judgment is the assessment made by experts. The number of respondents who took the test for the instrument test was 35 students. The respondents are students of secondary school in East Jakarta. The results of the instrument feasibility test show that: 1) Introvert-extrovert personality instruments have 17 statements that are eligible to retrieve the research data, and 2) The mathematical problem solving test instrument with linear equation system topic is feasible to use with some revisions from the expert judgment.

1. Introduction
In process of learning mathematics, the ability to express and represent mathematical ideas is something that must be done by everyone who studies mathematics. Besides that, mathematics serves to develop the ability to communicate using numbers and symbols and the sharpness of reasoning that can help clarify and solve problems in daily life. Parents and teachers should also be made conscious of their children’s abilities to be determined in the early period. The goal is the education that planned to the irneeds and abilities they have [1]. Teachers can provide learning by teaching abstract mathematical concepts, although basically students are easier to understand concrete concepts but by using symbols and mathematical notation students can represent their understanding [2]. But in other reason, teacher have to pose problems that the students do not yet know how to solve and to structure lessons that allow students to find solutions for themselves, part of which is encouraging students to persist with the challenges [3]. To describe and refer to the same mathematical entity the students can use multiple representations. Mathematical representation related to mathematical problem solving. That is because before we can solve a problem, we must understand the modeling of a problem itself. Solving a math problem is more than just filling in a blank in a test. Students have different thinking process. One way to solve this problem is by grouping them according to their level of creativity in order to respect each students and do not seeing them as similar [4]. Students need to form good expression in elaborating their solution. While solving a mathematical application problem, students...
need to observe and find out specific patterns or rules inside the problem. In the formulation process, students must have multiple representation skill to articulate the same problem in different forms or views [5]. In a research about multiple representations, said that multiple representations can foster problem solving mathematics. Combining text and formula was as helpful as the combination of text and graphic [6]. Multiple representation is also a problem-solving strategy. Using the full variety and power of all the forms of describing and presenting mathematics is an effective means for gaining insight into, and understanding of a problem situation. In this sense, multiple representation is a problem-solving process [7].

In other research, in order to the students have a good problem solving, the students must develop their kind of mathematical ability such as mathematical comprehension and representation [8]. Research on solving mathematical word problems suggests that students may perform better on problems with a close to real-life representation of the problem situation than on word problems. In this study we pursued real-life representation by a mainly depictive representation of the problem situation [9]. One of the first steps toward effective teaching of problem solving skills is to develop measurement instruments with well-establish validity. In other words, in order to improve student’s problem solving skills, educators should not only determine the degree to which students have these skills but also pinpoint to specific areas and skills in need of improvement [10]. In research about one of student’s problem solving strategies in classroom, which starting with open-ended problems and having sessions for students to solve the problems by themselves, encourages students to create their own problems and problem solving strategies [11].

The trait of extraversion–introversion is a central dimension of human personality theories. The terms introversion and extra version were popularized by Carl Jung. Based on research on significant differences between extrovert and introvert individuals against simple reactions in conflict situations, it was concluded that introverted individuals are focus and fear failure, that is make them more careful, and minimize making mistakes, but it takes a longer time to think [12]. In contrast, extroverted personalities respond faster but are prone to making mistakes, because they focus more on the environment not on themselves. In research about influence of extroversion and introversion on decision making ability, the introverts are better at decision making than extroverts. The introverts rely on their intuition and inner feelings and the other hand extrovert usually go for snap decisions, quick decisions, and decide what feels natural at the moment [13]. Concentration ability of extroverted individuals are lower than introverted individuals. Therefore, by understanding and describing one's inner feelings and present a descriptive thinking framework, then the characteristics of a person can be determined more easily. So that understanding will be obtained to increase self-awareness. Thus, the thinking process will be related to the personality of the students. In other research, indicated that in competitive group condition extraverts had higher performance and in cooperative group condition introverts performed better [14].

In research about designing assessment of performance in mathematics, the effective implementation of intended curricula that emphasise problem solving processes requires high-stakes tests that will recognize and reward these aspects of performance across a range of contexts and content [15]. Research instruments are made so that a researcher is helped in carrying out a research. The research instrument is said to be feasible to use when it is valid, internal consistency, and reliability. From the description, researchers are interested in developing a mathematical representation instrument design for secondary school students in solving mathematical problems in terms of extrovert-introvert personality types. One of research about validity and reliability development of extrovert and introvert personality, discuss to develop and acquire content validity and reliability for extrovert and introvert personality inventory (IPEI) that developed based on the personality theory by Jung [16]. Therefore, valid and reliable research instrument can be used further in research data collection.
2. Data/materials and methods
This research is a descriptive qualitative research using research methods, that is Research and Development. Respondents from this study were VIII grade students, namely SMPN 103, SMPN 49, and SMPN 223 in the area of East Jakarta, with respondents each of 35 students. The number of schools and students sampled from this research was taken with data collection techniques in multistage sampling.

Research method is Research and Development Method.

To determine research subject are Criterion-Based Selection Method dan Snow Ball Sampling Model.

Instruments of this research is personal questionnaire and problem solving test Method.

Research subjects are grade eighth students of secondary school in East Jakarta.

Figure 1. Research flow.

3. Results and discussion
The instrument is used to collect data of students on learning styles and creativity and then the instruments that have been made will be tested for content validity, internal consistency and reliability. Data collection steps follow the research flow, as shown in figure 1.

3.1. Content validity
To assess whether the questionnaire has good content validity is through expert judgment.

3.2. Internal consistency
To determine the correlation of the questionnaire items used Karl Pearson's product moment correlation formula as follows:

\[ r_{xy} = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{(n\sum X^2 - (\sum X)^2)(n\sum Y^2 - (\sum Y)^2)}} \]

3.3. Reliability
Reliability testing uses the Alpha formula, that is:
3.3.1. Troubleshooting test. The test prepared by the researcher is a closed test consisting of 2 items. Following are the results of instrument testing.

**Troubleshooting Task I**

| Date / Grade | : ................................................................. |
|--------------|----------------------------------------------------------|
| Name         | : ................................................................. |

**Task**

Mrs. Ani bought 2 kg of rice and 1 kg of sugar for Rp 30,000,00. Mrs. Shanti also bought 1 kg of rice and 3 kg of sugar in the same place for Rp 50,000,00. If the merchant's capital for buy 1 kg of sugar is Rp. 12,500.00, then the profit that the merchant takes in 1 kg of sugar is ...

**Troubleshooting Task II**

| Date / Grade | : ................................................................. |
|--------------|----------------------------------------------------------|
| Name         | : ................................................................. |

**Task**

The number of questions is done by Amir today has increased exactly 50% compared to what he did yesterday. The number of questions is done by Amir today at least ...

1) **Content Validity**

   Reviewing the content validity includes material, construction and language aspects. This review was carried out by three validators, namely Dr. Andri Suryana, Nurfidah Dwitiyanti, M.Sc. They are mathematics lecturers at Universitas Indraprasta PGRI, and Anggun Citra Dini Dwi Puspitasari, M.Pd, who is an Indonesian lecturer at Universitas Indraprasta PGRI. Based on the results of the content validity that the validator has stated, all items are worthy of use.

2) **Internal Consistency**

   Judging from internal consistency, the test items used to collect data on problem solving are having good internal consistency, that is \( r_{xy} \geq 0.30 \). Based on calculations for internal consistency, the results obtained are equal to \( r_{xy} = 0.32 \).

3) **Reliability**

   The test instrument used to collect data on student problem solving is \( r_{xy} \geq 0.70 \). Based on calculations for reliability of the problem with good results obtained at \( r_{xy} = 0.71 \).

Based on the results of validation conducted by an expert that the test is good. Then, from the results of the calculation of internal consistency, the product moment value is \( r_{xy} = 0.32 \), which if the product moment value is more than \( r_{xy} = 0.30 \) then the test is consistent. While, the reliability testing results are obtained at \( r_{xy} = 0.71 \), which if the value is more than 0.70 then the 2 test on the are reliable. So, based on the validation of expert judgment and the calculation of internal consistency and reliability, it can be concluded that problem solving test is valid and can be used.

3.3.2. Extroverted-introvert personality questionnaire. The questionnaire prepared by the researcher is a closed questionnaire consisting of 17 items. Following are the results of instrument testing.
Extrovert-Introvert Personality Questionnaire

Instructions:
1. Write the name and grade in the available column.
2. Choose one of the answers that best suits your real situation by giving a check mark (✓) in the column that suits your choice.

| Explanation: | SS : Strongly agree | TS : Disagree |
|--------------|---------------------|---------------|
| S : Agree    | STS : Strongly Disagree |

3. Read each statement carefully.
4. All answers do not affect the value of your lesson.
5. Answer all numbers, don't miss any numbers.

### Table 1. Extrovert-introvert personality questionnaire.

| No | Statement                                                                                           | SS | S  | TS | STS |
|----|------------------------------------------------------------------------------------------------------|----|----|----|-----|
| 1  | When I will hang out, usually I determine the place                                                  |    |    |    |     |
| 2  | I act more spontaneously without thinking first                                                     |    |    |    |     |
| 3  | I can usually hide angry or disappointed expressions when I'm around my friends                    |    |    |    |     |
| 4  | I admire one of the artists idolized from childhood until now                                       |    |    |    |     |
| 5  | I only act according to what I believe                                                               |    |    |    |     |
| 6  | I better introspect myself if I don't get first rank than blame others                              |    |    |    |     |
| 7  | I better think long before act                                                                      |    |    |    |     |
| 8  | I always look for busyness and can't stay quiet                                                     |    |    |    |     |
| 9  | It's easy enough for me to say yes or no when making a choice                                        |    |    |    |     |
| 10 | I really like competition / competition                                                              |    |    |    |     |
| 11 | I like to maintain arguments / opinions until the last drop of blood                                 |    |    |    |     |
| 12 | I often harbor whatever I feel                                                                      |    |    |    |     |
| 13 | I prefer to maintain my style rather than following the trend that is popular                        |    |    |    |     |
| 14 | I feel comfortable even with a new friend                                                             |    |    |    |     |
| 15 | My face and words usually show my emotional condition                                               |    |    |    |     |
| 16 | According to friends, I am a stubborn person                                                         |    |    |    |     |
| 17 | Even though I was working on something, I could not refuse if a friend asked for help               |    |    |    |     |

Statements in table 1 that are the extrovert and introvert personality questionnaires have been validated and examined for internal consistency and reliability. The results obtained are as follows.

1) Content Validity
   Reviewing the content validity includes material, construction and language aspects. This review was carried out by three validators, namely Hayu Stevani, M.Pd, a lecturer of Counseling Guidance (BK) of Universitas Indraprasta PGRI, Dian Novita Ariani, M.Psi a lecturer of Counseling Guidance (BK) of Padang State University, and Anggun Citra Dini Dwi Puspitasari, M.Pd, an Indonesian lecturer at Universitas Indraprasta PGRI. Based on the results of the content validity that the validator has stated, all items are appropriate.
2) Internal Consistency
Judging from internal consistency, the test items used to collect data on problem solving are having good internal consistency, that is $r_{xy} \geq 0.30$. Based on calculations for internal consistency, the results obtained are equal to $r_{xy} = 0.33$.

3) Reliability
The test instrument used to collect data on student problem solving is $r_{11} \geq 0.70$. Based on calculations for reliability of the problem with good results obtained at $r_{11} = 0.72$.

Based on the results of validation conducted by an expert that the questionnaire is good. Then, from the results of the calculation of internal consistency, the product moment value is $r_{xy} = 0.33$, which if the product moment value is more than $r_{xy} = 0.30$ then the test is consistent. While, the reliability testing results are obtained at $r_{11} = 0.72$, which if the value is more than 0.70 then the 17 statements on the questionnaire are reliable. So, based on the validation of expert judgment and the calculation of internal consistency and reliability, it can be concluded that problem solving test is valid and can be used. This is in accordance with the opinion on [16] one of research about validity and reliability development of extrovert and introvert personality, discuss to develop and acquire content validity and reliability for extrovert and introvert personality inventory (IPEI) that developed based on the personality theory by Jung (1954).

4. Conclusions
From the results of the above discussion, the following conclusions are obtained: (1) Personality questionnaire instruments have 17 statements that are suitable to be used to retrieve research data because they have fulfilled the requirements of validity, internal consistency, and reliability, (2) Mathematical problem solving test instrument with linear equation system material is feasible to use with several revisions from expert judgment.

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