



ANALYSIS OF DIFFICULTY LEVEL OF PHYSICS NATIONAL EXAMINATION'S QUESTIONS

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ABSTRACT

This study aimed to determine: (1) the difficulty level of items in physics National Exam of 2013 (2) physics materials that were difficult and very difficult. The subjects were all students of science major in third grade at SMAN Banda Aceh in the academic year of 2013/2014. The samples were 10 randomly selected senior high schools. The data were obtained through analyzing the answers of physics National Exam 2013. The results showed that (1) the high school students in Banda Aceh experienced difficult and very difficult level questions to be answer in the 2013 exam, (2) the difficult materials were: free fall, the potential energy and series of obstacles. The very difficult materials were: the rotational motion, motion and force on the pulley, effort, fluid, sound intensity, transformer, atomic theory, quantum theory, relativity, fusion and radio isotopes.

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Keywords: item analysis, item difficulty, physics.

INTRODUCTION

Measurement of learning results is conducted by the government embodied in the form of National Examination (Regulation of the Minister of National Education of Indonesia Republic Number 20 of 2007). National Exam is one of government efforts to spur an increase in the quality of education. Various studies indicate that by National Exam, students are encouraged to learn better and teachers are encouraged to teach better.

National Exam is used as a standardization tool to test the feasibility of a student to be able to continue his/her education to the higher level and as the distribution of education nationwide. The exam result is also used as a benchmark against other countries' education.

In relation to the learning outcomes, the instruments can be set as test or non-test. At high school National Exam, the measured outcomes

are mostly cognitive score using written tests, whilst the behaviour in the form of affective and psychomotor is measured through School Final Examination (UAS), which uses both tests and non-test. The test is an instrument to detect the subjects that has not been well understood by students. In National Exam, it is a mean to determine the ability or student mastery of the material in accordance with the basic competences/standard competence.

After some time, the implementation of the National Exam should have been maximized. However, an unlikely phenomenon shows that the percentage of graduation of senior high school students who join National Exam is not yet satisfactory. Sindonews.com, 26-05-2013, reported that Aceh and Papua province recorded the lowest graduation score in National Exam of 2013. Nationally, the number of unsuccessful rate of senior high school National Exam was 3.11 %, or 1,152 students. This number was the highest in Indonesia, followed by Papua province in second, and Central Sulawesi ranked third.

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In Banda Aceh city, the number of exam participants majoring in science was 1663 people, among them 42 people or 2,526% did not pass. From the education centre data, Banda Aceh resulted a relatively low Physics score ranges from 4.00 to 5.59 for 86 people or 5.17%, the range of 5.50 -5.99 for 23 people or 1.38%, and the range of 6.00 -6, 99 for 68 people or 4.09%.

Based on the data and the description can be concluded that students of SMA N of Banda Aceh encountered difficulties in answering the National Exam of 2013 especially in Physics. Referring to the problem, the purpose of this study was to determine: (1) The level of difficulty of the question in physics National Exam 2013 for high school students in Banda Aceh, (2) The difficult or very difficult physics subjects for high school students in Banda Aceh. The results of this study can be used as input and consideration for physics teachers, Principal of SMAN, and the Education Service of Banda Aceh in improving the quality of teaching physics in senior high school.

A test is a measurement tool that is specifically used to know someone's cognitive abilities. Assessment by using written tests most commonly used to determine students' cognitive ability (Rofiah et al. 2013). Typically, when a student has completed a subject, some part of the lesson, or at the end of the lesson the teacher gives a test to measure the extent of understanding and the learning outcomes of individuals or groups. One function of the final exam is to certify that students have learned or mastered the skills as demanded by the curriculum (Siskandar, 2008).

Test as a measurement technique can be interpreted as a gauge that has objective standard that can be used to calculate and to compare psychological circumstances or individual behaviours (Matondang, 2009). To measure student's ability to master a subject, the Government implements a form of test or evaluation through the National Examination. Implementation of the exam is the act of measuring the competence of graduates in terms of cognitive aspects nationally in primary and secondary education (Aisha, 2013).

The tests used in National Exam are objective multiple choice test. Objective multiple-choice test contains a set of questions with a number of possible answers to be chosen by the test taker. Examinees freely select an answer from the list so that the correction and scoring can be done objectively by the examiner. The checking of National Exam Answer Sheet (LJUN) is usually done using a scanner device.

National Exam's questions have been stan-

darized by the National Education Assessment Centre (Puspendik). The device has gone through trial process in all area, so it is believed to have met all the requirements as a good test. The parameters that must be met for standardized tests are the validity, reliability, level of difficulty, differentiating power and decoys' effectiveness.

In this study, the sole tested parameter was the items level difficulty. The difficulty of the questions can be defined as the proportion of the number of test participants (students) who can correctly answer certain item (Boopathiraj and Chellamani, 2013). This proportion is usually expressed in terms of difficulty index in the range of 0.00 to 1.00 (Sabri, 2013). The calculation is done to each item. The greater the level of difficulty index obtained from counting means the easier it is answered. The difficulty index level is counted using following formula: Level of difficulty (p) = Amount of students answered correctly / Sum of all test participants (Widodo, 2010).

Physics National Exam is a written test in multiple choice forms with each question contain four choices. This type of test can be evaluated easily, quickly, and having high objectivity, measuring various cognitive levels, and can include a wide scope of materials (Ministry of National Education, 2007). Written test in the form of multiple choice questions is widely used in exam with many test takers.

National Examination is a standard evaluation system for primary and secondary education nationally and equality of education level quality between regions conducted by the Centre for Educational Assessment at the Ministry of National Education. Evaluation is an inseparable part of the learning process. Evaluation aims to find out, improve and enhance the quality of the learning process (Ratnaningsih et al., 2013). The evaluation is always preceded by the measurement activities, the process of determining the number according to certain rules, continued by assessment. Evaluation is done toward the measurement results and assessment information (Purnomo and Munadi, 2005). The measurement results on a score that describes the level of success of student learning based on predetermined criteria.

METHOD

This study is a descriptive diagnosis research. The subject (population) in this study were all students of high school 3rd year science major of Banda Aceh in the education year of 2013/2014, while the samples were SMAN 1,

SMAN 2, SMAN 3, SMAN 4, SMAN 5, SMAN 6, SMAN 7, SMAN 8, SMAN 10 and SMAN 12 Banda Aceh. Determination of the samples was conducted using random sampling techniques. The object is the level of difficulty of Physics National Examination items in 2013. The research was conducted on December 10th, 2013 until March 12th, 2014.

The designated instrument was the questions of Physics National Exam in 2013. The difficulty level of the data in the form of a response or answer of high school students in the academic year 2013/2014 were analysed with Microsoft Office Excel 2007. The classification of difficulty level based on Safari (2012) as follows: 0.00 to 0,30 is difficult; 0.31 to 0.70 means medium; and 0.71 to 1.00 is easy. In particular, the difficult level is divided into difficult and very difficult categories. If the difficulty level reaches ≤ 0.25 , it is considered extremely difficult (Kusaeri and Suprananto, 2012).

RESULTS AND DISCUSSION

The results of the analysis of students' answers on the 10 high schools and the difficulty level of National Examination in 2013 for each school:

SMA Negeri 1 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 1 are shown in Figure 1.

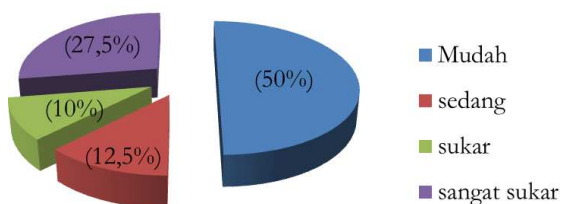


Figure 1. Difficulty level of National Exam in SMA Negeri 1 Banda Aceh

Difficult items were: item 2 (vector), item 3 (free fall), item 5 (motion on an incline), and item 34 (transformer). Very difficult items were: item 4 (rotational motion), item 6 (motion and force on the pulley), item 9 (effort), item 15 (fluid), item 30 (series of resistance), item 32 (magnetic field), item 36 (atomic theory), item 37 (quantum theory), item 38 (relativity), item 39 (fusion reaction), and item 40 (radioisotopes).

SMA Negeri 2 Banda Aceh

Of the 40 items tested, the results of the

analysis of the answers for SMA N 2 are shown in Figure 2.

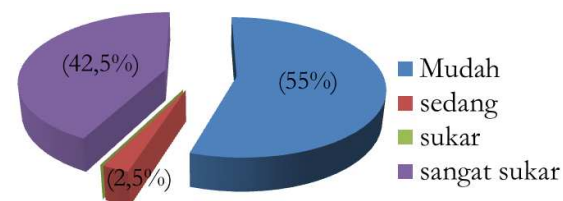


Figure 2. Difficulty level of National Exam in SMA N 2 Banda Aceh

The very difficult questions were: item 1 (measurement), item 2 (vector), item 3 (free fall-motion), item 4 (rotational motion), item 5 (motion on an incline), item 6 (motion and force on the pulley), item 9 (effort), item 15 (fluid), item 25 (sound intensity), item 31 (magnetic induction), item 32 (a magnetic field), item 33 (induction electromagnetic), item 34 (transformer), item 36 (atomic theory), item 38 (relativity), item 39 (nuclear reaction), and item 40 (radioisotopes).

SMA Negeri 3 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 3 are shown in Figure 3.

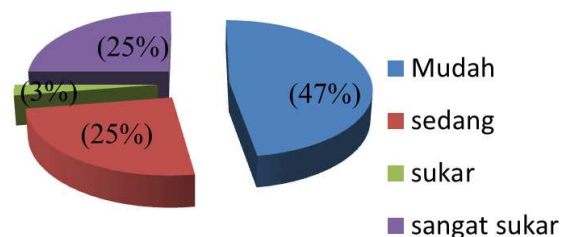


Figure 3. Difficulty level of National Exam in SMA N 3 Banda Aceh

The difficult question was item 32 (a magnetic field) and the very difficult problems were: item 4 (rotational motion), item 5 (motion on an incline), item 6 (motion and force on the pulley), item 9 (effort), item 11 (potential energy) item 17 (temperature and heat), item 29 (series capacitor), item 38 (relativity), item 39 (fusion reaction), and item 40 (radioisotopes).

SMA Negeri 4 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 4 are shown in Figure 4.

The difficult problems were: item 3 (free fall), 30 (series of resistance), and 31 (magnetic induction), and the very difficult questions were: item 4 (rotational motion), item 5 (motion on an

incline), item 6 (motion and force on the pulley), item 9 (effort), item 15 (fluid), item 25 (sound intensity), item 32 (a magnetic field), item 36 (atomic theory), item 37 (quantum theory), item 38 (relativity), items 39 (fusion reaction), and item 40 (radioisotopes).

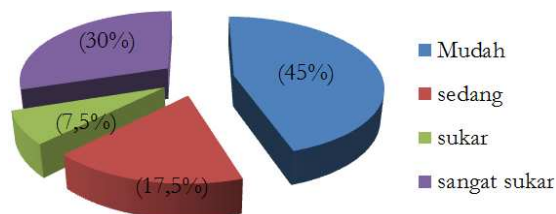


Figure 4. Difficulty level of National Exam in SMA N 4 Banda Aceh

SMA Negeri 5 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 5 are shown in Figure 5.

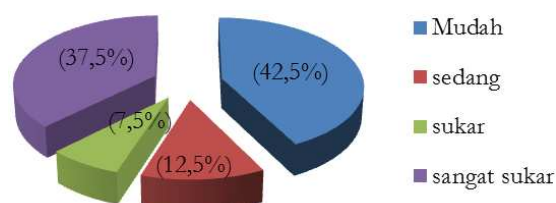


Figure 5. Difficulty level of National Exam in SMA N 5 Banda Aceh

The difficult problems were: item 1 (measurement), item 5 (motion on an incline) and item 38 (relativity). The very difficult items were: item 2 (vector), item 3 (free fall), item 4 (motion rotation), item 6 (motion and force on the pulley), item 9 (effort), item 15 (fluid), item 16 (temperature and heat), item 19 (thermodynamics), item 31 (magnetic induction), item 33 (electromagnetic induction), item 34 (transformer), item 36 (atomic theory), item 37 (quantum theory), item 39 (fusion reaction) and 40 (radioisotopes).

SMA Negeri 6 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 6 are shown in Figure 6.

The difficult problems were item 2 (vector) and item 11 (potential energy), while the very difficult questions were: item 3 (free fall), item 5 (motion on an incline), item 9 (business), item 15 (fluid), item 17 (temperature and heat), item 26 (Coulomb's law), item 30 (series of resistance), item 34 (transformer), item 36 (electromagnetic induction), item 37 (quantum theory) and item 39 (fusion reaction).

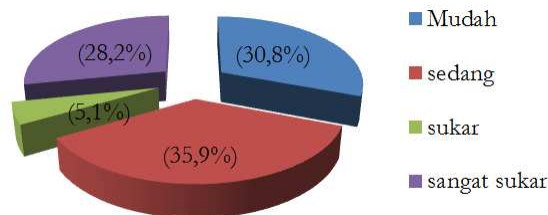


Figure 6. Difficulty level of National Exam in SMA N 6 Banda Aceh

SMA Negeri 7 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 7 are shown in Figure 7.

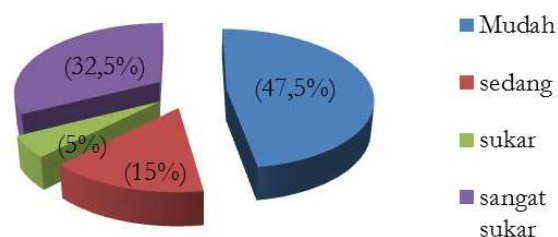


Figure 7. Difficulty level of National Exam in SMA N 7 Banda Aceh

The difficult problems were item 10 (elasticity) and item 29 (series capacitor). Meanwhile, the very difficult problems were: item 2 (vector), item 5 (motion on an incline), item 6 (motion and force on the pulley), item 15 (fluid), item 17 (temperature and heat), item 25 (the sound intensity), item 30 (series resistance), item 31 (magnetic induction), item 34 (transformer), item 37 (quantum theory), item 38 (relativity), item 39 (fusion reaction), and item 40 (radioisotopes).

SMA Negeri 8 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 8 are shown in Figure 8.

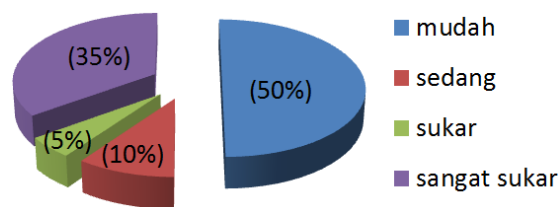


Figure 8. Difficulty level of National Exam in SMA N 8 Banda Aceh

The difficult questions were item 17 (temperature and heat) and item 33 (electromagnetic induction). While the very difficult items were: item 2 (vector), item 3 (free fall), item 4 (rotational motion), item 5 (motion on an incline), item

6 (motion and force on the pulley), item 9 (effort), item 15 (fluid), item 31 (magnetic induction), item 32 (magnetic field), item 34 (transformer), item 36 (atomic theory), item 38 (relativity), item 39 (fusion reaction), and item 40 (radioisotopes).

SMA Negeri 10 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 10 are shown in Figure 9.

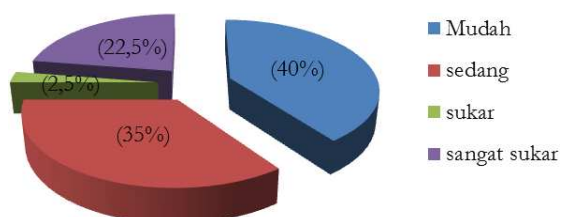


Figure 9. Difficulty level of National Exam in SMA N 10 Banda Aceh

The difficult problem was item 3 (free fall). The very difficult items were: item 4 (rotational motion), item 9 (effort), item 25 (sound intensity), item 32 (magnetic field), item 36 (atomic theory), item 37 (quantum theory), item 38 (relativity), item 39 (fusion reaction), and item 40 (radioisotopes).

SMA Negeri 12 Banda Aceh

Of the 40 items tested, the results of the analysis of the answers for SMA N 12 are shown in Figure 10.

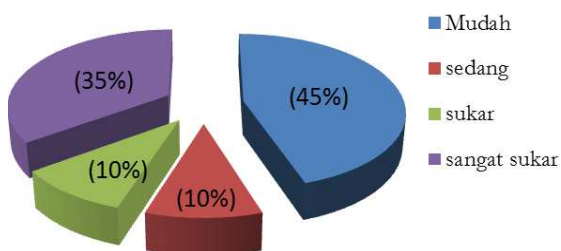


Figure 10. Difficulty level of National Exam in SMA N 12 Banda Aceh

The difficult problems were: item 3 (free fall), item 11 (potential energy), item 17 (temperature and heat), and item 30 (series resistance). The very difficult items were: item 2 (vector), item 4 (rotational motion), item 5 (motion on an incline), item 6 (motion and force on the pulley), item 9 (effort), item 13 (collision), item 25 (sound intensity), item 33 (electromagnetic induction), item 34 (transformer), item 36 (atomic theory), item 37 (quantum theory), item 38 (relativity), item 39 (fusion reaction), and item 40 (radioisotopes).

Based on the research findings, we concluded that the students still regarded physics as difficult subjects. Compared with other science material, students seem to dislike the physics rather than chemistry and biology (Erinosho, 2013). Fauzi and Radiyono (2011) suggested that the results of several studies on students' perception toward physics showed that physics often regarded as a complicated subject. Johnson (2012) also stated that the difficulties faced by students in solving physics problems is linking the problem to other subject especially mathematics. Almost all of senior high school students in Banda Aceh found it extremely hard to solve items 36 (atomic theory), 37 (quantum theory) 38 (relativity), 39 (fusion reaction) and item 40 (radioisotopes), due to the abstract concepts underlying them. As it is known that there are both abstract and concrete concepts in physics. Rahmawati et al. (2012) suggested that the abstract physics concepts are hard to visualize, making them difficult to be digested. Suzuk et al. (2011) added that physics is one of the most difficult lessons for its theoretical presentation, sometimes without the application of mathematical and abstract to everyday examples. According to Sabdin (2013), the unsuccessful effort of mastering the concepts of physics are mainly caused by three things: (1) the nature of physics itself, (2) the implementation of the teaching is not good/appropriate, and (3) the character of the learning. The material abstract characteristic of physics causes student to have difficulties in studying physics concept unless it is associated with everyday experience. Sugiharti (2005) suggested that only by mastering the concept of physics, the entire physics problem can be solved, both physical problem that exists in everyday life as well as physical problems in the form of questions, though the teacher still plays important role for the success of students. Barinto (2012) proposed that teachers are critical components in the success of an education because teachers are the spearhead in direct contact with students as subjects and objects of study. Physics as the basic science that will shape the analytical, logical and systemic mindset of students (Sunaryo, 2011), thus to learn and understand physics students must memorize, master the concepts of physics and have a strong mathematical foundation.

Item 9 (effort), 36 (atomic theory), 37 (quantum theory), 4 (rotational motion), 6 (motion and force on the pulley), 15 (fluid), 25 (sound intensity), and item 34 (transformer) were relatively concrete, but students find it very difficult, most likely because of the incorrect implementa-

tion of teaching. Ornek et al. (2008) showed that some factors causing physics become difficult can be categorized into: 1) a lack of motivation, interest, hard work and background knowledge, 2) Factors associated with learning, e.g. many assignments, class structure, not inadequate teachers, 3) factors related to the characteristics of the context of the physics of which is cumulative, abstract, involves a lot of things to learn, and requires a good understanding of mathematics. Physics as a subject related to the magnitudes of physical and mathematical calculations implies to almost all branches of physics resort to problem solving (Ogunleye, 2009).

here are two factors that could determine the success of students in answering questions in National Exam, they are mastering exam materials and mastering the cognitive level of the questions. If the physics teacher rarely gave a high level C4, C5 and C6 problems in school exams because of the inability to construct it, students would surely have difficulty answering the questions even though they master the materials. Results of research by Yusrizal & Zarlaida (2011) showed that the assessment components of student learning outcomes by certified Physics, Chemistry and Biology teachers in senior high schools of Banda Aceh are still apprehensive. According to Munasco (2013) the factor of the teachers' qualification is considered as the most dominant and highly influences the learning outcomes of physics, and the test format will bring an impact on students' unsatisfactory learning outcomes.

CONCLUSION

Based on the analysis, the researcher can draw some conclusions: (1) The students of SMA Negeri Banda Aceh encountered difficult and extremely difficult levels of questions in the National Examination of 2013, (2) materials that were perceived as difficult and extremely difficult by SMA N students of Banda Aceh were: fusion reaction, radio isotopes, rotational motion, motion and force on the pulley, relativity, fluid, sound intensity, atomic theory, quantum theory, and transformers.

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Appendix 1 The Grille and Questionnaire of Thinking Skills

Thinking Skills	Aspect	Score
Self Regulated Thinking	A. Realizing Mind Your Own Way	
	Consistent and accurate explain in detail a series of thinking used when faced with a task or problem and provides an analysis of how awareness of his way of thinking was evident from his appearance.	4
	Consistent and accurate explain how to think through tasks or problems and how awareness of the way he thinks it visible and appearance.	3
	Sporadic but accurately explain how to think through tasks or problems and how awareness of the way he thinks it is apparent from the appearance.	2
	Rare but accurately explain how to think through tasks or problems and how awareness of the way he thinks it appears from his appearance.	1
	B. Creating an Effective Plan	
	Consistent make the right destination, consider and take into account all the short-term goals that are considered necessary and make a detailed implementation time.	4
	Consistent making purposes, pay attention to short-term goals, and create a detailed implementation time.	3
	Sporadic making purposes, pay attention to short-term goals, and create a detailed implementation time.	2
	Rarely when working on making purposes, pay attention to short-term goals, and create a detailed implementation time.	1
	C. Realized and Using Resources You Need	
	Consistent display caution, detail to assess the resources required before starting the task. Repeat the resources available and consider alternatives. Anticipating the steps in a task that may be required as an additional source.	4
	Consistent assess the project to identify which parts require resources. Repeats of alternative sources to determine whether it is suitable for the project.	3
	Sporadic assess the project to identify the resources needed for the project, and often look for alternative sources.	2
	Rarely, if carried out to assess the project to identify the necessary resources and often seek alternative sources clear.	1
	D. Against sensitive Feedback	
	Consistent sensitive to diverse feedback. Always respond appropriately when approach deemed does not work well and look for advice and other sources of knowledge.	4
	Consistent attention to the main source of feedback and responses are varied, making adjustments when necessary correction. Listening to the advice of others.	3
	Sometimes noticed the main source of feedback and responses are varied, making adjustments when necessary correction, listen to the advice of others.	2
	Rarely when done, pay attention to the main source of feedback. Rarely respond and make adjustments when necessary corrections. Do not pay attention to the advice of others.	1
E. Evaluation of Effectiveness Measures		
Consistent repeat actions that have been done and the things that are considered useful, the evaluation of the impact of measures both short term and long term, finding good value in the lessons of success and failure.	4	
Consistent repeat the action and objective view reasonable, considering the short-term effects, and find lessons in his/her work.	3	
Sporadic repeat the action and objective view reasonable, considering the short-term effects, and find lessons in his/her work.	2	
Rarely repeats the action and objective view reasonable, considering the short-term effects, and find lessons in his/her work.	1	

Appendix 1 The Grille and Questionnaire of Thinking Skills

Thinking Skills	Aspect	Score
Critical Thinking	F. Accurate and Seek Accuracy	
	Consistent attention to detail where appropriate, match the information on all important resource, recognizing inaccuracies quickly, and make the correction of errors, and clear.	4
	Consistent attention to detail, to test multiple sources, identifies and correct inaccuracies.	3
	Sporadic attention to detail, to test multiple sources, identifies and correct the inaccuracies.	2
	Rarely attention to detail, to test multiple sources, identifies and correct inaccuracies.	1
	G. Clearly and Seek Clarity	
	Consistent creating a complete and free work and confusing elements.	4
	Consistent key element creates jobs free from confusing elements.	3
	Sporadic key element creates jobs free from confusing elements.	2
	Rarely key element creates jobs free from confusing elements.	1
	H. Open-minded	
	Consistent overcome differences and divergent views and to consider alternative viewpoints in a fair and rational.	4
	Consistent aware of different views and always strive to consider alternative views.	3
	When aware of different views and sporadically sought to consider alternative views.	2
	Rarely aware of different views and infrequently seek to consider alternative views.	1
	I. Preventing Properties Impulsive	
	Consistent and carefully consider the situation if it needs further study before doing the work, if necessary, follow-up study, conducted detailed research before doing work.	4
	Consistent consider the situation if it needs further study before doing the work; if necessary, follow-up study, gather enough information before doing work.	3
	Sporadic consider the situation if it needs further study before doing the work; if necessary, further studies, sometimes gather enough information before doing work.	2
	Rarely consider the situation if it needs further study before doing the work; if necessary, follow-up study, did not gather enough information before doing work.	1
	J. Taking Attitude When No Warranty	
	Consistent take appropriate attitude towards the situation, the value of which is displayed and views are not revealed. In addition to providing strong evidence to support its position.	4
	Consistent take appropriate attitude towards the situation and the views were ignored. Always provide enough validation for his/her attitude.	3
	Sporadic take appropriate attitude towards the situation and a clear stance. Sometimes provide enough validation for his/her attitude.	2
	Rarely take appropriate attitude towards the situation and a clear stance. Rarely provide enough validation for his/her attitude.	1
	K. Noting feeling and level of ability of Others	
	Consistent shows insight to the feelings and the level of ability of others that appear when communicating. Always give positive impetus to such differences.	4
	Consistently shows ability to communicate with people of different feelings and knowledge and respect for the feelings, knowledge and abilities of others.	3
Sporadic demonstrate the ability to communicate with people of different feelings and knowledge and respect for the feelings, knowledge and abilities of others.	2	
Rarely demonstrates the ability to communicate with people of different feelings and knowledge and respect for the feelings, knowledge and abilities of others.	1	

Appendix 1 The Grille and Questionnaire of Thinking Skills

Thinking Skills	Aspect	Score
Creative Thinking	L. In Constantly seek Completing Tasks Although the answer Could Not Anticipated	4
	Consistent shows the seriousness of reaching a solution, get involved. and develop and use many approaches to keep seeking duties	3
	Consistent shows seriousness and approaches to keep seeking tasks.	2
	Sporadic shows seriousness and approaches to keep seeking tasks.	1
	Rarely demonstrates its seriousness and approaches to keep seeking tasks.	
	M. Encouraging Self-Yourself to Try Something Not Sure Can Do	4
	Consistent look for challenging tasks and tasks to complete to complete or to gain significant understanding.	3
	Consistent accept existing challenges and tasks to complete to complete a task or to gain significant understanding.	2
	Sporadic accept existing challenges and tasks to complete to complete or to gain significant understanding.	1
	Rarely accept existing challenges and tasks to complete or to gain significant understanding.	
	N. Produce, Trusting, and Using Evaluation Standards for Work	4
	Consistent generate personal standards for tasks that can raise the level of quality of the task and follow the standard in order to obtain the final product.	3
	Consistent generate personal standards for the task and follow the standard in order to obtain the final product.	2
	Sporadic generate personal standards for the task and follow the standard in order to obtain the final product.	1
	Rarely produces personal standards for the task and follow the standard in order to obtain the final product.	
O. Make a New Perspective Unlike the Perspective Generally	4	
Consistent explore as many alternatives and resources that enable and analyze how the alternatives affect the results obtained. Alternative describes a variety but a very useful way to look at the situation.	3	
Consistent yield approach to the task and clicking analyzes how these alternatives affect the task. The alternative approach originally created as a student to complete the task.	2	
Sporadic generating approach to the task and clicking analyzes how these alternatives affect the task. The alternative approach originally created as a student to complete the task.	1	
Rarely produce and how to approach the task of analyzing how the alternatives affect the task. The alternative approach originally created as a student to complete the task.		