The divergent thinking of basic skills of sciences process skills of life aspects on natural sciences subject in Indonesian elementary school students

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Abstract

This research aims at measuring the divergent thinking of basic skills of science process skills (SPS) of life aspects in Natural Sciences subjects on Elementary School. The test instruments used in this research have been standardized through the development of instruments. In this case, the tests were tried out to 3070 students. The results of the try out indicated that all test items are fitted with the Partial Credit Model (PCM) using Quest Program. The measurements for the larger scale were performed to 7867 students selected using purposive sampling techniques by

considering the distribution of the schools in Yogyakarta Special Province i.e. the schools in the province, regencies, and districts. Findings are (1) the different indicators for each aspect of basic skills leads to the different attainment levels, and (2) with regard to grades 4,5, and 6, the higher the grades are, the higher the achievement percentage will be.

Keywords: divergent thinking, science process skills, Partial Credit Model

Introduction

It is evident that learning natural sciences serves an important role in establishing scientific attitude, processes, and products on the part of students of any levels. This is in line with the statement proposed by Carin and Sund (1989) who strongly urge that the essence of learning Natural Sciences is aimed to train students to investigate natural phenomena in order to find scientific products through a scientific process based on scientific attitude on the grounds that a considerable body of evidence highlights how inquiry-based science can enhance students'epistemic and conceptual understanding of scientific concepts, principles, and theories (Zhai, Jocz, & Tan, 2014).

Scientific processes involve aspects of SPS. If the scientific processes are arranged in a particular order, it is called the scientific method (Towle, 1989). The learning that can enhance learners' mastery inevery aspect of the science process skills is badly needed in order that they can master the scientific process. SPS consists of basic skills, process skills, and investigative skills. SPS should be taught to students especially for basic skills in earlier grades of elementary schools. After mastering basic skills, the students may step by step learn the process skills and are taught SPS as a unified of scientific method in the form of investigative skills.With regard to this, it is important to investigate the mastery of basic skills of students in elementary schools starting from grade 4.

Science Process Skills (SPS)

With regard to basic processes, Rezba et al. (2007) state that SPS can be divided into basic process skills and integrative process skills. Basic process skills include observing, communicating, classifying, measuring metrically, inferring, and predicting. Meanwhile, integrative process skillls consist of identifying variables,

constructing a table of data, constructing a graph, describing relationships between variables, acquiring and processing your own data, analyzing investigations, constructing hypotheses, defining variables operationally, designing an experiment, and experimenting. This classification is similar to that of Chiappetta (1997) who divides SPS into two aspects, namely basic skills and integrated skills. Basic skills refer to skills of observing, communicating, classifying, measuring metrically, inferring, and predicting. On the other hand, integrated skills include defining, formulating models, controlling variables, interpreting data, hypothesizing, and experimenting.

Different from the above classification, Bryce et al. (1990) classify SPS into three types which include basic skills, process skills, and investigative skills. Basic skills comprise of observational skills, recording skills, measurement skills, manipulative skills, procedural skills, and following instructions. Process skills deal with inferencing and selecting procedures. Investigative skills include skills of making a plan and carrying out a practical investigation.

In more details, Wenning (2005) classifies SPS into five types, namely rudimentary skills, basic skills, intermediate skills, integrated skills, and advanced skills. Then, Wenning (2010) adds new skills, namely culminating skills and elaborates each of the existing skills.

Creativity and Divergent Thinking

Solving problems to find new products through the scientific method is a process of inquiry. Mayer (1980) states that all science are inquiry in nature. Biology is one kind of science. In this case, biologists attempt to answer questions about living things. Finding new products is a creative work. Creative thinking belongs to the high cognitive domain/level in Bloom's taxonomy in reference to Anderson & Krathwohl (2001) and Dettmer (2006). However, it does not mean that creativity cannot be taught to elementary school students. This is supported by Miller (2005) who defines creativity as something which is not duplicated/imitated. He states that something which is not duplicated/imitated is categorized as creative.

Creative ideas are generated through the use of various thought processes such as divergent thinking, insightful thinking, associative thinking, homospatial thinking, blind-variation and selective retention, and janusian thinking (Sak & Oz, 2010). Derived from the psychometric tradition of creativity research, divergent thinking

tests are the major instrument for measuring people's creative potential (Zeng, Proctor, & Salvendy, 2011). However, divergent thinking does not guarantee actual creative achievement, but tests of divergent thinking are reliably and reasonably valid predictors of certain performance criteria (Runco & Acar, 2012).

Rule et al. (2012) quote several sources suggesting that elementary and middle school students who are high-achieving in science and who exhibit creativity are often not challenged or given the opportunity to fully utilize their abilities in the regular classroom. Many gifted students drop out because they think that school is boring, repetitious, and lacks relevance to real life. Students think that dropping out offers more excitement, challenging tasks, and coursework. Unfortunately, many classroom teachers lack sufficient background knowledge to design stimulating advanced science projects for their students. Added to this, some teachers avoid science altogether.

With reference to Csikszentmihalyi's model of creativity, individuals build on culturally valued practices and design to produce new variations of the domain, which, if deemed valuable by the community (i.e. the field), becomes part of what constitutes the evolving domain. Each component of the system continues to influence one another over time (Peppler & Solomou, 2011).

The rethinking of design for knowledge sharing is an important part of creating new work processes and has to evolve hand in hand with space planning (Mitchell, et al., 2003). Barrow (Hadzigeorgiou et al., 2012) states that the inquiry in science will be able to develop learners creativity if there is an imaginative and divergent thinking process.

The Measurement of Divergent Thinking

The measurement of divergent thinking skills of SPS of life aspects using instruments in the form of tests with polytomous scales (a scale for more than two categories).In this case, the polytomous scale should be between three and nine categories in order that the items can be analyzed empirically using modern approach in the form of Item response Theory (IRT).

According to Thissen et al. (2001), all the discussions about items parameter estimation for polytomous models are deeply elaborated by Baker, van der Linden, and Hambleton. In this case, Maximum Marginal Likelihood (MML) is used to

estimate items paremeter by Samejima for Graded Model (GM) and Generalization of Graded Model (GGM); Bock for Nominal Model (NM); and Muraki for Generalize Partial Credit Model (GPCM). Meanwhile, Masters & Wright as well as Andersen proposes a Partial Credit Model (PCM) and Rash Model (RSM) using MML and Conditional Maximum Likelihood (CML) to estimate item parameters. According to Wright & Masters (1980), an item is declared to be "valid" if the item fits with the model using an IRT approach. One of the ways to know the fitted items using polytomous scale on PCM model is by using Quest program (Adam & Kho, 1996).

Purposes of the Research

The divergent thinking ability is an early idea when the students perform SPS for example before observing, the students must have ideas about what they will observe. This research aims to investigate the divergent thinking in mastering each aspect of basic skills of SPS including its indicators met by the students of grade 4, 5, and 6.

Method

This research is descriptive research utilizing survey method. The data were collected using two instruments, test and questionnaire. Test were used to measure divergent thinking of basic skills of sciences process skills of life aspects on natural sciences subject in elementary school students. Meanwhile, the questionnaire is used to collect information about the characteristics of students and schools.

The tests were developed in three stages. The first stage was divided into two phases. In the first phase, the researcher developed the blue prints of Science Process Skills (SPS). The formulation of SPS blue prints based on SPS blue prints developed by Subali (2009) with reference to Rezba et al. (2007), Bryce et. al. (1990), and Cox (1956). The blue prints were used to construct the test items to measure divergent thinking ability of SPS in Biology subjects for Senior High School students.

The aspects of basic skills which are measured include (a) observing, (b) recording the data/information, (c) following the instructions, (d) classifying, (e) measuring, (f) manipulating the movement, and (g) implementing procedures/techniques/using equipment. With reference to the blue print of SPS, the researchers developed divergent thinking tests for SPS. All items have been judged by experts.

The divergent test scoring techniques were based on Diakidoy & Constantinou model (Kind and Kind (2007). In this model, there categories scale are used, which include category-1 if a testee gets score of 2 (giving two correct answers), category-2 if a testee gets score of 1 (giving one correct answer), and category-3 if a testee gets score of 0 (giving no correct answer).

The second stage of the research was trying-out the tests, which voluntarily involved 3070 students from 60 elementary schools employing purposive sampling techniques. This sample was taken by considering the minimum size of the sample. The number of ideal samples is at least 500 testees in order that a set of test can be used operationally (Muraki & Bock, 1998). The testees included students of grades 4 and 5. They were tested using 4 sets of test completed with anchor items in order that the data could be placed in a single scale. 783 testees did test I, 764 did test II, 753 did test III, and 760 did test IV.

The third stage was measurement stage. In this stage, the measurement was conducted to 84 elementary schools students selected using a purposive sampling technique by considering the distribution of the schools in Yogyakarta Special Province i.e. the schools in the province, regencies, and districts. There were 14 districts. Each district was sampled 4 public elementary schools and 2 private schools. The number of students from 84 elementary schools was 7867 testees consisting of 2563 testee of grade 4, 2685 testee of grade 5, and 2619 testee of grade 6.

The results of the tests were analyzed by using items analysis which utilizes Quest program (Adam & Kho, 1996) and scaled with polytomous of 3 categories to get information about the student's ability, the difficulty of items, and validity of each item. The testing of the fitted items to the Partial Credit Model is based on the score of Infit Mean Square (Infit MNSQ), with scores ranging from 0.77 to 1,30, therefore each item can be declared "valid" (Wright and Masters, 1982). Quest program can also be used to gain the test reliability based on the value of measurement errors and internal consistency. The measurement errors show the reliability of estimate from persons estimate (Adam & Kho, 1996).

Results

Findings show that each item fits with the model, so that the tests developed using a divergent answer model is declared "valid" (Wright, 1982) and reliable. This is supported by data that the reliability of estimate from persons estimate is 0,62 Reliability coefficient is slightly low and the internal consistency coefficient is 0.51. A confounding by fluency is a serious consideration. Such confounding is implied by bivariate correlations 355 among the various divergent thinking test indexes but was more dramatically demonstrated by Hocevar's analyses of the reliability of originality scores from various divergent thinking tests (alternate uses, plot titles, and consequences). He found that the reliability was quite low although reliable before 360 adjustments when the variance accounted for by fluency was removed from originality (Runco &Acar, 2012).

The results of the study present the detail of percentage score to the total score for each indicator with the value in the logit scale ranging from lowest mean abilities, items difficulties, and information on the items that are fitted with PCM.

Table 1. The divergent thinking of observing skills on grades 4 to 6 students and the test item information

INDICATORS	GRADE	% TOTAL SCORE	LOWES MEAN ABILITY	INFORMATION ITEM			
				DIFFCULTY	THAU		Infit MNSQ
					1	2	
1. Identify him/herselfthe names / types of animals based on animal sounds they hear	G4	95	-0.46	-1.10	3.15	-3.15	1.27
	G5	96	-0.40	-0.94	3.78	-3.78	1.23
	G6	99	-0.35	-0.76	3.56	-3.56	1.21
2. Selecthim/herselfthe symptoms that will be compared when they are faced with two kinds of living creatures to identify differences	G4	71	-0.47	-0.75	0.90	-0.90	0.98
	G5	77	-0.42	-0.68	1.14	-1.14	0.94
	G6	78	-0.36	-0.52	1.46	-1.46	0.92
3. Choose him/herselfspecies that will be observed their body parts changes in color, shape, and levels	G4	44	-0.46	-0.36	0.81	-0.81	1.10
	G5	49	-0.41	-0.29	0.84	-0.84	1.08
	G6	57	-0.35	-0.23	0.97	-0.97	1.08

4. Match him/herself a real organism with the picture or vice versa to know the diversity of appearance.	G4	43	-0.47	-0.44	1.33	-1.33	1.05
	G5	44	-0.41	-0.29	1.23	-1.23	1.02
	G6	57	-0.35	-0.31	1.44	-1.44	1.01
5. Identify him/herself circumstances that are equally having full potential risks when making observations in the school with everyday situations at home.	G4	32	-0.46	-0.17	0.99	-0.99	1.02
	G5	41	-0.41	-0.18	0.95	-0.95	1.02
	G6	47	-0.36	-0.13	1.22	-1.22	0.99
6. Identify him/herself the impact of technology in nature, in a region, or in images	G4	27	-0.50	-0.21	-0.44	0.44	0.96
	G5	28	-0.44	-0.18	-0.49	0.49	0.95
	G6	30	-0.37	-0.15	-0.42	0.42	0.94
7. Selectand match him/herself the object of observation in the form of living things with pictures	G4	19	-0.46	0.20	0.95	-0.95	1.00
	G5	26	-0.41	0.16	0.94	-0.94	1.02
	G6	35	-0.35	0.15	0.89	-0.89	1.04

Table 1 provides information about the measurement of divergent thinking of basic skills aspects of SPS on student observing skills. Firstly, all items fit with the PCM so that they are "valid" (Wright and Masters, 1982). Secondly, in reference to the types of indicators in the skills of observing, the seven items show different levels of achievement. This may imply that different indicators lead to different items and different students achievement. The easiest indicator is indicator number 1 in which grade 6 students attain 98.97% of the total score. Meanwhile, the most difficult indicator is indicator number 7 in which grade 4 students obtain 19.27 % of the total scores. Thirdly, with regard to the percentage score of the total score that have been able to be achieved by the students of grades 4, 5, and 6, the higher the grade is, the higher the percentage of success will be.

Table 2. The divergent thinking of recording data/information skills on grades 4 to 6 students and the test item information

INDICATORS	GRADE	% TOTAL SCORE	LOWES MEAN ABILITY	INFORMATION ITEM			
				DIFFCLTY	THAU		Infit MNSQ
					1	2	
1. Complete him/herself a chart, graphs or histograms	G4	81.72	-0.46	-0.98	2.92	-2.92	1.21
	G5	88.43	-0.41	-0.87	3.14	-3.14	1.2

of the life phenomenon of living things	G6	91.35	-0.35	-0.69	2.61	-2.61	1.18
2. Present him/herself data in tabular form completed with labels	G4	52.52	-0.46	-0.68	2.54	-2.54	1.14
	G5	49.80	-0.41	-0.49	2.68	-2.68	1.10
	G6	59.40	-0.35	-0.41	2.77	-2.77	1.09
3. Make a histogram of the symptoms of living things life completed with labels	G4	43.40	-0.48	-0.42	1.13	-1.13	0.92
	G5	56.42	-0.42	-0.45	1.18	-1.18	0.93
	G6	66.67	-0.36	-0.42	1.50	-1.50	0.93
4. Make him/herselef a summary of some paragraphs / chapters to review the symptoms of living things life	G4	43.31	-0.47	-0.46	1.36	-1.36	0.91
	G5	59.47	-0.42	-0.49	1.20	-1.20	0.9
	G6	65.62	-0.36	-0.39	1.35	-1.35	0.9
5. Write a paper him/herself containing information about the observations results of the life of living things completed with its title.	G4	34.80	-0.47	-0.15	0.68	-0.68	1.02
	G5	38.75	-0.41	-0.10	0.80	-0.80	1.01
	G6	46.56	-0.35	0.03	0.52	-0.52	1.00
6. Determine him/herself the information about the characteristics of an organism that is presented in charts, graphs or histograms.	G4	28.48	-0.47	-0.01	0.74	-0.74	0.93
	G5	37.38	-0.42	-0.05	0.7	-0.7	0.92
	G6	43.88	-0.36	0.00	0.79	-0.79	0.92
7. Make him/herself charts, graphs or histograms of living things life.	G4	18.34	-0.46	0.00	2.09	-2.09	1.02
	G5	26.75	-0.41	-0.08	2.09	-2.09	1.03
	G6	31.27	-0.35	0.02	2.1	-2.1	1.02
8. Determine him/herself body or parts of living bodies to be drawn accurately.	G4	16.62	-0.46	0.40	0.74	-0.74	1.01
	G5	23.63	-0.41	0.37	0.56	-0.56	1.02
	G6	33.19	-0.35	0.23	0.71	-0.71	1.02

Table 2 provides information about the measurement of divergent thinking with the same pattern as observing skills. Firstly, all items fit with the PCM so that they are "valid" (Wright and Masters, 1982). Secondly, with regard to the types of indicators the skills of data recording, the eight items show different levels of achievement. This means that different indicators lead to different items and different students' attainment. The easiest indicator is indicator number 1 which grade 6 students

attain 91.35% of the total score. Meanwhile, the most difficult indicator is indicator number 8 in which grade 4 students obtain 16.62 % of the total score. Thirdly, concerning the percentage score that has been achieved by the students of grades 4, 5, and 6 students, the higher the grade is, the higher the percentage of success will be.

Table 3. The divergent thinking of following instructions skills grades 4 to 6 students and the test item information

INDICATORS	GRADE	% TOTAL SCORE	LOWES MEAN ABILITY	INFORMATION ITEM			
				DIFFCLTY	THAU		Infit MNSQ
					1	2	
1. Prepare equipment or arrange him/herself the steps to be taken in observing the symptoms of living things life after the teachers give written explanation	G4	53.81	-0.48	-0.58	1.11	-1.11	0.91
	G5	68.15	-0.42	-0.59	1.17	-1.17	0.91
	G6	73.24	-0.36	-0.48	1.45	-1.45	0.90
2. Prepare equipment or arrange him/herself the steps to be taken in observing the symptoms of living things life after the teachers perform demonstration	G4	31.21	-0.47	0.12	0.23	-0.23	1.00
	G5	40.28	-0.41	0.00	0.39	-0.39	1.01
	G6	49.39	-0.35	-0.03	0.56	-0.56	0.99
3. Prepare equipment or arrange him/herself the steps to be taken in observing the symptoms of living things life after the teachers give oral explanation	G4	31.76	-0.47	-0.15	0.92	-0.92	1.03
	G5	39.33	-0.41	-0.09	0.71	-0.71	1.04
	G6	46.71	-0.35	0.00	0.62	-0.62	1.06
4. Prepare equipment or arrange him/herself the steps to be taken in observing the symptoms of living things life after reading written procedures stated in the students working sheet.	G4	18.65	-0.46	0.43	0.48	-0.48	1.01
	G5	23.70	-0.41	0.51	0.27	-0.27	1.02
	G6	28.67	-0.35	0.49	0.37	-0.37	1.02

Table 3 gives information about the measurement results of divergent thinking of basic skills aspects of SPS on student skills in following instructions. This has the

same pattern as the previous two skills i.e. observing and data recording skills. Firstly, all items fit with the PCM so that they are "valid" (Wright and Masters, 1982). Secondly, in reference to the types of indicators in the skills of following instructions, the four items show different levels of scores achievement. This means that different indicators lead to different items and different students attainment. The easiest indicator is indicator number 1 in which grade 6 students attain 73.24% of the total score. Meanwhile, the most difficult indicator is indicator number 4 in which grade 4 students obtain 18.65 % of the total score. Thirdly, with reference to the percentage score of the total score that have been achieved by grades 4, 5, and 6 students, the higher the grade is, the higher the percentage of success will be. The skills of classifying only have two indicators. Therefore, 4 different items are developed for the second indicator. The results are presented in Table 4 below.

Table 4. The divergent thinking of classifying skills on grades 4 to 6 students and the test item information

INDICATORS	GRADE	% TOTAL SCORE	LOWES MEAN ABILITY	INFORMATION ITEM			
				DIFFCLTY	THAU		Infit MNSQ
					1	2	
1. Determine him/herself the base to separate animals or plants or parts of his body that have different characteristics based on data presented in books or given by the teachers.	G4	25.75	-0.47	0.09	0.68	-0.68	0.99
	G5	34.90	-0.41	0.01	0.70	-0.70	1.00
	G6	41.97	-0.35	0.05	0.73	-0.73	0.99
2.a. Determine him/herself the base to separate animals or plants or parts of his body that have different characteristics and put them together based on the same characteristics in reference to the observations results	G4	24.97	-0.47	0.07	0.79	-0.79	0.93
	G5	29.08	-0.42	0.10	0.84	-0.84	0.93
	G6	45.87	-0.36	-0.07	0.96	-0.96	0.92
2.b. Determine him/herself the base to separate animals or plants or parts of his body that have different characteristics and put them together based on the same	G4	16.78	-0.46	0.31	0.94	-0.94	1.00
	G5	23.12	-0.41	0.26	0.87	-0.87	0.99
	G6	41.74	-0.35	0.00	0.92	-0.92	0.99

characteristics in reference to the observations results							
2.c. Determine him/herself the base to separate animals or plants or parts of his body that have different characteristics and put them together based on the same characteristics in reference to the observations results	G4	18.65	-0.46	0.29	0.77	-0.77	1.01
	G5	30.03	-0.41	0.07	0.88	-0.88	1.03
	G6	41.82	-0.35	0.00	0.92	-0.92	1.04
2.d. Determine him/herself the base to separate animals or plants or parts of his body that have different characteristics and put them together based on the same characteristics in reference to the observations results	G4	15.53	-0.46	0.48	0.67	-0.67	1.00
	G5	20.94	-0.41	0.41	0.68	-0.68	1.01
	G6	35.93	-0.35	0.23	0.53	-0.53	1.03

Table 4 presents information about the divergent thinking of basic skills aspects of SPS on student classifying skills. This has the same pattern as the previous three skills i.e. observing, data recording, and following instruction skills. Firstly, all items fit with the PCM so that they are "valid" (Wright and Masters, 1982). Secondly, in reference to the types of indicators in the skills of classifying, the items mastered by the students are almost equal. The easiest indicator is indicator number 2.a in which grade 6 students attain 45.87 % of the total score. Meanwhile, the most difficult indicator is indicator number 2.d in which grade 4 students obtain 15.53 % of the total score. Thirdly, with regard to the percentage score of the total score that have been able to be achieved by the students of grades 4, 5, and 6, the higher the grade is, the higher the percentage of success will be.

Table 5. The divergent thinking of measuring skills on grades 4 to 6 students and the test item

INDICATORS	GRADE	% TOTAL SCORE	LOWES MEAN ABILITY	INFORMATION ITEM			
				DIFFCLTY	THAU		Infit MNSQ
					1	2	
1. Find him/herself the causes of inaccuracies in measuring the characteristics of living things bodies using tools	G4	43.17	-0.48	-0.35	0.81	-0.81	0.9
	G5	54.53	-0.42	-0.38	0.90	-0.90	0.89
	G6	59.40	-0.36	-0.28	1.07	-1.07	0.89

2. Find him/herself a mistake in using blue prints (grid) to estimate the area of a surface of the body / parts of the living things body	G4	36.75	-0.48	-0.07	0.34	-0.34	0.91
	G5	45.66	-0.42	-0.15	0.54	-0.54	0.90
	G6	53.08	-0.36	-0.14	0.79	-0.79	0.90
3. Find him/herself the causes of inaccuracies in reading the scale of the living things body temperature measurement using thermometers	G4	33.16	-0.47	-0.12	0.69	-0.69	1.03
	G5	37.51	-0.41	-0.04	0.67	-0.67	1.04
	G6	52.29	-0.35	-0.14	0.84	-0.84	1.05
4. Determine him/herself themeasuring instruments in accordance with the characteristics of the living things body to be measured	G4	30.28	-0.51	-0.29	0.30	-0.30	0.86
	G5	41.55	-0.46	-0.33	0.25	-0.25	0.89
	G6	58.36	-0.41	-0.40	0.19	-0.19	0.89
5. Find him/herself the causes of inaccuracies in measuring the living things body temperature using a digital thermometer	G4	29.18	-0.47	0.01	0.61	-0.61	1.01
	G5	29.52	-0.41	0.29	0.33	-0.33	1.02
	G6	38.55	-0.35	0.23	0.41	-0.41	1.04
6. Find him/herself the causes of inaccuracies in measuring characteristics of the living body using up and down scales	G4	28.40	-0.47	0.03	0.63	-0.63	1.00
	G5	32.72	-0.41	0.14	0.47	-0.47	1.00
	G6	44.28	-0.35	0	0.75	-0.75	0.99
7. Find him/herself the causes of inaccuracies in reading the meter scale or measuring tape when measuring the characteristics of the living things body	G4	23.64	-0.47	0.25	0.45	-0.45	1.00
	G5	26.68	-0.41	0.4	0.28	-0.28	1.02
	G6	34.17	-0.35	0.39	0.27	-0.27	1.04
8. Estimate him/herselfthe size similarity of the two bodies or body parts of living things roughly	G4	15.84	-0.46	0.44	0.73	-0.73	1.01
	G5	19.12	-0.41	0.48	0.68	-0.68	1.02
	G6	20.57	-0.35	0.55	0.86	-0.86	1.02

Table 5 provides information about the divergent thinking of basic skills aspects of SPS on student measuring skills. The results show the same pattern as the previous four skills i.e. observing, data recording, following instruction, and classifying skills. Firstly, all items fit with the PCM so that they are "valid" (Wright and Masters, 1982). Secondly, in reference to the types of indicators in the skills of measuring, the four

items show different levels of scores achievement. This means that different indicators lead to different items and different students attainment. The easiest indicator is indicator number 1 in which grade 6 students attain 59.40 % of the total score. Meanwhile, the most difficult indicator is indicator number 11 in that the students of grade 4 obtain 15.84 % of the total score. Thirdly, with regard to the percentage score of the total score that have been able to be achieved by the students of grades 4, 5, and 6, the higher the grade is, the higher the percentage of success will be.

Table 6. The divergent thinking of movement manipulation skills on grades 4 to 6 students and the test item information

INDICATORS	GRADE	% TOTAL SCORE	LOWES MEAN ABILITY	INFORMATION ITEM			
				DIFFCLTY	THAU		Infit MNSQ
					1	2	
1. Find him/herself the ways to move solid or liquid in anexperiment related to the symptoms of living things life	G4	33.55	-0.47	-0.22	1.06	-1.06	1.04
	G5	44.87	-0.41	-0.25	0.98	-0.98	1.07
	G6	52.39	-0.35	-0.17	0.95	-0.95	1.08
2. Find out him/herself how to use the hand skills to create works that are associated with the symptoms of living things life	G4	31.68	-0.47	-0.02	0.51	-0.51	0.91
	G5	36.64	-0.42	-0.01	0.65	-0.65	0.91
	G6	41.21	-0.36	0.05	0.80	-0.80	0.90
3. Find him/herself the things that cause errors in using a thermometer to measure and observe the symptoms of living things life	G4	**31.07**	-0.47	-0.07	0.69	-0.69	1.02
	G5	**30.32**	-0.41	0.25	0.36	-0.36	1.03
	G6	**43.27**	-0.35	0.08	0.54	-0.54	1.05
4. Find him/herself the things that cause errors in squashing material derived from living things	G4	20.83	-0.46	0.29	0.59	-0.59	1.02
	G5	27.26	-0.41	0.21	0.66	-0.66	1.03
	G6	31.19	-0.35	0.34	0.55	-0.55	1.03
5.a. Find out for him/herself how to use the body/organs of the living body as measurement tools	G4	3.67	-0.46	1.17	1.53	-1.53	1.00
	G5	5.82	-0.41	1.01	1.52	-1.52	0.99
	G6	10.47	-0.35	0.81	1.47	-1.47	0.98
5.b. Find out for	G4	2.73	-0.46	1.18	2.06	-2.06	1.00

him/herself how to use the body/organs of the living body as measurement tools	G5	3.20	-0.41	1.26	1.97	-1.97	1.00
	G6	5.73	-0.35	1.11	1.79	-1.79	1.00
6. Find out him/herself how to use the hand skills to create works that are associated with the symptoms of living things life	G4	2.26	-0.46	2.26	0.52	-0.52	1.00
	G5	4.43	-0.41	1.30	1.30	-1.30	1.00
	G6	5.58	-0.35	1.79	0.53	-0.53	1.00

Table 6 presents information about the divergent thinking of basic skills aspects of SPS on student movement manipulation skills. The results show a little bit different from skills of observing, data recording, following instruction, classifying, and measuring skills. Firstly, all items fit with the PCM so that they are "valid" (Wright and Masters, 1982). Secondly, in reference to the types of indicators in the student movement manipulation skills, the six items show different levels of scores achievement. This means that different indicators lead to different items and different students' attainment. The easiest indicator is indicator number 1 in which grade 6 students attain 52.39 % of the total score. Meanwhile, the most difficult indicator is indicator number 11 in which grade 4 students obtain 2.26 % of the total score. Thirdly, concerning to the percentage score of the total score that has been able to be achieved by the students of grades 4, 5, and 6, the higher grade levels, the higher percentage of success will be. However, The students of grade 5 attain lower score than grade 4 for indicator number 3. The students grades 5, 4, and 6 attain the score of 30.32%, 31.07%, and 43.27%. respectively.

Table 7. The divergent thinking of implementing procedures/techniques/tool usage skills on grade 4 to 6 students and the test item information

INDICATORS	GRADE	% TOTAL SCORE	LOWES MEAN ABILITY	INFORMATION ITEM			
				DIFFCLTY	THAU		Infit MNSQ
					1	2	
Find out him/herself the causes of errors in using a stop clock or stopwatch	G4	49.86	-0.48	-0.48	0.90	-0.90	0.89
	G5	61.87	-0.42	-0.49	0.96	-0.96	0.89
	G6	65.32	-0.36	-0.35	1.06	-1.06	0.89
Find him/herself the things that cause the malfunction of a pipette to move the solution in the experiments associated	G4	43.54	-0.48	-0.34	0.73	-0.73	0.90
	G5	56.00	-0.42	-0.41	0.97	-0.97	0.89
	G6	58.59	-0.36	-0.26	1.03	-1.03	0.89

with the symptoms of living things life							
Choose him/herself theways to reduce errors in the experiments associated with the symptoms of living things life.	G4	37.72	-0.47	-0.35	1.26	-1.26	1.02
	G5	47.64	-0.41	-0.35	1.32	-1.32	1.02
	G6	60.06	-0.35	-0.34	1.45	-1.45	1.01
Find him/herself the things that cause the malfunction of a liquid chemical test paper on the testing of materials derived from living things	G4	35.04	-0.48	-0.2	0.82	-0.82	0.90
	G5	43.55	-0.42	-0.2	0.86	-0.86	0.91
	G6	52.22	-0.36	-0.18	1.04	-1.04	0.91
Find him/herself the causes of error in mixing the solution of the materials used in the experiment associated with the symptoms of living things life.	G4	29.50	-0.47	0.30	0.00	0.00	1.00
	G5	36.22	-0.41	0.18	0.19	-0.19	1.01
	G6	37.84	-0.35	0.27	0.34	-0.34	0.99
Find him/herself the ways to avoid the mistake of using a measuring spoon to move the substance	G4	28.79	-0.46	0.05	0.53	-0.53	1.04
	G5	35.71	-0.41	-0.02	0.74	-0.74	1.04
	G6	42.20	-0.35	0.03	0.79	-0.79	1.05
Find him/herselfthings that cause errors in filtering to obtain the extract from living organisms	G4	24.58	-0.46	0.17	0.56	-0.56	1.02
	G5	35.55	-0.41	0.04	0.58	-0.58	1.04
	G6	42.97	-0.35	0.06	0.62	-0.62	1.04
Find out him/herself the things that cause an error in using magnifying lenses to observe the symptoms of living things life	G4	22.47	-0.46	0.44	0.17	-0.17	1.01
	G5	28.86	-0.41	0.43	0.10	-0.10	1.02
	G6	34.10	-0.35	0.49	0.08	-0.08	1.03
Find him/herself the secure working steps in using flammable laboratory equipments	G4	17.71	-0.46	0.62	0.22	-0.22	0.99
	G5	21.59	-0.41	0.51	0.41	-0.41	1.00
	G6	30.66	-0.35	0.44	0.36	-0.36	0.99
Find him/herself the things that cause the error in determining the type of equipment that will be used to observe the	G4	14.83	-0.46	0.62	0.49	-0.49	1.00
	G5	22.03	-0.41	0.62	0.19	-0.19	1.01
	G6	31.80	-0.35	0.36	0.46	-0.46	1.02

symptoms of living things life							
Find him/herself the type of equipment to be used in accordance with the tasks assigned by the teachers	G4	2.42	-0.46	1.24	2.12	-2.12	0.99
	G5	2.47	-0.41	1.76	1.30	-1.30	0.99
	G6	5.58	-0.35	1.09	1.94	-1.94	0.98

Table 7 presents information about divergent thinking of basic skills aspects of SPS on student skills of implementing procedures/techniques/tool usage. The results show the same pattern as skills of measuring, classifying, following instruction,observing and data recording. Firstly, all items fit with the PCM so that they are "valid" (Wright and Masters, 1982). Secondly, in reference to the types of indicators in the skills of implementing procedures/techniques/tool usage, the eleven items show different levels of scores achievement. This means that different indicators lead to different items and different students attainment. The easiest indicator is indicator number 1 in that the students ofgrade 6 attain 65.32 % of the total score. Meanwhile, the most difficult indicator is indicator number 11 in that the students of grade 4 obtain 2.42% of the total score. Thirdly, with regard to the percentage score of the total score that have been able to be achieved by the students of grades 4, 5, and 6, the higher the grade is, the higher the percentage of success will be.

Discussion

Findings of present study show that the percentage score of all indicators indicates that divergent thinking of basic skills in SPS on life aspects achieved by the students of grade 4, 5, and 6 varied for each indicator. Some scores are relatively high or low for a certain aspect of basic skills in SPS. This result is in contrast to to the statement of teachers reported on the research by Subali & Mariyam (2013). In this case, most of the teachers stated that they did not teach creativity to their students. This condition may be caused by the teachers' inadequate understanding about how to develop student's creativity.

Teachers concentrate more on developing learners in order that they can understand the concept and automatically develops their convergent thinking skills. Teachers will seldom provide questions that required divergent answer (Croom & Stair, 2005). The second possibility is that there are some aspects of basic and process skills that

cannot be taught easily to the students. Another cause is that teachers focus only on concepttual understanding as a target in their teaching. As a result, creativity is not the main teaching target. Whereas, integrating creativity into a standards-based system needs to consider the learning needs of talented learners (Burke, 2007).

The findings show that the percentage of student scores against the total score indicating that grade 4 students attain the lowest achievements, lower than Grade 5 students and grade 6 students who get the highest scores, except in one indicator of all aspects of basic skills (indicator number 3 of movement manipulation skills: find him/herself the things that cause errors in using a thermometer to measure and observe the symptoms of living things life in Table 6). This means that the learning outcomes will be better in line with the higher grade levels. However, with reference to lowest achievement in a particular indicator, it can be interpreted that the teacher's role in developing the divergent thinking skill may not be optimal. This is probably because the sixth grade teachers focus more on the achievement of the National Examination. Therefore, it is necessary to conduct further research.

Most teachers are worried about the statement that teaching creativity to their students who have low academic potential is recommended on the grounds that students encounter some difficulties to do. However, such a perpective is not totally true. According to Ferrando et al. (2005), smart students are not always creative. In support of this, Cromie (2007) strongly urges that not all studies show a correlation between students' IQ and creativity. Moreover, Rawat et al. (2012) argue that the development of creativity is closely related to the development of skills to form a corresponding consideration in different situations. Therefore, the development of creativity should be taught as early as possible.

Teachers do not realize that the development of creativity in natural sciences teaching aims at directing learners to perform opened-discovery or inquiry or do the related tasks. In this case, teachers are supposed to develop student's thinking in order that they can perform logical thinking creatively (Kind & Kind, 2007). When phenomena and problems as part of teaching natural sciences are found at home and in the community contexts, different students build on their everyday experience and language to make connections among school science and home and community (Januszyk, Miller, & Lee, 2016).

It is realized that students still show low achievements. This evidence is closely related to the low reading habits conducted by elementary school students. This

reading habit correlates to the achievement of the divergent and convergent thinking skills. Maerten-Rivera et al. (2010) quoated by Linderholm, Therriault, & Kwon (2014) state that among elementary school children a correlation between reading and science scores on a high stakes test was notably high ($r = 0.78$, $p < 0.01$). Added to this, Addis, Pan, Musicaro, and Schacter (2014) show that the divergent thinking is significantly associated with the amount of episodic detail for imagined future events. Moreover, while age is significantly associated with imagined episodicdetail, this effect is strongly related to age-related changes in episodic retrieval rather than divergent thinking. Jones and Estes (2015) also show that the individual differences in convergent and divergent thinking may uniquely explain variation in analogical reasoning ability. Therefore, the low achievement of divergent thinking skills of SPS may inhibit students to deal with imagination and establish their thinking skills in verbal analogy.

Another finding shows that the students give one correct answer easier than giving two correct answers in almost all of items. This is indicated by the score of *thau-1* and *thau-2* of items difficulty. This is in line with the asumption that if the students have divergent thinking, the second answer will be easier than the first one because they have got both answers. Also, this is similar to the idea of Diakidoy and Constantinou in 2000-2001 referring to the idea of Guilford cited by Kind and Kind (2007) which states that smoothness aspect is one of the characteristics of divergent thinking skill.

It is evident that the study of natural science and social science is not substantially different. This suggests that the scientists' views about the nature of science are not related to their scientific disciplines (Bayir, Cakici, & Ertas, 2014). This means that the results of the research can be explored to develop the divergent thinking skill test to investigate students' mastery in divergent thinking skills on SPS in the sosial sciences.

Ideally, creativity learning must use an applied learning model and an ideational learning model (Dettmer, 2006: 70-78). Teachers can also stimulate the children to be creative by giving example of how to perform (a) substituting/replacing, (b) combining, (c) adapting, (d) modifying, (e) adding, (f) putting something for another use, (g) eliminating or reducing and (h) reconstructing or reversing (Michalko, 2000).

Conclusions and Recommendations

With regard to the above findings, it is evident that students' achievements on divergent thinking skills in grades 4, 5, and 6 vary and some indicators are still low when measured using measurements of basic skills in SPS of life aspects.

With reference to these findings, some recommendations are presented. Firstly, teachers could adapt the test items which are used in this study to measure students' divergent thinking skills of SPS on the grounds that all of the test items fitted to the model so that they are "valid". Secondly, it is found that there is a low achievement toward indicators of basic skills of SPS. This could encourage teachers to make an attempt for selecting appropriate teaching and learning strategies/models in order that their students attain high divergent thinking skills of SPS which could establish their skills to deal with imagination and creativity. Thirdly, the results of the research could be used as the basis of policy making by some related parties to enhance teachers' professional and pedagogical competence so that they are able to develop students' divergent thinking skills under the issue of SPS in natural sciences in particular and other social sciences in general. Fourthly, the results of this research are of great importance for other researchers who are keen on conducting research on natural sciences and social. Added to this, the results of this study could be the reference to deal with conducting similar research, for example at secondary schools and university levels.

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