Developing self-concept instrument for pre-service mathematics teachers

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Abstract. This study aimed to develop self-concept instrument for undergraduate students of mathematics education in Palembang, Indonesia. Type of this study was development research of non-test instrument in questionnaire form. A Validity test of the instrument was performed with construct validity test by using Pearson product moment and factor analysis, while reliability test used Cronbach's alpha. The instrument was tested by 65 undergraduate students of mathematics education in one of the universities at Palembang, Indonesia. The instrument consisted of 43 items with 7 aspects of self-concept, that were the individual concern, social identity, individual personality, view of the future, the influence of others who become role models, the influence of the environment inside or outside the classroom, and view of the mathematics. The result of validity test showed there was one invalid item because the value of Pearson's r was 0.107 less than the critical value (0.244; α = 0.05). The item was included in social identity aspect. After the invalid item was removed, Construct validity test with factor analysis generated only one factor. The Kaiser-Meyer-Olkin (KMO) coefficient was 0.846 and reliability coefficient was 0.91. From that result, we concluded that the self-concept instrument for undergraduate students of mathematics education in Palembang, Indonesia was valid and reliable with 42 items.

1. Introduction

Self-concept is an individual view of him/her self that can influence his/her life. That view can be the individual appraisal of him/her self. That appraisal is yielded from a mental appraisal of the individual of his/her characteristic that can be positive or negative. Positive self-concept indicate that individual accept him/her self in an individual position that has excess and inadequacy, and this leads to individual confidence in socialization, exhibit behaviour as an independent individual, responsible, not easy disconsolate, enthusiasm to face a challenging duty, give a positive influence to others, whereas negative self-concept reflect a feeling paltry, incapable or incapacity, avoid a situation that can make worried, like to blame others, impressionable by others, and often frustration [1, 2].

The self-concept consists of the way of someone see him/her self as an individual, individual feeling about him/her self, and the point of view of the individual as a human that he/she expects. Leonard and Supardi [3] also stated that self-concept is an individual responsibility which is positive about his/her life and self. Individual self-concept relates to his/her past, present, and future life [4, 5, 6, 7]. Individual future is determined by his/her perception what he/she may become later, what he/she will like to become, or what he/she is afraid of becoming. Those things correspond with hopes, fears, objectives, goals, and threats from individual condition today. The condition is an incentive for future behaviour. So, individual perception about his/her past and future life associates to his/her perception today [4].
Self-concept is a factor that is formed through individual experience by interaction with others. Gunawan implied that self-concept is notched because an influence from peoples that is deemed important by the individual which is a role model for him/her [3]. The peoples are the parent, family member, friend, teacher, or others [8]. Besides that, Jalaludin phrased self-concept is determinant in interpersonal communication which every individual behavior describe his/her self-concept [3]. According to Takaria [9], self-concept is individual perception to him/her self, a point of view from another person to excess, inadequacy, a capacity that inside the individual, and individual attitude. A positive self-concept inside individual can be seen from his/her activity, such as activity in learning mathematics, individual perception is showed through high enthusiasm, hardworking, confident, and high motivation to solve varying mathematics problem.

Every individual has a unique self-concept that can be identified his/her characteristic. First, physique characteristic is an important component of self-concept because other people use it to appraise individual. People often mention his/her physique characteristic to show that he/she different positively or negatively from the others because he/she understands that his/her characteristics prominent and probably is used by others to appraisal him/her. Ethnic individuality in self-concept is an exclusive function of the individual in a social environment. The second characteristic of self-concept reflects individual involve in social group concerning his/her existence and caring. In this matter, the general response is such as "I am an artist", "my ethnic is Melayu", and "I am a college student at State Islamic University". Individual participation in social group notches an important part of self-concept because it gives his/her social identity. Social identity is an individual appraisal that involves the social group. The last characteristic of the self-concept is personality. Personality is an individual characteristic that is permanent and special which describe his/her self, for example, "I am a friendly person", "I mousy", and "I am persistent". This individual difference is important to determine individual behavior, and this aspect of self-concept reflects people diversity [10].

Hurlock stated there are three principal components that are as follows [9]:

- Perception is an individual point of view that concern to his/her physique characteristic and others point of view to him/her too.
- Conceptual is an individual conception that concern to his/her capability an incapability, background, and cogitation about future.
- Attitude relate to feeling, belief which is inside individual about his/her self, and others perception of that individual.

From the components of self-concept, aspects that can be used to measure an individual self-concept, that is 1) individual point of view about his/her capability, 2) Attitude and individual belief, 3) individual perception about him/her self, 4) individual cogitation about his/her future.

From several affirmations above, there are many aspects that form self-concept of the individual. It can affect directly or indirectly. One of them is the influence of surrounding environment because it has an important role in the development of individual self-concept [11]. It means that self-concept of who is in X environment cannot be measured by using self-concept instrument that is valid in Y environment. An instrument which is used directly can make the result may risk oversimplification [12]. Hence, the instrument ought to be modified to correspond with the environment. According to Villegas and Tomasini, an instrument which is used as a measurement tool and evaluation depends on the specific condition of the environment [13]. Consequently, self-concept instrument should be developed to measure individual self-concept in specific environment and condition. In this study, we developed a self-concept instrument that focuses on the undergraduate student of mathematics education in Palembang, Indonesia. So, self-concept can be concluded as a point of view, idea, and individual appraisal to his/her self that is formed from academic and non-academic experience which is felt when he/she interact with his/her surrounding environment so that its influence positively or negatively to his/her behavior. The aspects of self-concept that we analyzed, that are the individual concern, social identity, individual personality, view of the future, the influence of others who become role models, the influence of the environment inside or outside the classroom, and view of the mathematics. We did not analyze physique characteristic because we assume that aspect is not appropriate with a questionnaire as the instrument, but the observation is more enable.
2. Methods
The type of this study was development research of non-test instrument. The procedure was as follows, that is (1) determine all possible aspects that form self-concept, (2) write the statements for each aspect, (3) discuss the instrument with mathematics education experts, (4) field test, (5) instrument analysis, (6) determine the final instrument. The respondents of this study were 65 undergraduate students of mathematics education at one of the universities in Palembang, Indonesia. The form of the instrument was questionnaire in Likert scale with four options. For positive statement, the score is 4 = Strongly Agree, 3 = Agree, 2 = Disagree, and 1 = Strongly Disagree. A negative statement is vice versa. The respondents must choose only one of the options. The technique of data analysis used (1) expert judgment for construct validity test theoretically, (2) Pearson product moment and factor analysis for construct validity test empirically, and (3) Cronbach’s alpha for the reliability test. To help data processing, SPSS 16.0 was used in this study.

3. Results and Discussion
The aim of this study was to develop self-concept instrument for undergraduate students of mathematics education in Palembang, Indonesia. The focus in this study was self-concept of undergraduate students of mathematics education. The instrument was developed from previous studies [9, 13, 14, 15, 16]. After literature review, We designed 43 items with 7 aspects of self-concept, that are individual concern with 4 items (example: If my friend has a difficulty in doing a calculus task, then I will be happy help him/her), social identity with 6 items (example: I am ashamed to introduce myself to others as an undergraduate students of mathematics education), individual personality with 10 items (example: If I do not understand about calculus, then I will strive to find out for myself first), view of the future with 5 items (example: Being a mathematics teacher is my dream), the influence of others who become role models with 5 items (example: I feel Ki Hadjar Dewantara’s thinking in education is feasible to be an example), the influence of the environment inside or outside the classroom with 8 items (example: I am delighted with the method of teaching that applied by calculus lecture), and view of the mathematics with 5 items (example: I find that mathematics is beautiful, because the rules are logical). For construct validity test theoretically, the instrument was reviewed by the experts in mathematics education. From discussion with four doctors and one professor in mathematics education as the experts, the instrument was revised. They suggested the number of positive and negative statements for every aspect should equal, the statement like “If I cannot do mathematics task, then I will not shame to ask assistance to a friend who is can” must avoid, because there are two negative sentences, and the influence of others who become role models as lecture or instructor must explicit, is the lecture mathematics education or else?. After revising, the detail of 7 aspects of academic self-concept, that are individual concern with 2 positive and 2 negative statements, social identity with 3 positive and 3 negative statements, individual personality with 5 positive and 5 negative statements, view of the future with 3 positive and 2 negative statements, the influence of others who become role models with 3 positive and 2 negative statements, the influence of the environment inside or outside the classroom with 4 positive and 4 negative statements, and view of the mathematics with 3 positive and 2 negative statements.

For construct validity test empirically, the instrument was tested by 65 undergraduate students of mathematics education at one of the universities in Palembang, Indonesia. The items validity test used Pearson product moment. The result showed there is one item is invalid, because the value of Pearson’s r is 0.107 less than its critical value (0.244; α = 0.05). The item is “I will angry, if someone disparage mathematics education department”. That item is included in social identity aspect. After invalid item was removed, we tested the normality of the data. We found that Mean of the data is 141.35 and standard deviation is 12.65. The self-concept of students, according Arikunto [17], can be categorized by using that data. The result was 16.92% students are low, 67.69% students are moderate, and the rest of them are high. It showed that there are still students need to improve their self-concept. The result from Kolmogorov-Smirnov test also showed significant value is 0.200. It means that the distribution of the data is normal, because its significant value is more than 0.05. Next analysis was factor analysis to 7 variables of self-concept. Construct validity test empirically with factor analysis showed Kaiser-Meyer-Olkin (KMO) of Measure of sampling Adequacy (MSA) is 0.846. That value is more than 0.5. It show adequacy of sample, while reliability test used Cronbach’s alpha. The value of reliability coefficient is
Besides that, the value of Bartlet’s test was 232.806 and significance was 0.000 which showed that there are correlations among variables and proper to process furthermore. The values also indicated that the instrument has satisfied valid requisite.

Hereafter, to know which variables that can be processed further or removed can be observed from the MSA values in anti-image correlation (Table 1). All MSA values for each variable were more than 0.5. It shows all variables can be processed further and valid as formers variable of academic self-concept.

| Variable                                      | A   | B   | C   | D   | E   | F   | G   |
|-----------------------------------------------|-----|-----|-----|-----|-----|-----|-----|
| A                                             | 0.852<sup>a</sup> |     |     |     |     |     |     |
| B                                             | -0.221 | 0.882<sup>a</sup> |     |     |     |     |     |
| C                                             | -0.280 | 0.014 | 0.795<sup>a</sup> |     |     |     |     |
| D                                             | -0.020 | -0.143 | -0.389 | 0.846<sup>a</sup> |     |     |     |
| E                                             | -0.024 | -0.362 | 0.072 | 0.017 | 0.871<sup>a</sup> |     |     |
| F                                             | 0.110 | -0.147 | -0.541 | 0.134 | -0.111 | 0.819<sup>a</sup> |     |
| G                                             | 0.036 | -0.179 | -0.045 | -0.378 | -0.240 | -0.263 | 0.876<sup>a</sup> |

<sup>a</sup> Measures of Sampling Adequacy (MSA)

A: individual concern  E: the influence of others who become role models
B: social identity    F: the influence of the environment inside or outside the classroom
C: individual personality G: view of the mathematics
D: view of the future

The next analysis was to know how much the factors are formed can explain all variables. It can be observed from communalities value. The result showed that the factor can explain 30.60% of individual concern, 65.50% of social identity, 69.50% of individual personality, 63.60% of view of the future, 49.60% of the influence of others who become role models, and 66.20% of the influence of the environment inside or outside the classroom, and 72.80% of view of the mathematics. Because an average of explanation is more than 50%, then the fixed factor will be determined.

| Variable                                      | Initial | Extraction |
|-----------------------------------------------|---------|------------|
| Individual Concern                            | 1.000   | 0.306      |
| Social Identity                               | 1.000   | 0.655      |
| Individual Personality                        | 1.000   | 0.695      |
| View of The Future                            | 1.000   | 0.636      |
| The Influence of Others Who Become Role Models| 1.000   | 0.496      |
| The influence of The Environment Inside or Outside The Classroom | 1.000 | 0.662      |
| View of The Mathematics                       | 1.000   | 0.728      |

Extraction Method: Principal Component Analysis.

The next analysis was to know how many possible factors are formed, it can be observed from Total Variance Explained. The variance could be explained by one factor, that was 59.686% and there was no other factor. It means that seven independent variables only formed one factor of self-concept. The variables could not be simplified to become more than one factor. All that variables were needed to explain self-concept for
undergraduate students of mathematics education. 59.686% could be explained by them, and the rest by other factors were not observed. While that, the correlation between independent variables with the factor can be seen in the component matrix.

**Table 3. Component Matrix**

| Variable                                               | Component 1 |
|--------------------------------------------------------|-------------|
| Individual Concern                                     | 0.553       |
| Social Identity                                        | 0.809       |
| Individual Personality                                 | **0.834**   |
| View of The Future                                     | 0.798       |
| The Influence of Others Who Become Role Models         | 0.704       |
| The influence of The Environment Inside or Outside the Classroom | 0.814       |
| View of The Mathematics                                | **0.853**   |

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

It shows that ‘view of the mathematics’ and ‘individual personality’ have a strong correlation with the factor of undergraduate students self-concept of mathematics education. That finding is different with Yahaya, et al [18]. They claimed that the correlation between students’ personality and his/her self-concept is very weak. They observed secondary school students. So, their claim cannot be generalized to all students’ level. This because of individual personality will develop from time to time. From the result, we could imply that the factor can be described as formers factor of self-concept for undergraduate students of mathematics education. Besides that, the correlation between independent variables can be seen from this table below.

**Table 4. The Correlation between Independent Variables**

| Variable | A   | B    | C    | D    | E    | F    | G    |
|----------|-----|------|------|------|------|------|------|
| A        | 1   |      |      |      |      |      |      |
| B        | 0.425 | 1   |      |      |      |      |      |
| C        | 0.461 | 0.536 | 1   |      |      |      |      |
| D        | 0.366 | 0.557 | 0.675 | 1   |      |      |      |
| E        | 0.284 | 0.622 | 0.408 | 0.428 | 1   |      |      |
| F        | 0.315 | 0.570 | **0.738** | 0.535 | 0.491 | 1   |      |
| G        | 0.329 | 0.638 | 0.627 | 0.682 | 0.582 | 0.659 | 1   |

A: individual concern  
B: social identity  
C: individual personality  
D: view of the future  
E: the influence of others who become role models  
F: the influence of the environment inside or outside the classroom  
G: view of the mathematics

Based on Arikunto [19], Table 4 shows that view of the mathematics has strong correlation with other variables except for individual concern and the influence of others who become role models, individual personality has strong correlation with the influence of the environment inside or outside the classroom and view of the future, and social identity has strong correlation with the influence of others who become role models. Each of variables also showed sig. < 0.05. It means that each of variables has
significant effect difference on self-concept for undergraduate students of mathematics education in Palembang, Indonesia.

4. Conclusion
From this study, we have succeeded to develop self-concept instrument for undergraduate students of mathematics education in Palembang, Indonesia. The instrument consisted of 7 aspects, that are the individual concern, social identity, individual personality, view of the future, the influence of others who become role models, the influence of the environment inside or outside the classroom, and view of the mathematics. All that variables were needed to explain academic and non-academic self-concept for undergraduate students of mathematics education. 59.686% could be explained by them, and the rest by other factors were not observed. The result from this study, we also could conclude that the instrument is valid and reliable with 42 items and could be used to measure the self-concept of undergraduate students of mathematics education in Palembang, Indonesia.

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