

Contributions of Cultural Elements of Modern Science, Scientific Thinking Skills, Scientific Thinking Habits, to the Culture of Indigenous Science

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Abstract: This study aims to assess the modern science culture from the scientific thinking skills, habits of thinking sciences and its contributions to the culture of indigenous among high school students of West Sumatra. The analysis was done by descriptive data and inference analysis by using one-way univariate test and linear regression analysis. The results showed that the scientific thinking skills students are at high stage and the habit of scientific thinking of them are at high stage too. The analysis of one-way univariate test showed there is no significant difference on the confidence level of 95% ($F_{2, 448} = 0.354, p = 0.702$) in terms of the scientific thinking skills among high school students based on location of residence, and there is no significant difference on the 95% confidence level ($F_{2, 448} = 1.116, p = 0.328$) in term of the scientifically thinking habit among high school students based on location of residence. The linear regression analysis showed that both independent variable those are culture of modern science variable of students from their scientifically thinking skills and habits, both variables give significant influence on the indigenous science culture about 3.7%. The high variable that contribute to the culture of indigenous science that is the ability to scientifically thinking skills 3.0% and the habits of scientifically thinking 0.7%. The implications of this research are necessary coaching and developing the modern scientific thinking in the high-school student's level through qualified learning science. Therefore, providing the facilities of learning and improving the quality of teachers should receive high attention.

Key words: Contribution, scientific thinking skills, scientific thinking habits, culture of indigenous science

INTRODUCTION

The development of education to day has been made for changes in the character of science culture within the students. Changes that occur in the character of the indigenous science culture and the cultural character of modern science. Snively and Corsiglia (2001) says that Indigenous science as ethno science is described as the study of knowledge systems that developed from the perspective of the local culture with respect to the classification of the objects and activities related to natural phenomena. Modern science is defined as a collectively response to the reality presented and recognized by the scientific community activities and scientific products in the form of scientific knowledge.

Indigenous science culture: Stanley and Brickhouse (2001), Kamisah and Har (2012) say that the scientific knowledge or science is always based on the empirical experience and experimental activities. Darmojo (1986) say that indigenous science based on trust and reasoning without trial or field observation. Solomon (1992) says that the scientific concepts is a collection of science are arranged regularly associated with natural phenomena

both live objects and objects not live with an objective method through the experimental method to generate confidence and verified statement In the process of scientific refer to some literature and the results showed that the children had developed his ideas about natural phenomena before they are taught science in the school (Driver and Bell, 1986, Gunstone 1990; Dawson 1992; Suastra 1996).

Snively and Corsiglia (2001) states that the original science related to the non-scientific knowledge gained from knowledge, experiences where they live. This knowledge is partly derived from their cultural community beliefs about the universe. However, until now the indigenous-science is a subculture of society, less attention from scholars and teachers of science education in Indonesia. Adimassana (2000) say that something causes is due to the failure of the education sector in implementing educational values in the schools. This is supported by studies conducted by Sadia and Suastra, which states that were largely 90 percent toward the scientific learning in the schools aimed to the achievement of scientific knowledge and the rest is aimed to the development of skills process, attitudes and values. Baker and Taylor (1995), Kamisah and Har (2012) also stated that

the concepts of science which was developed at the school did not run smoothly as strongly influenced by social factors, particularly the intuitive knowledge of life-world. Such knowledge is developed for students when they were younger and encultured others (such as parents and peers. Goldstein and Goldstein (1980) states that science is an activity which is characterized by three things:) a searching to reach the understanding, and to obtain answers about reality, terms are obtained by studying the principles and laws happen as much as possible in the real phenomenon and the laws and principles of science can be tested by experiment. The event of searching the solution is called discovery activities where activity is moving from problem to the possible solution, since discovery only generates the hypotheses that may or may not be true. So the process of discovery is moving activity from level observation (be specific) to the level of theory (general). The emergence of tentative theory or working hypotheses, requiring the scientists to test its truth. The first step to test the truth is the process of deduction. This process is the displacement of the theory to the test or from hypothesis to experiment. When the prediction is made, then the experiment is done. Science back to sensory domain of experiences as the ultimate criterion of truth.

Ogawa states that intuitive science is a culture or social science called indigenous science. Snively and Corsiglia states that indigenous science relation to the scientific knowledge gained through oral culture in the place of longer occupied. This knowledge is already a portion of their culture derived from community's belief about the universe. However, until now the pseudo-science was subcultures of society, less aware and attention from scholars of educational science and teachers in Indonesia.

Modern science cultural: In a study of Kamisah and Har (2012) says that the cultural elements of science consist of 13 variables. They are divided into four category (4) sections, in this study referred to modern science (1) Ethics, Values and Response (Awareness about the ethos of science, concept about the nature of scientific knowledge, awareness about human limitation to conquer the natural phenomena, the awareness of responsibility towards nature in daily life), (2) Attitude (Attitude towards Science and Technology,) (3) the existence of the modern scientific culture (thinking skills, Habits of scientifically thinking), (4) personality Strait (Endurance, Competitive, thinking ability, Dynamic, Technological Skills). By the way the reviewer would like to see how far the implementation of the science among high school students in West Sumatra who can contribute or influence

the existence of the pseudo-science culture of students.

Mannoia (1980), classifies the limitations of science into two groups, namely: the limitations of the methodology and intrinsic limitations. The appearance of methodological limitations because scientific ideas are formed / constructed. Methodological limitations include: Error, is the source of error in the process of scientists work. Confirmation, is the error in making the confirmations such as the problem of induction Earlier Prejudice, is a member who analyze the structure of human brain, the structure of language, always look at the real limitations alone. This limitation is due to the structure and use of the ideas of science in various ways which include: the use of statistics, uncertainty. Jegede and Okebukola stated that combines indigenous science of students (science socio-cultural) with science subjects at school has increased the academic achievement of students. It is admitted, if in the process of scientific teaching and learning, belief or traditional view of the universe is not incorporated into the curriculum, will appear the conflict among students' views about the differences of traditional and scientific will result the understanding of scientific concept becomes less meaningful. Jegede and Fraser (1989), Kamisah and Har (2012) suggested that learning science use the pedagogy of social constructivism. But a few decades, the system of indigenous science learning or traditional knowledge began to talk and get serious attention from the experts of science education in the various parts of the world. (Cobern, 1996; Ogunniyi *et al.*, 1995).

Scientific thinking skill : The specific nature of scientific thinking skill is still unknown (Kuhn *et al.*, 1988). The ultimate goal of science education is to enrich students' Scientific Thinking in order to obtain approval from the experts of science educators. This goal saw elements of thinking skills is integrated into the science curriculum, because thinking is not only a teaching objectives, outcomes appear at the end of practice specifically, instead of thinking are methods for studying that needs to be practiced throughout the learning process (Csapo 1999). The move is in line with the desire to foster the intellectual generation, rational, analytical and ability to contribute to economic development in general. Docking between mind and science in harmony with the opinions of Gagne in 1963 (Finley, 1983) in bring about the scientific inquiry.

The relationship between science process skills with the skills of thinking also dictated by Schaferman in a statement. When one uses the scientific method to study or investigate nature or the universe, one is practicing scientific thinking. In addition to the labor activity is

considered as an opportunity to improve the science process skills as well as improving the skills of critical thinking

The characteristic of scientists is a typical example and the values proposed are: curiosity, open minded and skeptical nature in the science education. The characteristics mentioned are not unique to science or scientists, but the nature of it should be an important element in business of science (Volkman and Eichinger, 1999). Habit of scientifically thinking is a portion which is overlooked in the curriculum of scientific education. It based on scientific values and attitudes, as well as a set of skills to think scientifically is to be formed in the ranking schools (Anderson *et al.*, 1970).

Scientifically of thinking habit: All values, attitudes and skills to be considered a habit of scientifically thinking because all of them related with individual views of knowledge, learning and ways of thinking and acting. Volkman and Eichinger (1999) says that in America, although emphasis is given to integrity, perseverance, fairness, curiosity, openness to new ideas, the nature of skepticism and imagination as the habit of thinking. Emphasis on thinking skills such as computing, budget, manipulation, observation, and communication in the habit of cognitive and procedural that should be developed by individuals. All of this is an important aspect of scientific literacy but only the communication skills that contribute to the habit of individual thinking and social can be calculated (Volkman and Eichinger, 1999).

Inquisitive nature is accepted by many as the driving force or main motivation of the science study (Lakshmi, 2000). Operating from inquisitive nature as an act of self-initiating on a new aspect or in the surrounding environment. Exploratory, manipulative or active is the term commonly used to describe the curious nature. Germann (1988) states that the desire to know the knowledge is structured is often known as the inquiry scientifically that a major power move the science.

Trowbridge and Bybee (1996) has known that scientifically thinking skill that need to be mastered by students before mastering the communication skills in science education entirely is a skill that begins with: The problems that students learn how to form a good problem, choosing to make the problem and how can students encouraged to use their own methods to get an answer. Talk, where students learn how to contributing his own ideas of others, addressed the topic being discussed, consign the time of talking fairly and ensure the conversation lead to a conclusion. Information, clarify the main points to another party, exhibiting patience and the ability to repeat the lighting. Reporting, make a solid

reporting and concise orally to the class or teacher about science topics from materials that can be trusted. Writing, writing an experimental reports or demonstrative, not just fill in the blanks, but start writing on blank paper, bring about the problem, methods to be used, data collected, methods of analysis, the conclusions and implications for further work. To criticize or judge constructively a result of work, procedural scientific or conclusions. Drawing a graphs, show the results of research or experimentation in the form of graphs and trying to interpret the graphs for the other party. Teaching is something subject to the comrades in the classroom after normal or nearly proficient about something topic so teachers do not need to repeat the topic.

Activities aimed to fostering the communication skills of students in achieving the learning environment to resolve problems where problems due, criticism and responsibility assessment will occur. Learning environment lead the students prepare to experience about the easiness and difficulty of working in getting the communication successful. Students will realize not anyone have enough knowledge or expertise to answer all of the problems and also the collection of intellectual resources thus allowing students produce a settlement of a higher quality.

Based on observations and experiences in real life today, we do not yet know the extent of whether the original character of science culture and to what extent of the cultural character of modern science within the students.

Purpose: Therefore this study aims to assess the modern science culture and its contribution to the culture of indigenous-science among high school students in West Sumatra. Therefore the objectives of this study are:

- Knowing the stage of the modern Scientific culture from the elements of scientific thinking skills and habits of scientifically thinking among high school student
- Comparing the modern Scientific culture from the elements of scientific thinking skills and habits of scientifically thinking based on location of students' residence
- Assessing the contribution of the modern Scientific culture from the elements of scientific thinking skills and habits of scientifically thinking to the culture of indigenous-science of students

MATERIALS AND METHODOS

This research uses quantitative data, the instrument as the primary data collection tool. Subjectswere students

in grade two high school in West Sumatra. The number of samples is determined using a table Krejcie Morgan (1970). As many as 449 students have responded to the instrument deployed. In these instruments there are two variables cultural character of science , culture character of modern science to the 90 items and the cultural character of the indigenous science 26 items.

Data analysis was conducted to answer the stage presence of indigenous students' science culture and stage presence of the culture of modern science by using descriptive analysis. To see the differences in the culture of the indigenous science based on the location of residence used one-way univariat analysis of inference and to see the cultural contribution of modern science to the culture of indigenous science used multiple linear regression analysis.

Below shows that there are 8 items for the variable skill of thinking scientifically. Shows that the value of the correlation score items with the total score for the variable skill of thinking scientifically is between 0.56-0.66. When the correlation value items are corrected by total score is 0.35-0.53. Cronbach Alpha totally is 0.84. Further below shows that there are 7 items for variable Habit of scientifically thinking. This shows the value of the correlation score items with the total score variable Habit of scientifically thinking is between 0.47-0.56. The Corrected Item-Total Correlation is 0.24-0.37. Cronbach Alpha totally is 0.79

RESULTS AND DISCUSSION

Scientific Thinking Skills Variable in the element of the existence of modern scientific cultures are studied is scientific thinking skills of students in high school. Elements scientific skills referring to related statements.

There are eight item of statement about scientifically thinking skill as shown in Table 1. Respondents were asked to provide their answers about the statements in the context of the existence of the modern scientific culture to follow the knowledge and habits as well as the practice of students. Comparison of opinions among students describes the approval stage of student skill to think scientifically as shown in Table 1.

Overall analysis of the scientific thinking skills of students, they agree on the high stage (score mean = 3.86, SD = 0.55). In more detail and sequence of eight statement as the response of the students stating that scientists attempt to explain scientifically the phenomenon of natural resource (score mean = 4.12 SD = 0.75), they also stated that the hypothesis is a temporary answer to the problems of research (score mean = 4.08, SD = 0.84), information science can be used to explain the observation made in several fields of science learning (score mean = 4.00, SD = 0.76), for answering the question of science they can make hypotheses (score mean = 3.85, SD = 0.83), they also can give an explanation of the chart science they have made (score mean = 3.80, SD = 0.81), they also can make experiments in science (score mean = 3.76, SD = 0.86) and late once they can report the task of science in graphic form only in the stage of average (score mean = 3.64, SD = 0.85). Through this response, meaning that students have the skills to think scientifically are high.

Scientific thinking of habit: The second variable in the element of the implementation of the existence of modern scientific culture which studied tested to high school students' level. The elements of scientifically thinking habit refer related statements. There are seven statements of scientifically thinking habit as shown in Table 2. Respondents were asked to provide answers

Table 1: Scientific thinking skills among high students level

Codes	Scientific thinking skills	Mean Skor	SD	Interpretation
BS1	I can report the task of science in the form of graphs	3.64	0.85	Fair
BS2	I can give an explanation of the graph of science that I have made	3.80	0.81	High
BS3	I can make an operational definition of research variables that have been created	3.67	0.84	High
BS4	Information science can be used to explain the observations made in several fields of science learning	4.00	0.76	High
BS5	To address the problem of science I can make the hypothesis	3.85	0.83	High
BS6	Hypothesis is at emporary answer of the researchproblem	4.08	0.84	High
BS7	I can make experiments in science	3.76	0.86	High
BS8	Scientist stry to explain scientifically the phenomenon of natural resources	4.12	0.75	High
	Total	3.86	0.55	High

Table 2: Scientifically thinking habit among high school students level

Codes	Scientific thinking habit	Mean Skor	SD	Interpretation
B8S7	Talking with group member show to complete the task of science	4.35	0.54	High
B8S8	Reading the book or magazine about natureor science	4.30	0.57	High
B8S9	Describe the task of science to other	4.18	0.58	High
B8S10	Propose to your group about the steps to complete the task of science	4.31	0.51	High
B8S13	Able to accept a task from colleagues in finishing the task of science	4.27	0.55	High
B8S18	Reading the map to get street	4.13	0.64	High
B8S19	Read and underst and the map to get street	4.20	0.73	High
	Total	4.24	0.38	High

Table 3: Analysis of differences among elements of the modern scientific culture based on shelter locations

Variable	Sources	DF	CD	AS	F	Sig.p
Scientific thinking skill	Inter group	2	0.253	0.126	0.41	0.66
	Ina group	446	137.486	0.308		
	Total	448	137.738			
Scientific thinking habit	Inter group	2	0.320	0.160	1.07	0.34
	Ina group	446	66.222	0.148		
	Total	448	66.542			

CMS: The Culture of Modern Science, DF: Degrees of freedom, CD: Number kuadrat, AS: the average squared

Table 4: Multiple regression analysis for the existence of the modern scientific culture that contributes to the existence of the culture of Indigenous science

Element of science culture activities	B	Corrected	β	t	Sig.	r	R ²	Contribution
Scientific thinking skill	0.157	0.043	0.170	3.655	0.000	0.180(a)	0.030	3.0%
Scientific thinking habit	-0.128	0.062	-0.096	-2.071	0.039	0.204(b)	0.037	0.7%
Constant	2.162	0.326						

Regression = 0.204, Coefficient Determinant = 0.037, Corrected = 0.062

about the statements in the context of the existence of the modern scientific culture to follow the knowledge, habits and practice. Comparison of opinions among students describes the approval stage of students' habit to think scientifically as shown in Table 2.

Overall analysis of the students' habit of scientific thinking, they agree on the high stage (score mean = 4.24, SD = 0.38). In more detail and sequence of seven statements in response are student talking with group members how to complete the task of science (score mean = 4.35, SD = 0.54). Propose to your group about the steps to complete the task of science (score mean = 4.31, SD = 0.51), Reading the book or magazine about nature or science (score mean = 4.30, SD = 0.57), they are able to accept a task from colleagues in finishing the task of science (score min = 4.27, SD = 0.55), reading and understanding a map to get street (score min = 4.20, SD = 0.71), and students should explain the task of science to the comrades in a collection of science (score min = 4.18, SD = 0.58). Through Table 2 responses students for this instrument, meaning that high school students in West Sumatra has a Habit of scientifically thinking are high. Differences The Existence of Modern Scientific Culture By Location of Residence

Table 3 Analysis of Differences among Existence Elements of the Modern Scientific Culture Based on Shelter Locations

Analysis of one-way Univariate test in Table 3 shows there is no significant difference on the confidence level of 95% ($F_{2,448} = 0.354, p = 0.702$) in terms of the scientific thinking skills of high school students based on location of their residence. Therefore hypothesis null $H_0.1$ is accepted. This decision means that the approval of high school students to the existence of the modern scientific culture is based on location of residence is the same from the side of their scientific thinking skill in West Sumatra. Analysis one-way Univariate test in Table 3 shows there is no significant difference on the confidence level of 95%

($F_{2, 448} = 1,116, p = 0.328$) in the term of high school students' scientifically thinking based on location of their residence. This decision means that the approval of students to the existence of the modern scientific culture is based on location of residence is the same from side of their scientifically thinking habit in West Sumatra. Contribution of The Modern Scientific Culture to The Culture Indigenous-Science

Table 4 Multiple regression analysis for the modern scientific culture that contributes of the culture of Indigenous science

Table 4 showed that both the independent variables namely of modern scientific culture among high school students, both variables contribute the significant influence on the Indigenous science culture about 3.7%. The highest variable that contributes the existence of culture of Indigenous science is the skill of scientifically thinking (3.0%) and the Habit of scientifically thinking (0.7%).

The results showed a correlation between variables lean and the whole set of independent variables is 0.042 (Multiple Regression). Levels of variance in the variables aligned significantly with all the independent variables can be explained by the regression models with value of R² is 3.7%.

Major contribution and the highest for culture of indigenous-science among high school students is the skills to think scientifically (Beta = 0.170, $t = -3655$ and Sig. $p = 0.000$) and contributed as much as 3.0%. This condition can be indicated if the score scientific thinking skills increased by one unit causes of the culture of indigenous -science to high school students increased by 0.170 units.

When the most important second variable give contribute as much as 0.7% on the indigenous- science culture to high school students is the habit of scientifically thinking (Beta = -0.096, $t = -2.071$ and Sig. $p = 0.039$). In the sense of the other when the score mean increased by one unit also gives the impression to

Table 5: Analisis of variance

Sumber	Secondary total	df	Secondary mean	F-value	Sig.
Regression	4.879	2	2.440	9.678	0.000(b)
Residual	112.428	446	0.252		
Total	117.308	448			

the reduction of the culture of indigenous science to high school students as many as 0.096 units.

Through Table 5 analysis of variance found that the value of $F = 9678$ ($DK = 2, 446$) and significant ($\text{Sig. } p = 0.000 < 0.001$). As an explanation, the value of $R^2 = 0.037$ percentage refers to the contribution of the entire two observed variables namely scientific thinking skills = 3.0 percentage and the Habit of scientifically thinking = 0.7 percentage. Overall both the independent variables that contribute significantly to value of culture of science indigenous to high school students can be counted by regression equation principle as follows:

$$Y = 2.162 + 0.170 X1 - 0.096 X2 + 0.326$$

Where:

- Y = The indigenous science culture
- X1 = Scientific Thinking Skill
- X2 = The scientifically thinking of habit
- Constant = 2.162
- Correction expert = 0.326

CONCLUSION

Contributions of both variables in the implementation of the culture of science to high school students in terms of skills to think scientifically refer to Indigenous science culture are positive. Where the time variable of scientifically thinking habit give a negative effect, which means that if the habit of scientifically thinking student increase would give the impression of a reduction in the existence culture of indigenous -science to students. In this research, the researcher said that the development of science and technology in a sustainable manner followed by the students will give the impression, influence and contribute to the reduction of the culture of indigenous-science to high school students and the community from time to time. Indigenous -science will be left by the students and the society, especially in West Sumatra.

The results showed that from the students' scientific thinking skills are at high stage (score mean = 3.86, $SD = 0.55$) and the habit of scientifically thinking of students, are at high stage (score mean = 4.24, $SD = 0.38$). The decision of one-way Univariat test showed that the agreement students of the modern scientific culture is based on location of residence is the same from side of scientific thinking skills and habit of scientifically thinking

of high school students in West Sumatra. All contribution for two observed variables that skill to think scientifically = 3.0% and the habit of scientifically thinking = 0.7%. In general, the overall both independent variables contributed significantly to the culture of indigenous-science to high school students in West Sumatra. Ogawa that the intuitive science is a social science or culture (culture or social science) or also called real science (indigenous-science). Snively and Corsiglia (2001) states that the original science related to scientific knowledge acquired through oral culture in a place that has long occupied. This knowledge has been a portion of their culture derived from his view of the universe that is relatively believed by the community. However, until now that is an original science subculture of society, less aware and less attention from the experts of science education and science teachers in Indonesia. In contrast to Snively and Corsiglia (2001) says that the original science as science ethno described as the study of knowledge systems developed from the perspective of the local culture with respect to the classification of the objects and activities related to natural phenomena. In the phase of Implementation of the culture of science to high school students is high, it is due to facilities and curriculum used in science learning are the same, the teacher who gives lessons also have level of education is relatively the same, they are predominantly graduates of science. It also means that the facilities exist in science learning in the city, outside the city and suburbs also showed the facilities are relatively the same. This is because geographically all areas in West Sumatra can be reached by means of transportation available to distribute the necessary facilities for schools. In this research, the researcher said that the development of science and technology in a sustainable manner followed by the students will give the impression, influence and contribute to the reduction of the culture of indigenous-science to high school students and the community from time to time. Indigenous -science will be left by the students and the society, especially in West Sumatra.

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