Development of multiple intelligence test instrument for teen students in perspective of physics learning

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Abstract. The purpose of this study is to develop multiple intelligence instruments for teen students (15-19 years old). The research method used mixed-method with sequential explanatory design. The research activities were conducted in the odd semester of the academic year 2017/2018. The subjects of the study were the students of class X and XI in one of the private vocational school in Bandung consisting of one class for each random sampling. The results showed that the multiple intelligence test instrument developed in this study has been able to provide a profile picture of multiple intelligences owned by middle-aged students. This multiple intelligence profiles can be used as a basis that can be used by teachers in the design of physics learning in the classroom. The profiles of multiple intelligences result obtained: musical intelligence 9 students, kinesthetic intelligence 8 students, logical mathematic intelligence 8 students, spatial intelligence 3 students, linguistic intelligence 7 students, interpersonal intelligence 7 students, intrapersonal intelligence 8 students, and naturalist intelligence 7 students.

1. Introduction

In one of the objectives of physics subject at vocational school level, it is mentioned that the implementation of physics subjects at vocational school level is intended as a rides or facilitations to train students to master the knowledge, concepts, and principles of physics [1]. In the process of learning physics not only emphasizes the mastery of the concept (content) but also should contain the four things: the content or products, processes or methods, attitudes, and technology so that students' understanding of physics becomes complete and can be useful to solve the problems faced in daily life [2]. Content or products, means that in physics there are facts, laws, principles, and accepted theories. calProcess or method means physics is a process or method to gain knowledge. Attitude, meaning physics can develop a scientific attitude such as diligent, thorough, open and honest. Technology means physics related to the improvedquality of life.

In addition, in the learning process, it is necessary to be able to understand the ability of students personally, acknowledges their existence with all capabilities, appreciates the talent and the results of their works. A number of researchers [3-10] provide an assertion that the success of students in the class...
depends on the proper use of the various multiple intelligences it has. Multiple intelligences include not only linguistic and logical-mathematical but also include kinesthetic, musical, visual-spatial, interpersonal, intrapersonal and naturalist aspects tailored to the characteristics of learned concepts. These types of intellectual intelligence are known as multiple intelligences, introduced and developed by Howard Gardner [11].

Linguistic intelligence indicates a person's ability in oral and written mastery and the ability to use language theory to achieve a particular goal. Logical-mathematical intelligence is demonstrated by ability in both deductive or inductive reasoning, as well as the ability to understand and make excuses about relationships based on patterns of numbers. Kinesthetic intelligence allows for the connection between mind and body that is necessary to succeed inactivity. A person's ability to use parts or whole body to communicate and solve problems. Musical intelligence shows one's ability to be sensitive to the sound or sound, environment, and music that surrounds it. Visual-spatial intelligence demonstrates one's ability to understand more deeply the relationship between objects and space. The ability to imagine a real form and then solve the problem. Interpersonal intelligence shows a person's ability to be sensitive to the feelings of others, including the ability to socialize with the environment around him. Intrapersonal intelligence shows one's ability to be sensitive to one's own feelings, able to recognize the various strengths and weaknesses that exist in itself. Naturalist intelligence shows the ability to recognize, differentiate, express and categorize what is found in nature and the environment. One's ability to be sensitive to the natural environment [12].

From the purpose and description, the subject of physics is very good for students if it can be implemented as expected and implemented based on the consideration of multiple intelligences owned by each student. Therefore, it becomes very important for physics teachers to have a good and reliable test instrument in obtaining a profile of multiple intelligences of each student in his class. With good and reliable test instruments, physics teachers can engineer groups or design learning in the classroom based on the multiple intelligence profiles of each student.

Based on the above description, the purpose of this study is to obtain a good test instrument and can reliably obtain a profile of multiple intelligence of adolescent students in the perspective of physics learning. A good and reliable test instrument in the context of this study is an instrument that can measure what is to be measured [13].

2. Method
The research method used is mixed-method with sequential explanatory design design [14,15]. The stages in the development of multiple intelligence test instruments are carried out by starting with defining the concept of multiple intelligences, defining standardized test instruments adopted based on some expert judgments, language adjustment with language often used by students, constructing scoring items and guidance, validating content by seeking expert help two physics lecturers who have a reset about multiple intelligences and a professor in psychology), preliminary trials to determine the degree of instrument legibility, and triangulation of data. Stages and procedures for developing multiple intelligence test instruments can be detailed in table 1.

| No | Stages | Procedures |
|----|--------|------------|
| 1  | Defines the concept of multiple intelligences | - Analyze the concept of multiple intelligences |
|    | Determine standard compound intelligence test instruments | - Analyze the characteristics of multiple standardized intelligence test instruments |
| 2  | Language adjustment | - The transfer of language, from the original language to the language commonly used by participants (Indonesian) |
Table 1. Cont.

4 Constructing items and scoring guides
   - Mapping items in the form of instrument grilles
   - Construct items and their formats
   - Prepare scoring guides
5 Content validation (Expert Review)
   - Require experts to review the instrument (item relevance with purpose, clarity of information presented items and clarity of words, phrases and sentences in the items)
   - Revise the instrument
6 Preliminary trial
   - Ask participants to read instruments, write down or underline words, phrases and sentences on items that are not understood
   - Analyze and revise instruments
7 Triangulation of data
   - Ask participants to work on instruments as directed
   - Ask for assessment assistance from homeroom teacher and counselling teacher
   - Interpretation of the results of multiple intelligences by means of data triangulation

The compound intelligence test instrument developed is a test instrument adapted from the standard Multiple Intelligences Developmental Assessment Scales (MIDAS) instrument for adolescents (15-19 years old). Teen-MIDAS is a standard instrument of multiple intelligences composed by Branton Shearer. The test instrument consisting of 119 items in the form of multiple choice has been recommended by Howard Gardner with some conditional approaches to be taken when interpreting the results. According to Gardner, intelligence such as interpersonal, kinesthetic and others should be judged by more than one measure [12]. Therefore, it is necessary to triangulate data when interpreting the results by considering the assessment of homeroom teachers and BK teachers who are considered to have known each of these students.

The research activities were conducted in the odd semester of the academic year 2017/2018. The subjects of the study were the students of class X and XI in one of the private SMK in Bandung consisting of one class for each random sampling.

3. Result and discussion

3.1. Development of multiple intelligence test instruments
Based on the stages and procedures for the development of multiple intelligence instruments that have been implemented, it is necessary to improve and develop the standard test instruments Teen-MIDAS. This is done to obtain a good and reliable multiple intelligence test instruments. Both in terms of language, context issues, words, phrases, and sentences are used. In addition, data triangulation techniques at the time of interpretation of multiple intelligence results to further reinforce teachers' confidence in the profile of the resulting multiple intelligences.

3.2. Multiple intelligences profile students
The multiple intelligences referred to in this study are multiple intelligences as stated by Howard Gardner, the problem-solving ability and the creation of culturally valuable products or a set of capabilities, skills or intelligence that can be grown to include musical intelligence, kinesthetic, logical-mathematical, visual-spatial, linguistic, interpersonal, intrapersonal and naturalist.

Table 2. Recapitulation of student's multiple intelligence result of SMK.

| Types of Multiple Intelligences        | VH | H  | M  | L  | VL | Frequency |
|----------------------------------------|----|----|----|----|----|-----------|
| Musical Intelligence                   | 1  | 6  | 2  | 0  | 0  | 9         |
| Kinesthetic intelligence               | 0  | 0  | 8  | 0  | 0  | 8         |
| Logical-mathematical Intelligence      | 0  | 5  | 0  | 3  | 0  | 8         |
| Visual-Spatial Intelligence           | 1  | 1  | 1  | 0  | 0  | 3         |
| Linguistic Intelligence               | 0  | 3  | 4  | 0  | 0  | 7         |
| Interpersonal Intelligence            | 0  | 3  | 4  | 0  | 0  | 7         |
| Intrapersonal Intelligence            | 0  | 4  | 3  | 1  | 0  | 8         |
| Naturalist Intelligence               | 0  | 3  | 2  | 2  | 0  | 7         |
Table 2 above shows the recapitulation of students' multiple intelligence results based on their dominant level. VH (Very High), H (High), M (Moderate / Medium), L (Low) and VL (Very Low). As figure 1 above shows that of 57 students there are various types of dominant intelligence dominantly owned by each student. From figure 1 can also be seen that musical intelligence is more dominant with the number of students as much as 9 students. However, that does not mean that in the learning process physics can be ignored for other plural intelligence, such as kinesthetic intelligence 8 students, logical-mathematical intelligence 8 students, visual-spatial intelligence 3 students, linguistic intelligence 7 students, interpersonal intelligence 7 students, 8 students intrapersonal intelligence naturalist 7 student's intelligence.

4. Conclusion
Based on the research that has been done to obtain the conclusion that the instrument of multiple intelligence tests developed in this research has been able to provide a profile of multiple students' plural intelligence (15-19 years). This multiple intelligence profiles can be used as a footing ground that can be used by teachers in making group engineering and physics learning design in the classroom that accommodates multiple intelligences. This is important, considering the distribution of multiple intelligence profiles in a class is not only dominated by one kind of multiple intelligences.

In addition, based on the results of research that has been done on the interpretation of the results of multiple intelligences researchers recommend to keep doing triangulation of data by involving the assessment of others who are considered to have known close students who will be assessed.

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