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Article

Assessing the Content Validity and Construct Validity of Non-Cognitive Skills Assessment Instruments for Science Subjects at Junior High School in Indonesia

Widha Nur Agastya*
Universitas Hasyim Asy'ari Jombang, East Java, Indonesia, widhaagastya@gmail.com
https://orcid.org/0000-0002-5501-7534

Dinny Devi Triana
Universitas Negeri Jakarta, Indonesia, dinnydevi@unj.ac.id
https://orcid.org/0000-0002-3588-7890

Herwindo Haribowo
Universitas Negeri Jakarta, Indonesia, herwindo.ina@gmail.com
https://orcid.org/0000-0002-2298-0922

Abstract

The objective of the study was to test the content validity and construct validity of non-cognitive skills assessment applied to science subjects at Junior High Schools in Indonesia. Non-cognitive skills are traits and skills that can be used to measure non-cognitive factors involved during learning. The study consisted of eight factors namely, critical thinking, open-mindedness, accuracy, perseverance, carefulness, ability to innovate, responsibility, and sensitivity. The content validity method involved 40 experts and panelists (20 teachers and 20 students). The assessment used in this study was self-assessment technique. Exploratory factor analysis was used as construct validity assessment technique and involved as many as 210 students. Viewing the cut-off value of the CFI < 0.96 dan SRMR > 0.06 meant that all eight factors were qualified. The result of the Geomin Rotation Analysis was found valid in 17 items, and 14 items confirmed the cross-loading criteria. The implications of this study included that the instruments' items do not have to be seen through variables; if the variables are not qualified, the dropped items could be reviewed again through indicators and item editors. Moreover, constructs formed in this study are transferable and replicable, and can be used in future studies, even to test instruments using a large sample and to search item bias. The study recommends using this instrument on teachers and parents too to know the extent of students' non-cognitive skills.

Keywords

Non-cognitive skills, content validity, construct validity, exploratory factor analysis, assessment scales

Correspondence to Widha Nur Agastya, Universitas Hasyim Asy'ari Jombang, East Java, Indonesia, Email: widhaagastya@gmail.com
Orcid: https://orcid.org/0000-0002-5501-7534

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Cognitive skill is a way to understand, remember and acquire knowledge. Specifically, it can be defined as the knowledge acquired by the student, and the ability to learn new knowledge (Glewwe et al., 2017). Cognitive skills are also required in learning, as is the case with non-cognitive skills. According to Borghans et al. (2008) non-cognitive skills can be defined as patterns of thought, feelings, and behaviors that affect social interaction with others. This understanding is the basis of several studies on non-cognitive skills in various fields, for example, learning. Cognitive skills and non-cognitive skills are interconnected with each other, so they can be interrelated. Generally, people who have non-cognitive skills tend to have good cognitive skills and the probability of succeeding in life is higher than those who only have cognitive skills.

Several studies showed that non-cognitive skills affect learning. West et al. (2016) in his research showed that non-cognitive skills such as conscientiousness, self-control, grit, and growth mindset were positively correlated with students' acceptance of lessons, behavior, and grade increase test assessment gains. Confidence was found the highest predictor of student academic achievement (Stankov & Lee, 2014; Stankov et al., 2014). Self-concept was also found affecting high academic scores and better academic performance (Parker et al., 2014; Seaton et al., 2014). Self-confidence and self-control were responsible for impact on education and outcomes in young adults (criminality, education, employment, and social capital), and social skills were seen as important but neglected aspects of the development of non-cognitive skills (Algan et al., 2014). This proves that involvement of non-cognitive skills is necessary for classroom. Through proper assessment, teachers can find out the potential of students in addition to their cognitive abilities and knowledge.

That non-cognitive skills influence student decision-making was emphasized in the 2013 curriculum of Indonesia. It was specified that to face future challenges related to competence, several abilities need to be possessed, including the ability to communicate; the ability to think clearly and critically; the ability to live in a globalized society; have the readiness to work; have intelligence according to their talents/interests and have a sense of responsibility to the environment (Kebudayaan, 2014). It was recommended to implement the 2013 curriculum both in learning and assessment. It is often felt that an unstandardized assessment is the core of the problem of developing non-cognitive assessment instruments that include attitudes and personalities. In the absence of assessment instruments, the teacher judges subjectively. Therefore, it is necessary to have a standardized assessment that can be used as a reference for teachers to assess students' non-cognitive skills. The assessment of non-cognitive skills is needed by parents as well to find out the extent to which these non-cognitive skills are acquired by children.

Some learning activities in Indonesia, especially in the science lessons, employ non-cognitive skills but are carried out inadvertently with no tangible results. This is certainly one of the problems that need to be resolved immediately. To bring out the existence of non-cognitive skills in learning, an in-depth analysis of basic competencies, learning indicators, and subject matter should be taught in schools. Each activity in a subject already has some non-cognitive skills in is curriculum, but teachers are not equipped with the methods how to assess these skills. Teachers need to understand that non-cognitive skills form a clear and directed student mindset so that they are more confident of their abilities.

Some development research on non-cognitive skills have recommended assessment instruments namely: 1) Instruments for assessing learning behavior: these instruments generate three factors consisting of items about feelings of competence, preparation for the day, routine academic tasks and specific academic preparation tasks such as papers and exams (Bliss & Mueller, 1993); 2) Learning and Study Strategy inventory (LASSI) designed to produce diagnostic information about self-perception of learning skills, and learning orientation (Flowers et al., 2012; Weinstein et al., 2016); 3) Student Readiness Inventory (SRI), which has ten scales namely: academic discipline, academic self-confidence, commitment to college, communication skills, emotional control, general determination, goal striving, social activity, social connection, study skills (Peterson et al., 2006); 4) Grit Scale, defined as perseverance and desire for long-term goals, having two factors, namely: consistency of interests and perseverance of effort. In this case, it was further studied by involving six studies to see its effects in the long term (Duckworth et al., 2007); 5) Development of non-cognitive scales as needed in Danish School Children, including intrinsic motivation, self-efficacy, self-regulation, perseverance, conscientiousness, behavioral engagement, cognitive engagement, cooperation, resilience, attention, extrinsic motivation, proactive behavior/drive, critical thinking, creativity/openness, emotional engagement, well-being, self-esteem, outcome expectations, empathy (Makransky et al., 2020).

Previous research involved non-cognitive skills in the learning process and focused on specific functions like motivation for achievement and critical thinking (Fajri, 2017; Sanderayanti, 2015) but none of those studies involve any specific subject or discipline. Besides, most of these studies results failed to determine any learnings about assessment. Unlike this previous research, the current study aimed to develop and validate non-cognitive skill instruments in science subjects at the junior high school level.

This study fully presents the validation results of non-cognitive skills instruments in Junior High School science lessons that can be used by teachers to explain children's skills in detail, so that teachers have clear guidelines in describing student skills. The developed factor refers to basic competencies in science lessons in Grade 8, Junior High School. These basic competence are contained in Permendikbud no. 37 of 2018 (Minister of Education and Culture Republic of Indonesia, 2019).

Literature Review

In order the devise relevant instrumentation, it is necessary to first define, review and analyze the meaning of non-cognitive skills and what factors contribute to building up the scales

i. Non-Cognitive Skills

Non-cognitive skills assist the teacher to provide a stimulus to develop students' personality traits useful for future life. There are several terms used to name non-cognitive skills, such as: socioemotional skills, character skills, and competencies of the 21st century (Duckworth & Yeager, 2015); personality traits (Almlund et al., 2011; Cubel et al., 2016; Heckman & Rubinstein, 2001; Lundberg, 2017); and, behavior, skills, attitudes (Farrington et al., 2012; West et al., 2016). Non-cognitive skills can be defined as patterns of thinking, feelings, and behaviors that affect social interactions with others (Borghans et al., 2008). Non-cognitive skills are included in social, motivational, and leadership skills and involve important personality traits (Brunello & Schlotter, 2011). Non-cognitive has become a trait or skill that cannot be seen through the assessment of abilities or general knowledge. Non-cognitive skills have emphasized the importance of traits such as awareness, self-control, and fortitude that seem to contribute to the student's ability to maintain effort in fulfilling tasks academically (West et al., 2016). In the current study, the term non-cognitive skills are sued to refer to traits that are used to measure the factors involved during learning.

The taxonomy of non-cognitive constructs can be divided into four groups namely attitudes and beliefs; social and emotional qualities; habits and processes, and personality traits (Lipnevich et al., 2013). Of these four taxons, the current study focused on three taxons to map eight factors, namely: critical thinking, open-mindedness of thought, accuracy, conscientiousness, perseverance, ability to innovate, responsibility, and sensitivity. Categorically, attitudes and beliefs comprise conscious and unconscious attitudes that students have about science lessons including critical thinking and open thinking; habits and processes comprise the way students perform intentional actions that demonstrate the learning process reflected through accuracy, perseverance, and the ability to innovate; and, personality traits comprise traits of students that are formed when conducting learning and used in everyday life such as responsibility and sensitivity. Each of these eight taxons are briefly reviewed here.

i. Critical thinking

Ennis (1985) defines critical thinking as reflective and reasonable thinking that is focused on deciding what to believe or do. According to him, it should be noted that creative activities covered by the definition include formulating hypotheses, asking questions, offering alternative answers, and experimental plans. It should be noted, too, that defining critical thinking is a practical activity because deciding what to believe or do is a practical task. The taxonomy of critical thinking developed by Ennis (1985) therefore included dispositions and abilities. In another study Aizikovitsh-Udi and Cheng (2015) asserts that disposition of thinking is the impetus to think, so the ability to think can be said to be a consistent effort to encourage higher-order thinking skills to contribute to the development of the student's ability to think critically (not only during the experimental learning period but also in the long term since this skill becomes an integral part i.e. part of students' thinking habits). In this study, critical thinking is defined as the way students see and solve problems not only in lessons but in everyday life.

ii. Open-mindedness of thought

Open-mindedness is often associated with openness to experience. The two words have different meanings, namely open-mindedness and open-mindedness of experience. Openness to experience (briefly often called "openness") is most commonly recognized as one of the dimensions of the personality and is associated with adjectives such as intelligent, original, curious, broad-minded, artistically sensitive and introspective (Woo et al., 2015). An open-minded person is ready to accept the relevant evidence, admitting that undesirable conclusions must be followed and the position held at the moment may be untenable (Hare, 2011). Hare (2011) also explains that open-mindedness involves a determination not to ignore, negate, or conceal relevant evidence, and requires readiness to revise our beliefs if subsequent questions show that there is an error or incompleteness. Openness minded as a trait involves big intellectual curiosity, wide thought, a strong willingness to collect as many proofs as possible (to support knowledge), aptitude to receive others' opinions, and more correct proof. Here, the students are expected to have such traits (Agastya et al., 2020). Referring to this definition, students are expected to have such a trait in everyday life.

iii. Accuracy

According to Selvik and Abrahamsen (2017) accuracy is as follows: "accuracy" has 3 main interpretations: a) the correctness of a value, that is, the resulting portion is close to the correct or correct value. b) correctness of the entire set of underlying observations (value and results), which is used to produce this value. c) the accuracy of the process, that is, related to the quality of the assessment of the method." Often "accuracy" relates to the value of being true or "true, where a high degree of accuracy can mean that the value assessed for some people is close to some actual value.

In this study, accuracy is seen as the truth of a value from the beginning of the process to making the same value true. The accuracy is achieved when students work on several experiments that required the accuracy of the process from the initial stage to the end so that students are trained and accustomed to following the process carefully to provide maximum results.

iv. Conscientiousness

According to Levin (2013), conscientiousness is the nature of a person who is efficient and organized rather than relaxed and careless. Individuals who have conscientiousness are characterized as those who are clean and tidy, who work hard, follow the rules of society and have politeness in socializing, thinking before acting, and being orderly (Jackson et al., 2010). Of all major personality traits, conscientiousness is very relevant to success in the realm of life such as school and work. A conscientious person is characterized as a diligent, systematic, obedient high in achievement, and hardworking (Trautwein et al., 2009). Conscientiousness is also often used as a strong predictor of academic achievement.

Several theories explain the facet of conscientiousness. According to Costa Jr and McCrae (1998); Costa Jr et al. (1991) six facets are included in conscientiousness, namely: competence, order, dutifulness, achievement striving, self-discipline, and deliberation. a) Competence in question is the feeling that a person is capable, reasonable, and accomplished (Costa Jr et al., 1991). Costa, et al. hypothesized that the locus of control is related to the competence aspect. b) Order means a tendency to keep one's environment neat and well organized, familiar with some list of personality traits (Costa Jr et al., 1991).c) Dutifulness refers to strict adherence to standards (Costa Jr et al., 1991). d) Achievement striving is a struggle for excellence (Costa Jr et al., 1991). e) Self-discipline is defined as the ability to start a task and complete it despite boredom and other distractions (Costa Jr & McCrae, 1998). f) Deliberation means prudence, planning, and attention (Costa Jr et al., 1991).

Some of the facets that have been outlined are inherent traits or branch properties of the conscientiousness. Hence, this shows that conscientiousness is closely related to the achievements produced because the traits possessed include competence, order, adherence to standards of rules, struggle, self-discipline, and prudence. From facets that were reviewed during this research, conscientiousness was established to include factors such as competence, achievement, self-discipline, and deliberation. A student who has conscientiousness has competence, is eager to struggle for excellence, is disciplined in learning, has carefulness in the act and learning, and is well-planned (Agastya et al., 2020).

v. Perseverance

According to Merriman (2017), perseverance is a human quality associated with outstanding leaders in various domains. A general tendency to perseverance or fortitude (*grit*) has been shown to predict the achievement of individuals in various situations even after considering cognitive abilities and certain other personality traits associated with performance such as *conscientiousness*. This means that perseverance can predict an individual's cognitive abilities in performance achievement since perseverance is associated with caution. Duckworth et al. (2007) define grit as perseverance and passion for a long time. Perseverance is part of grit. Perseverance in this case can be carried out by students continuously. Based on these the current study defines perseverance as an effort by students to get individual achievements in various ways, especially in learning.

vi. Ability to Innovate

Power to innovate or the ability to innovate is intended as a personality trait that students have in learning. The word innovative itself often appears in economic studies of companies that will issue their products. This study understands power to innovate as the ability of students to process and review the learning they have gained to implement in everyday life (giving innovative examples/ideas). This definition corresponds to several expert opinions including (Van de Ven, 1986) who defines the process of innovation as the development and implementation of new ideas by people who carry out transactions with others in an institutional context. Innovation is seen as a multilevel process with a variety of different individual activities and behaviors required at each stage (Scott & Bruce, 1994). According to Kerr et al. (2018), innovative traits can be considered as something common or one's specific personality traits, or as behavioral concepts such as the adoption of new products by consumers. Innovative processes can be honed as experience and learning increase, but innovative traits belong to everyone, depending on how they are processed.

vii. Responsibility

Responsibility is defined as a personality trait of conscientiousness (McCrae & John, 1992). The dependency side of the nature of conscientiousness reflects the degree to which a person is organized, intentionally, methodically, and reliably to fulfill one's duties and responsibilities (Zhao & Seibert, 2006). The two most identified domains of conscientiousness are self-control and responsibility. The highest level of responsibility reflects the tendency to follow up on the promises that have been made to others and follow the rules that have been agreed upon by the social group for the work to be smoother. Responsibility can also be identified as an aspect of consciousness (agreeableness) and is very highly correlated to it. Therefore, its placement may change depending on the content of the actions used in this aspect (Roberts et al., 2014).

The definition of responsibility in science and technology, according to Abel (2020), includes "I-We-World/Nature Relations". Of the three dimensions, "I" means responsible for one's actions (including negligence committed by oneself), "We" means taking responsibility for what others, institutions, or accounting for them as we are collectively involved in such activities; "World/Nature" means responsible for what we do, we must face the challenges of life, society, and nature with future-oriented solutions. Responsibility is also often defined as accountability for their explanations and thoughts, for their knowledge, action, and speech. The person who tends to be responsible will not easily ignore whatever has been agreed with the instructor, he will try to keep it.

viii. Sensitivity

Sensitivity is defined as a person's passion for something. In personality traits, it is often called "sensory processing sensitivity" (SPS). According to Aron and Aron (1997) sensitivity is related to social introversion and is related to emotions. Sensitivity leads to great passion or sensory sensitivity. It is a fundamental attribute of the nervous system. According to Aron et al. (2012), SPS involves the deeper processing of stimuli in a very wide range of situations, supported by greater responses to positive and negative stimuli that can motivate learning and lead to more successful responses in the same situation in future. SPS is a personality trait characterized by sensitivity to internal and external stimuli, including social and emotional cues (Jagiellowicz et al., 2011).

Highly sensitive individuals tend to see more subtle stimuli in their environment and are more easily aroused, while also being able to respond to even lower stimulus (Grimen & Diseth, 2016). From the review, researchers interpret sensitivity as an innate human trait in general. These traits can be processed along with the experience they get. Sensitivity is a personality trait related to emotions and society. Sensitivity intended by researchers specifically is sensitive to science is necessary so that students are sensitive to problems or issues about science in the future.

Research Methodology

- *Research Design*

This study is confined to only the content validation and construct validation.The flow of content validation and construct validation is presented in Figure 1.

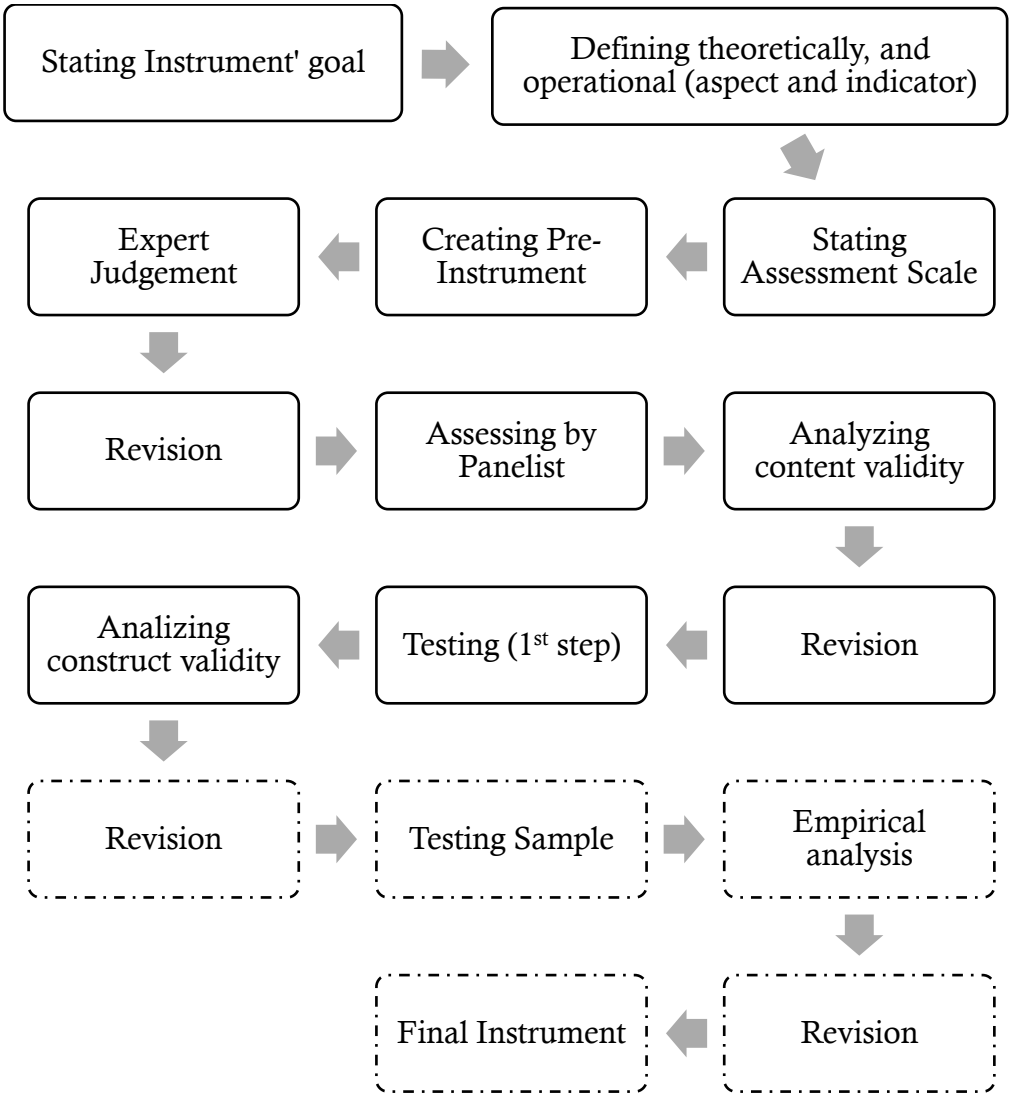

Figure 1 *Content and Construct Validation Flow on Non-Cognitive Skills Instruments*

- *Sampling*

The population of this study was class VIII students in DKI Jakarta Province I nthe age group of 14-15 years old. The sampling technique adopted in this study was *non-probability* or non-random sampling technique carried out through judgmental/purposive sampling methods. First, the areas were selected from the DKI Jakarta province, then the researchers were appointed to identify the sample (Taherdoost, 2016). One school in each city area was selected. The selected schools were in West Jakarta, East Jakarta, South Jakarta, Central Jakarta, and North Jakarta. The sample of students numbered 210.

- *Research Instruments*

A self-assessment instrument was developed for the study and distributed through a google form for identifying the sample. Table 1 presents the instrument used for sampling

Table 1 *Non-Cognitive Skills Assessment Instruments in Junior High School Science Lessons class VIII*

Atribute	Variable	Factors	Indicator
Non-cognitive skills	Attitude and self-confidence	Critical thinking	1) Able to pay attention to the surrounding situation by thinking openly about information and knowledge related to science lessons and global issues about science
			2) Able to present works (in the form of papers) related to the material studied and then associated with global science issues
		Open-mindedness of thought	1) Able to collect information as evidence to complete the discussion in the experimental report as a reference that has been studied (collecting evidence of information about IPA)
			2) Able to give opinions and accept the opinions of others with more accurate evidence
	Habits and processes	Accuracy	1) Able to present experimental data according to what is observed
			2) Able to explain problem-solving by associating data with references that are used simply
		Perseverance	1) Able to be serious in studying the concept of science material as a whole
			2) Able to insist/have a strong ability to present works from various sources of information that can be accounted for their truth
		Accuracy	1) Able to correct the assignment/writing that will be submitted to the teacher
			2) Mampu menyajikan karya dan menyelidiki tentang materi yang dipelajari
		Ability to innovate	1) Mampu menyajikan karya yang inovatif tentang konsep IPA yang telah dipelajari sehingga mudah diingat dan diterapkan dalam kehidupan sehari-hari
	Sensitivity	Responsibility	1) Able to control yourself not to do deviant things, both in the form of written and unwritten rules
			2) Able to take responsibility for the knowledge that has been learned (not plagiarism and cheating)
		Sensitivity	1) Able to be sensitive and respond to events related to science in schools and the surrounding environment of residence
			2) Able to make written works that are relevant to daily life including something consumed including useful or not

- *Data Analysis*

This study used two data analysis technique, namely validity of content with the help of expert judgment and constructs validity using Exploratory Factor Analysis (EFA). In the expert judgement test, the researcher used Delphi's decision-making technique. This technique is used for the selection of expert judgments who have competence in the instruments developed. According to Moore, Delphi's decision-making method referred to the expert in a particular subject including his experience and knowledge (Clayton, 1997). In other words, the expert must have competence in the material to be developed by the researcher. Furthermore, the instruments that were reviewed by experts were revised by researchers, before carrying out an assessment.

According to Clayton (1997) the size of Delphi technique panel depends on the purpose of the study, its complexity, and the expertise required and a size of 15-30 panelists should be for homogeneous populations (i.e., experts who come from the same discipline); 5-10 panelsits for heterogeneous populations, (i.e., people with expertise in a particular topic but coming from different social/professional stratifications). In this study, there were 20 panelists, all homogeneous. The results of the panel was tested using Aiken analysis (Retnawati, 2017).

The second data analysis test was testing the factors, for which Exploratory Factors Analysis was used (Brown, 2015; Hidayat et al., 2018; Z. Hu & Li, 2015). The Factor analysis employed Mplus software with Exploratory Factor Analysis to measure categorical factor indicators, with weighted least-squares estimator with mean and variance adjustment (WLSMV) (Asparouhov & Muthén, 2010; Li, 2014, 2016; B. O. Muthén et al., 2015; L. K. Muthén & Muthén, 2015). The analysis with the determination was used because there was missing data in the instrument results.

Results

An expert review of the research instrument was carried out by three experts, Science Experts, Psychologists, and Linguists. Each expert produced several revisions (three revisions from science experts, three from psychologists, and two from linguists).These experts suggested that the basic competencies that would be used as the initial foundation of the instrument dimensions were basic competencies and that these basic competencies had a soft elaboration (could be adjusted to the abilities of each school when the teacher uses them), for example: presenting measurement data with appropriate measuring instruments on oneself, other living things, and objects around using non-standard units and standard units. Table 2 presents qualitatively the dimensions used in each competency and subject matter.

Table 2 *Results of Science Expert Input on non-cognitive skills instruments in junior high school science lessons.*

No	Things that need to be fixed	Suggestion
1.	Naming non-cognitive skills that fit the term	Accuracy, perseverance, accuracy, responsibility, critical thinking, ability to innovate, open thinking, sensitivity
2.	On competence of "presenting works"	"Perseverance" is required
3.	On competence of "results of the investigation"	For the investigation of the influence of force on motion, it is necessary open-minded: curiosity and not all hypotheses can be proven
4.	On competency of "results of the investigation or problem-solving"	The subject matter of simple aircraft, utilization needs accuracy and open thinking
5	For competence of "making a written work"	For the subject matter of additives and addictive substances, it is necessary to analyze the sensitivity to the issues
6	For competence pf "trial results, effects of activity (type, intensity, or duration) on heart rate frequency"	Analysis of accuracy, open-mindedness, and perseverance is required
7.	On competence of "presenting the data of the results of the experiment"	Analysis of accuracy, open-mindedness, and perseverance is required

After the development of dimensions was completed in the revision, the researcher developed indicators and instrument items, the instrument items also changed such as expert input, to separate questions containing the subject matter. The subject matter used was not all class VIII material, because before separating the question, researchers had received several answers from panelists regarding the subject matter which was often used as an investigation, making works and experiments of class VIII students.

Suggestions for improvement from science experts in the final stage were as follows: 1) the use of different responses depending on the statement given (to unearth the truth of the student); 2) the use of one type of operational verb in each statement; 3) it is not necessary to use all the material taught since not all materials make observations, investigations or creation of works; 4) the use of hot issues in the instrument should be adapted to current conditions.

The second group of panelists, the psychologists, analyzed the usefulness of the term psychology in the instrument, and whether the indicators used were appropriate for junior high school children or too high for them. Table 3 presents the inputs given for making changes in instruments.

Table 3 *Results of Psychological Expert Input on Non-Cognitive Skills Instruments in Junior High School Science Lesson Phase 1*

No.	Things that need to be fixed	Suggested Improvements
1	Conceptual Definition	Explain as clearly as possible the goal of conceptual definition
2	Operational Definition	Non-cognitive skills need to be clarified
3	Dimensions of accuracy in indicator 1, statements no. 1 and 2 are less concrete	State it more concretely, so that the intention of the indicator is conveyed clearly
4	The intent of the statement on the dimensions of perseverance is less by the indicators	Terms in statements should be adjusted for students in junior high school
5	The intent of the statement on the dimension of *conscientiousness is* ambiguous	Fix some ambiguous statements and adjust them to the context of science for students to easily understand
6	In the dimension of the ability to innovate there is a statement that is too high for junior high school students	Fix it to make it easy for junior high school students to understand

These suggestions for improvement were used by researchers to repair instruments. The following were the suggestions for improvement in the stage two by psychologists, namely: 1) Clarify the intent and definition of sensitivity; 2) the response of the answer should not be replaced by hesitation; 3) use terms that junior high school children understand; 4) avoid negation sentences; 5) consult with the teacher for what subject matter the student uses to create works, investigations, and experiments; 6) Do not include two ideas in a single item of the statement; 7) it is best to pay attention to each sentence in the statement so as not to miss measure; 8) It is recommended that sentences with the word 'always' and other superlatives be omitted because they are difficult to respond to, and students tend to give the best response. These suggestions were used to update the statements in the instrument.

The Linguist corrected the phrasing and the language used in the instrument so that it was not ambiguous, and according to the indicators used. Linguists highlighted a few foreign terms that were not necessary to be included in the instrument. It was suggested that the use of punctuation marks on each item was less. The subject in the questioning item also needed to be clarified so that the reader understood the intent of the statement. The researchers revised the instrument according to the inputs provided by linguists.

The revised instruments were tested by the panelists, namely teachers and students. This test was used to determine the readability of the instrument. The panelist test resulted in the form of a classification of instrument items that were compiled into three categories (less validity, medium validity, and high validity) as shown in Table 4. The classification obtained was the result of the validity of the contents of the panelists using Aiken's analysis (Retnawati, 2017). The proposed Aiken's analysis index was as follows:

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

$s = r - lo$

r = Rater/rater category score

lo = lowest score in the scoring category

n = number of raters/appraisers

c = the number of categories chosen by the rater/appraiser

Validity criteria:

V ≤ 0,4: Less validity

0,4 < V < 0,8: Medium validity

V ≥ 0,8: High Validity

Table 4 *Results of Aiken's Analysis on Instruments for Teachers and Students*

Category	No	Validity Criteria	Item
Teachers Instrument	1.	High Validity	2, 4, 5, 10, 13, 29, 30, 37, 38
	2.	Medium Validity	1, 3, 6, 7, 8, 9, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 31, 32, 33, 34, 35, 36, 39, 40
Students Instrument	1	High Validity	3, 7, 11, 12, 15, 19, 20, 25, 34, 35, 37, 38
	2	Medium Validity	1, 2, 4, 5, 6, 8, 9, 10, 13, 14, 16, 17, 18, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 36, 39, 40

The next analysis was the formation of factors using Exploratory Factor Analysis. This exploratory analysis was used to determine the number of its factors, determine the quality of the measuring instrument, identify variables that were poor indicators, and identify factors that were not well measured (Linda K Muthén & Muthén, 2009).

Table 5 *Results of Fit and Residual Variances Models (n = 210)*

Factors	CFI/TLI	SRMR	Res Negative.
1	0.364/0.342	0.195	-
2	0.496/0.460	0.164	-
3	0.639/0.599	0.138	-
4	0.792/0.761	0.107	-
5	0.829/0.796	0.097	KNK1
6	0.863/0.829	0.086	KNK2
7	0.880/0.846	0.076	KNK2
8	0.897/0.862	0.071	KNK2

CFI: Comparative Fit Index

TLI: Indexes Tucker Lewis

SRMR: Standard Root Mean squared residue

Tabel 6 *Geomin rotated loadings (sign at 5%) for accepted item*

No	Factors							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	.907							
2	1.061							
7	.532							
13		.777						
17			.445					
20			.514					
23			.646					
26				.648				
32					.803			
36					.644			
40					.675			
41					.419			
45						.578		
53							.530	
54							.560	
55								.710
57								.390

Geomin rotation was by default used in Mplus software. Geomin is also a rotation that can work for simple and quite complicated matrix loading structures. For a more complicated example, Geomin will give better results (Asparouhov & Muthén, 2009).

Tabel 7. *Cross Loading*

No.	Factors						
	1	**2**	**3**	**5**	**6**	**7**	**8**
8	.442	.536					
9	.289		.457				
10	.343		.567				
14		.257	.627				
35				.334	.608		
42				.358	.391		
43				.524	.273		
44					.379	.492	
47					.304		.670
48					.314		.589
49					.144		.370
51						.336	.452
59						.817	.231
60						.611	.449

Discussion

Students demonstrate their skills of reasoning, processing, and studying in a creative, productive and critical, independent, collaborative, and communicative realm, in the concrete realm and the abstract realm according to those

learned in school and other similar sources in the point of view/theory (Kementerian Pendidikan Dan Kebudayaan, 2017). In this case, the researcher needed to develop operational verbs and desired properties at minimum standards that students must master, to find the right dimensions, to examine the properties of non-cognitive skills that were based on theories. In this nature, it had several facets that could be used as the basis for making this instrument. For example, data was measured with appropriate measuring instruments on oneself, other living things, and surrounding objects using non-standard units and standard units. This included subject matter of Science Concepts: Units and quantities, Characteristics of living things, and properties of objects. These subject matter concepts required measuring non-cognitive skills in the form of accuracy, perseverance, environmental awareness (these were the observations of the characteristics of living beings and the nature of things), and responsibility (these skills were attached to all competencies, in the learning process when students were given tasks either individually or in groups, such as they made observations, investigations, and experiments, work-making projects).

The instrument used in the current study had already been used for all grade levels in Junior High School in previous studies with factors: *accurateness; perseverance; conscientiousness; responsibility; critical thinking; innovation; open-mindedness; sensitivity; empathy; and environmental awareness* (Agastya et al., 2020). The current study used these scales only for class VIII, after making this instrument more effective for measuring non-cognitive skills despite the limitations of the research.

The science expert recommended not to use all the material taught. This aimed to anticipate the accumulation of statements on instruments that produced the same analysis, for example: when researchers used the verb "present work," not all subject matter that required the presentation of the work was made a statement. Analysis of the word presenting the work in a subject matter showed the dimensions of students' critical thinking on variables of student attitudes and beliefs towards the science subject matter. Apart from these considerations, this instrument aimed at junior high school students in class VIII, so a small number of questions were better for the quality of students' answers.

The psychologist recommended that a few statements were too high for the understanding of junior high school children (on the dimension of the ability to innovate). For example, a statement said, "I try to make a simple formula to understand the concept I got". This was replaced with "After getting and understanding the material presented by the teacher, I summarize it with mapping to make it easier to learn". The dimension of the ability to innovate had one indicator, namely the ability to present innovative work about science concepts that were studied so that it was easy to remember and apply in everyday life. The ability to innovate in question was the ability of students to process and review the learning they had gained to implement in everyday life (giving innovative examples/ideas). The teacher could find out by giving essay assignments or simply written works. The evaluation of the psychologist for the final stage underlined the statements that made students tend to give the best answers. This was needed to avoid getting answers that measured the correctness of students' non-cognitive skills.

After incorporating these suggestions into the instruments, it was pilot tested on students. The final instrument was a 60-item instrument with 3 types of response answers. The result that needed to be considered was the use of sentences in instrument statements because the intended respondent was a grade VIII junior high school student. The use of light and clear sentences made it easier for students to give their opinions, and there was no misconduct. In teacher's instrument, the question items which had high validity (Table 4) were understood by the teacher and answered by the teacher, while the items with medium validity were themed questions. These themed questions included several themes that teachers were likely to use to assess students' non-cognitive habits and skills in science lessons. Themed items numbered as 1, 14, 24, 27, and 39 were revised by eliminating themes (subject matter) that were not used in the assessment of non-cognitive skills so that the themes raised were narrower. In addition to the items with the theme, other items in the instrument were corrected so that the reader understood the questions unambiguously.

In the original instrument (used for panelist assessment), there were 12 subject matter items shown to the teachers, to choose which subject item should be used to assess skills (investigation, experiment, present work, present data on experimental results, and create works). This selection was used in this study to make statements that could be used to assess students' non-cognitive skills.

The results of the second research test were the panelist test of junior high school students, which was intended to determine the readability of the instrument by junior high school students of class VIII. The results of the student panelist test are found in Table 3. In the item with high validity (Table 4), the students were well acquainted with the questions and the possibility of the desired answers (the question led the student to answer

to strongly agree or strongly disagree). The language of a few statements was changed, for example: "I am used to looking for articles/materials to solve problems in new subject matter, to be able to discuss in detail" was revised as: I'm used to looking for additional subject matter on the internet to solve problems on the new subject matter, to be able to discuss in detail. After the revision, the answer choices were also changed so that students did not answer with a high response only and chose answers according to the revised statement.

In the items with moderate validity (Table 4), students were familiar with the sentences in the statement, and there were several themed questions that students chose, a few of which had more than one theme. The researcher took a middle ground between the teacher's answers and the students' answers to find out what themes the teacher used to teach non-cognitive skills to students. The results of the panelists were used to revise the instruments to be used for limited trials. Limited trials were intended to determine the validity of the instrument on a small scale.

This analysis involved missing data, where the data was empty because students did not choose the specific subject matter mentioned by the instrument, so the missing data analysis was still used. The data used was missing, so the estimator used was a WLSMV (weighted least-squares with mean and variance adjustment) estimator. The criteria used were CFI and SRMR values (L. t. Hu & Bentler, 1999) where the number of $N \leq 250$, so that if the cutoff value chosen was CFI < 0.96 and the SRMR > 0.06. According to the Table 5, eight factors were formed and in factors 5, 6, 7, and 8, there were 1 and 2 items respectively that were dropped. But to determine the quality of variables, it was necessary to analyze the Geomin loading factor contained in the output. As seen in Table 6, out of 60 question items, 17 questions corresponded to the significance of Geomin rotation. For the question items included in the cross-loading, 14 items were displayed in Table 7. On this question, the factors and indicators were matched. If they matched, they were included in the item used. If the possibility was wrong in the item, it was deleted. For question items that were themed (missing data), the researcher reviewed the theme as well as the question item (Linda K Muthén & Muthén, 2009).

The results of cross-loading were identified through variables, if the variables were bad, they were dropped. The decision on the dropped item was reviewed through the item editor. The EFA was used in this instrument with the scope of material contained in the science lesson of junior high school class VIII, in order to use the factors. Z. Hu and Li (2015) state that EFA is a stage to explore the relevance between common factors and variable measurements, so there was no index in the EFA to indicate which model was better.

Conclusion

This study presented results after correlating the assessment instrument items with the results of the cognitive assessment of students to assist the teachers to analyze the potential that students had in science lessons. The use of these non-cognitive assessments helped the teacher to know to what extent students understood explicitly the learning of science in everyday life. Besides, the understanding of instrumental statements aimed at junior high school children was also one of the students' reading abilities, the ability to understand texts by students was easier to give relevant answers so that it had a positive effect on their achievements in mathematics and science (Akbasli et al., 2016). Therefore, the preparation of text statements needed to pay attention to students' ability to read and understand so that they will get the answers needed.

The current research findings can be used as a reference for the process of content validation and construct validation of new instruments. This study would also serve as a useful study to fill the research gap as it developed instruments to use in the right construct of a specific subject. The constructs that were formed in this study are transferable and replicable, and can be used in future studies, namely, even to test the instruments using a large sample. Future research can further analyze items in the instrument, to search the item bias. It is recommended that this instrument can be used on teachers and parents too, to know the extent of students' non-cognitive skills. Future research may also use a larger sample and other grades at junior high school levels. Future studies can use Confirmatory Factor Analysis (CFA) to confirm the factors formed.

The limitations of this study included that this research was only focused on class VIII of junior high school. In addition, the use of large samples would affect the result of the validation of this instrument. Other researchers who disagree with this analysis can use CFA instead of EFA and then it should be further analyzed. The implications of this study are that: first, content validation and construct validation studies can be carried out by dropping items and carrying out the analysis through the variables, and if variables are bad, the drop decisions could be reviewed through indicators; secondly, this method can be used as a reference for item analysis.

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