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Developing the Instrument of Non-Cognitive Skill Assessment for Science at Junior High School Grade VII: A Conceptual Review

Widha Nur Agastya[1], Dinny Devi Triana[2], and Herwindo Haribowo[3]

[1]Postgraduate student of Universitas Negeri Jakarta, Jakarta, Indonesia; Department of Science Education, Univeristas Hasyim Asy'ari, Jombang, Indonesia
[2]Department of Dancing Art Education, Universitas Negeri Jakarta, Jakarta, Indonesia
[3]Faculty of Psychology, Universitas Negeri Jakarta, Jakarta, Indonesia

Abstract

This research is a qualitative study based on the previous research, which will, apply and adapt the earlier findings to Indonesia's education system. The particular focus of this study is the non-cognitive skills needed for the study of science subjects at junior high school grade VII, namely: accurateness; perseverance; conscientiousness; responsibility; critical thinking; innovation; open mindedness; sensitivity; empathy; and environmental awareness. This is based on non-cognitive skill construction involving: individual character; emotion; habit; and process. Those aspects can be developed into the syllabus and lesson plans, both evaluating and developing the students' non-cognitive skills.

Keywords: developing instrument, cognitive skill, non-cognitive skill, science, junior high school

Corresponding Author:
Widha Nur Agastya
widhaagastya@gmail.com
widhanur_pep16s3@mahasiswa.unj.ac.id

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1. Introduction

Education in Indonesia adopts 3 taxonomies proposed by Bloom namely: cognitive, affective, and psychomotor. In Taxonomy Bloom, the skills are included in 5 categories namely: comprehension, application, analysis, synthesis, and evaluation. Intellectual ability and skill will be applied more than the knowledge [1]. In the taxonomy of Anderson et. al, cognitive is a process of completing the prior knowledge before the students obtain new knowledge through cognitive activity. Anderson et. al defined the skill in which the procedural knowledge is included in the first taxonomy (knowledge domain) [2].

The term cognitive skill has many synonyms, according to Pascarella and Terenzini in Kim et. al, namely: critical thinking, reflective assessment, epistemological development, etc. [3]. According to Jones, the development of cognitive skill refers to the acquisition of

competence and intellectual skill or general cognitive, if it is not connected to curriculum or study program, then it is considered as a distinctive result of postsecondary education [3]. According to King, the development of cognitive skill covers various construction and approach [4]. From those two opinions, cognitive skill is a skill which needs high analysis from students; the students have to have good comprehension to be able to explain based on scientific fact obtained. Besides cognitive skill, the students also need non-cognitive skill to support the success of their learning. There are number of researches showing that the factors of non-cognitive skills can support student's academic achievement, such as: there is a strong relation between achievement, self-efficacy, and self-concept in learning mathematics in the age of 15; self-concept and self-efficacy are strong predictors as the passing grade to enter higher education at the end of high school; self-efficacy and self-concept on mathematics are significant predictors to enter university and post graduate in science, technology or mathematics major. The students who have high self-concept in academic have better academic work [5, 6]. The taxonomy of non-cognitive construction in general covers: 1) attitude and believe, 2) social and emotional quality, 3) habit and process, 4) individual character [7]. The dimension used is formed from the analysis of basic competence of science subject at junior high school grade VII.

A research on the effect of non-cognitive skill has been conducted in Indonesia, among others: a research by Ahmad (2015) shows that the influence of critical thinking ability on the achievement of science learning, student's self-concept of learning achievement, ability of critical thinking on science learning achievement are indirectly significant, the critical thinking ability has direct significance on self-concept, [8]. A research shows that motivation on achievement directly influences mathematic learning result and critical thinking [9]. Those researches have not resulted in standard instrument which can be used by the teacher, supervisor, or professional who want to study more about student's psychology. In science subject there are several non-cognitive skills which are needed to be aroused (emphasized on students) in order to form scientific habits which are useful in the future. In the level of junior high school, the students will learn to have greater responsibility, at the time the non-cognitive skills are needed to be applied earlier in the learning so the students are accustomed to know themselves and have self-concept for academic achievement and life in the future. The application on learning besides science subject is also needed so the teacher knows the students' tendency in learning a particular subject.

2. Method and Equipment

2.1. Methods

This research used qualitative approach with non interactive inquiry type which is also called as analytic research [10]. The researchers collect, identify, analyze, synthesize the data, then interpret the concept, policy, and event which can be directly or indirectly observed. The source of the data is in the form of document.

2.2. Equipment

The document used in the data analysis is the document in the form of articles in national and international journal, printed media which can be traced through digital record, books referring the base concept which relevant for this research. This concept analysis is the analyses of important concepts which are interpret by the users or executors so it raised much confusion. To avoid such confusion, the researchers adjust the concept which can be used in Indonesia (relevant to Indonesian curriculum from the researchers' point of view).

3. Results

The analysis of basic competence resulted can be seen in Table 1.1. The result of non-cognitive skill can be used for all kind of main materials resulted.

4. Discussion

4.1. Accurateness

Accurateness in kbbi.web.id means carefulness, precision. Accurateness in English is also called "accuracy". According to Menditto, Patriarca, & Magnusson (2006), accuracy is the characteristic of qualitative performance which reveals the closeness of agreement between the result of the measurement and the measured value. The quantitative prediction from the result accuracy is very important in determining the level of reliability and validity of the decision made based on that result. It means that qualitative and quantitative accuracy is compatibility between result and measured value. The difference is that quantitative accuracy needs reliability and validity level from the result of the accuracy [11]. This explanation shows that the suitability between

Table 1: The Analysis of Basic Competence of Science Subject at Junior High School Grade VII

Basic Competence (3)		Non-Cognitive Skill
3.1	Applying the concept of measurement of various quantity using standard unit	*Accurateness, Perseverance Conscientiousness*
3.2	Classifying animate being and inanimate thing based on the observed characteristics	*Critical thinking Accurateness Conscientiousness*
3.3	Explaining the concept of mixture and single element (substance and compound), physical and chemical characteristics and changes in daily life	*Responsibility, Conscientiousness*
3.4	Analyzing the concepts of temperature, dilatation, heat, heat move and their application in daily life including mechanism of keeping the stability of body on human and animal	*Conscientiousness Critical thinking Power of innovative*
3.5	Analyzing the concept of energy, various sources of energy, and change of energy form in daily life including photosynthesis	*Conscientiousness*, *Openness minded*, *Critical thinking Sensitivity*
3.6	Identifying life organization system starting from cell level to organism and main composition of cell	*Accurateness Critical thinking*
3.7	Analyzing the interaction between animate being and its environment also the population dynamic caused by the interaction	*Conscientiousness Openness minded Critical thinking*, *Sensitivity Environmental awareness*
3.8	Analyzing the occurrence of environmental pollution and its effect on ecosystem	*Conscientiousness, Openness minded, Critical thinking Environmental awareness*
3.9	Analyzing the climate change and its effect on ecosystem	*Conscientiousness, Openness minded, Critical thinking, Environmental awareness*
3.10	Explaining the earth layer, volcano, earthquake, and the action to decrease the risk before, on, and after natural disaster based on regional threat	*Responsibility, Conscientiousness Empathy*
3.11	Analyzing solar system, earth rotation and moon revolution and their effect toward life on earth	*Conscientiousness Openness minded, Critical thinking, Environmental awareness*

the result of the measurement and the measured value should be precisely the same so the students are accustomed to write something based on fact and have self confidence toward the result they worked on. The researchers intend that the students have accurateness which can be learned and trained using relevant method. The benefit to have such quality is that the students do not tend to hurry in doing an activity so they can produce a precise product.

4.2. Perseverance

Perseverance means diligence. According to Merriman (2017), perseverance is a human quality related to great leader in various domains. The general tendency of perseverance or grit has been shown to predict individual achievement in various situations even after considering the cognitive ability and particular individual trait related to work like

conscientiousness [12]. This opinion means that perseverance can predict an individual cognitive ability in working achievement because perseverance is related to carefulness. Duckworth, Peterson, Matthews, & Kelly (2007) defined grit as perseverance and passion for a long time [13]. Perseverance is a part of grit. Perseverance in this case is done by the students continuously. Based on that study, the researchers define perseverance as the student's effort in getting individual achievement in various fields especially in learning.

4.3. Conscientiousness

Conscientiousness is awareness or carefulness. According to Levin (2012), conscientiousness is individual trait which is efficient and organized instead of easygoing and careless [14]. An individual who has conscientiousness is characterized by a person who is clean and neat, works hard, follows the social rules and has politeness in socialize, thinks before act and organized [15]. Conscientiousness is very relevant with the success in life like school and work. A person who is careful (conscientiousness person) is characterized as a diligent, systematic, obedient, high achievement, and hard work person [16]. Thus, conscientiousness is always made as strong predictor in academic achievement.

There are several theories explaining the facet of conscientiousness. According to Costa, Mccrae, & Dye (1991); Costa & Mccrae (1998), there are 6 facets included in conscientiousness, namely: competence, order, dutifulness, achievement striving, self-discipline, deliberation [17, 18]. Several facets elaborated are the attributes or branch traits of conscientiousness by Costa et. al. Being careful (conscience) is related to the trait grown in human individual. Conscientiousness is closely related to the achievement resulted because the trait owned covers competence, regularity, obedience toward rule standard, struggle, discipline, and carefulness. From several experts' opinions and facets which have been reviewed, the researchers determine the chosen definitions for conscientiousness are competence, achievement string, self-discipline and deliberation. Conscientiousness is the student who has competence, is eager to struggle for excellence, is discipline in learning, has carefulness in act and learn, and is well-planned.

4.4. Responsibility

According to Lichtenberg, Pollock, & Mawr (1967) in their article, "responsible" is one of the words used in America which can be connected to the thing that can be accountable

for as the main factor, motive, or agent responsible for something. Responsibility is also related to the individual trait of conscientiousness [19]. The dependence side of conscientiousness reflects how far someone is organized, deliberately, methodically, and can be dependable for a task and someone's responsible [20]. Two main domains identified from conscientiousness are self-control and responsibility. Responsibility is indentified on most previous studies. At the moment, highest responsibility reflects the tendency to follow-up a promise that has been made to someone and follow the rule that has been agreed with social group so the work can be run well. Responsible can also be identified as agreeableness aspect and is very high correlated. Thus, its placement is changeable based on the content of the action used in this aspect [21].Related to the previous definition mentioned, the definition of responsibility used by the researchers is that the students can be responsible for their explanation and thought about science subject. This case has an effect on life in the future that the student will tend to be responsible toward scientific knowledge, action, and statement. A person who tends to be responsible will not be easier to neglect something that has been agreed with other, he will try to fulfill it.

4.5. Critical Thinking

Critical thinking is a component of both cognitive ability and non-cognitive ability (personality trait). The theory initiator of critical thinking which involves disposition and ability is Ennis (1985). According to him, critical thinking has two components. Disposition component covers open minded, paying attention to the total situation, seeking reasons, and trying to be well informed. All those dispositions are included in self-explanatory. There are general settings of main ability in critical thinking, they are: the ability related to clarity – is loosely divided into two rules, namely basic and advanced, the ability related to inference, the ability related to build a strong basic of inference, and the ability to be involved in decision making that is orderly and useful, which is called as problem solving [22]. According to Rimiene (2002), critical thinking is defined as a cognitive process, assessment of self-arrangement which is directed and has two components, namely cognitive component (interpretation, analysis, inference, evaluation, explanation and self-arrangement); and motivation component (disposition toward critical thinking) [23]. Those two opinions strengthen that critical thinking is not only purely cognitive ability, but also influenced by someone's individual trait.

A research conducted by Phan (2010) emphasizes that the theoretical orientation of critical thinking and self-regulation is operated in an interaction between learning and

teaching which is dynamic [24]. From those theories, the researchers define critical thinking as the student's ability in processing knowledge obtained and supported with new knowledge, then accompanied by some good motivation inside and outside the student's self. So, critical thinking is individual's trait which is innate and can be trained using cognitive ability which is obtained during learning.

4.6. Power to Innovative

Power to innovative consists of 2 words intended as the individual trait owned by a student in learning. The word 'innovative' itself frequently emerges in economics deals with a company that will launch a new product. Innovative which is intended by the researchers in here is the student's ability in processing and reviewing the lesson they get to implement it in daily life (give an example/innovative idea). The researchers' opinion is made based on the experts' opinions. According to Van de Ven (1986), innovation process is defined as the development and implementation of new ideas by the people through time to do transaction with others in the context of organization. So, innovation is viewed as a graded level with various activities and individual behaviors which are differently needed in every stage [25, 26]. Prior to Kerr, Kerr, & Xu (2017), innovative trait can be considered as something in common, or specific domain of someone's individual trait, or a concept of behavior like an adoption of a new product by a consumer [27]. Innovative process can be trained through the increase of experience and learning, but innovative trait is owned by every individual based on its processing.

4.7. Openness Minded

Openness minded is frequently connected to openness to experience. But the two phrases are actually different in meaning. Openness to experience (shortly called as "openness") is generally considered as one of the big five individual dimensions and connected to the adjectives like smart, original, curious, has wide thought, artistically sensitive and introspective [28]. According to Rothmann & Coetzer (2003), openness to experience covers active imagination, esthetical sensitivity, caring on inner feelings, preference on variation, intellectual curiosity, and independent assessment. A person who has low score on openness tends to behave conventionally and conservatively, want to question authority, and are ready to entertain new ethical, social, and political ideas [29].

Prior to Hare (2011), open-mindedness involves a strong intention not to ignore, except, or hide a relevant proof and needs a readiness to revise our belief if in the next investigation stage it is shown that they are wrong or incomplete [30]. Someone who is openness minded should really follow the proof and the existing truth, and put aside his personal opinion. After reviewing some experts' opinions, the researchers define openness minded as a trait involving big intellectual curiosity, wide thought, strong willingness to collect as many proof as possible (to support knowledge), aptitude to receive others opinion and proof which is more correct. In here, the students are expected to have such trait.

4.8. Sensitivity

Sensitivity is sensibility of someone toward something. In individual trait, it is called as "sensory processing sensitivity" (SPS). According to Aron & Aron (1997), sensitivity is related to social introversion and connected to emotion [31]. Its emphasis is on the sensitivity toward great passion or sense sensitivity. Basically, sensitivity is the basic attribution of nerve system. Prior to Aron, Aron, & Jagiellowicz (2012), SPS is conceptualized to involve the deeper stimulus processing in various and wide situations, and supported by greater response toward positive and negative stimulus that can motivate learning and direct to more success response in the same situation in the future [32]. SPS is individual trait which is indicated with sensitivity toward internal and external stimulus, including social and emotional signal [33]. An individual who is very sensitive tends to see softer stimulus in the environment and easier to be stimulated, besides he can even response toward the lower threshold stimulus [34]. From the review, the researchers define sensitivity as an innate trait of human in general. This trait is processed along with the experience obtained. Sensitivity is the individual trait connected to emotional and social. Sensitivity is needed to make the students become sensitive toward the problems and issues of science in the future.

4.9. Empathy

According to Davis (1983), empathy in general sense refers to a reaction of one person toward an experience of other person. Empathy is classified into 2 response groups, namely: cognitive response and affective response (emotional reaction, visceral, etc) [35]. According to Choi & Watanuki (2014), empathy is the essential ability needed for human social activity [36]. The difference of individual is in the empathy trait. In other

word, sensibility for various other's emotion and readiness to consider other's position is different in each individual. Empathy is the ability and method to adapt with different social environment.

According to Batson (2009), there are eight situations to use the term empathy: 1) knowing other's internal condition; 2) adopting posture or adjusting nerve response of other which is observed; 3) coming to feel like other's feeling; 4) projecting self into other's situation; 5) imagining how other think and feel; 6) imagining how people think and feel in other's place; 7) feeling sad because seeing other's suffering; 8) feeling for other who suffers [37]. Batson used emotional concept to explain situating empathy. From that case, empathy is an affective aspect inside individual self. From the explanation above, the researchers define empathy as the student's feeling to feel what other feels, like natural disaster which is felt by some Indonesian society, in order that the student can think how to act to prevent the disaster or minimize its effect by learning the procedure of self-rescuing.

4.10. Environmental Awareness

According to Le Roux in Komane (2005), environment included but is not limited on: plant and animal; soil, air, and water; people; interaction; political and economical power; human system, culture, and social [38]. In his research, Komane (2005) defined environment as biotic and abiotic organism, all factors (social, politic, economy, and culture) and how human interact with ecosystem [38]. In this case, the researchers define environment as the place for all animate being (both biotic and abiotic organisms), air, soil, water and the problems related to them. Based on the objective of education, Tbilisi Intergovernmental Conference on Environmental Education in 1977 defined environment as: **awareness**: to help student, social group, and individual to have awareness and sensibility toward the whole environment and its problems (including environmental issues); **sensitivity**: to help social group, student, individual to get experience in environment and basic understanding about the environment and related problems; **attitude**: to help student, group of people, individual to have a set of value and caring feeling toward environment and motivate to actively participate in environmental restoration and protection; **skill**: that is to help social group or individual to get skill in identifying and solving environmental problem; **participation**: to give chance to social group and individual to be involved actively in all levels to work heading to environmental problem solving [38, 39].

Mei, Wai, & Ahamad (2016) argued that the higher the cognitive level of an individual toward environmental problem and its cause and effect scheme, the higher the deliberated environmental behavior [40]. Referring to those references, the researchers define environmental awareness in the scope of this research as the student's sensibility toward surrounding environment (including air, soil, water, animal, plant, and all biotic and abiotic organisms) and toward environmental problems including popular environmental issue which needs serious handling. It is expected that the environmental awareness can influence the students' behavior in taking take the surrounding environment.

5. Conclusion

Several arguments in this research are strong references used by the researchers. The research assumption is made based on books and articles' review. The assumption which can be concluded in this research is that the study on competence standard of science subject of junior high school at grade VII in Indonesia has its own scope of individual trait which needs to be observed, namely: accurateness, perseverance, conscientiousness, responsibility, critical thinking, power to innovative, openness minded, sensitivity, empathy, environmental awareness. Those non-cognitive skills are analyzed with the construction scope in the form of: individual trait, emotion, habit, and process. The next researcher can use this non-cognitive skill construction which is based on the other expert's opinion and can implement it on other subject.

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Conflict of Interest

The authors have no conflict of interest to declare.

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