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Building Students' Character in Elementary School through the Scientific Method: A Case Study of the Lampung Province

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ABSTRACT

The scientific method is a popular mechanism through which science teachers can impact students' cognitive domains and academic nature. The purpose of this study is to analyze the implementation of the scientific method of teaching social science subjects and educational character in the affective domain. To do so, we engaged in research using quasi-experimental methods. A random sample of 40 students was chosen. Data were collected using a questionnaire on students' character consisting of three aspects: reasoning, feeling, and behavior. The data have a normal distribution with a significant value of 0.966 and are homogeneous with a significant value of 0.100 > 0.05. The data were analyzed using a paired sample *T*-test. The character value of social studies learners, after being taught using the scientific method, was higher than ever with a significance of 0.000 < 0.05. The character of students in the affective domain was influenced by the feelings aspect resulting from the scientific method. Thus, using the scientific method in educational interventions improved the character of fifth-grade elementary school students.

Keywords: Affective domain, elementary school, character education, scientific method

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INTRODUCTION

In recent years, the issue of character development has become a prevalent one faced by all institutions (Schreuder, 2011) such that schools and colleges have sought to develop curricula to enhance students' character. Formal educational institutions are one category of organizations that

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have pursued this goal (Anwar, 2016), as schools have the role, resources, and cultural capital of the powerful to shape students' experiences (Chang & Chou, 2015; Lareau, 1987; Lickona, 1996). Activities in the classroom affect and change students (Tinto, 1987); thus, it is necessary to integrate the values of society into their formal education (Owour, 2008). It is difficult, however, for schools to create programs that lead to character education and to measure the success of these programs (Schaps et al., 2001).

Learning in schools should not only be oriented to domain-oriented (cognitive) academic activities, but also to the affective domain of social, emotional, and ethical competence. This can be done by scientific method, where scientific method has been used only by teachers in the field of natural science. The scientific method is built on the understanding of the theories of the constructivist Piaget (1968), as well as Ausubel (1968)'s theory of meaningful learning. Bruner (Carin & Sund, 1975) posited that people only learn and develop the mind through discoveries that will strengthen memory retention. Vygotsky (1990), a social constructivist, believed that cognitive learners will be developed at the moment when the teacher provides scaffolding through interaction with peers. Scientific methods are applied in class and group so that students can build knowledge and develop their character.

Value education scaffolds social and emotional learning, develops peer group friendships, and promotes a sense of "togetherness" as the basis for the classroom community (Oers & Hannikainen, 2001). According to Woolfolk (2004), cognitive development was influenced by maturity, activity, and social transmission. With the activities that form the scientific method, cognitive and character learners will develop in tandem. Through the method, where students work together to conduct research, as well as through discussion, the teacher can create a moral community. Such a community is characterized as one where students respect and care for one another such that mutual respect exists within the group, and where a democratic environment exists in the classroom such that students are involved in decision making. Teachers train the students on a moral discipline, using the creation and application of the rules as an opportunity to promote moral reasoning, self-control, and respect for others, as well as to teach values through the curriculum using academic subjects (Cheung & Lee, 2010).

Character education involves values education or religious education, which must teach the scientific method (Kirschenbaum, 2000). Character education has the educational value of helping students to develop dispositions to act in ways that definitely. The role of schools that stand out with regard to the formation of character can be characterized as follows:

> *"to build on and supplement the values children have already begun to develop by offering further exposure to a range of values that are current in society (such as*

> *equal opportunities and respect for diversity); and to help children to reflect on, make sense of and apply their own developing values'* (Halstead & Taylor, 2000, p. 169).

Halstead and Taylor (2000) found that character values were taught and presented in learning Citizenship, Personal, Social, and Health Education (PSHE), and other subjects such as History, English, Math, Science and Geography, Design and Technology, as well as Physical Education and Sport. According to Lickona (1991), and Ryan and Bohlin (1999), character education includes moral reasoning (or the ability to know when something is good), moral feelings, love, kindness, as well as moral behavior (or doing something good). Gleeson and Flaherty (2016) stated that the role of the teacher consists of being a moral educator, role model, and holistic educator. The responsibility of schools is, thus, to provide a moral education on behalf of the state. Lickona (1991) showed that character education was developed to train students to be able to decide what is right or wrong, and to act in accordance with their beliefs.

Character is a collection of qualities, or a mark that distinguishes itself from others (Homiak, 2007). The character of an individual determines whether they understand love and kindness, and whether they do well (Ryan & Bohlin, 1999). Character education is not only limited to courage, integrity, decency, kindness, perseverance, responsibility, tolerance, discipline, respect, and responsibility, but also denotes how a person responds to desires, fears, challenges, opportunities, failure, and success (Cheung & Lee, 2010). Character education helps students to understand right from wrong and to know how to control themselves and consistently do what is right (Josephson, 2002). According to Lickona (1991), character education addresses three aspects: knowledge (cognitive), feelings, and action. This study examined the scientific method and character education and focused on three aspects, namely reasoning, feeling, and behaviors.

For these reasons, it is necessary to study whether the scientific method influences the character of elementary school students of Social Science in the Lampung province of Indonesia. Elementary schools are the most basic institutions for shaping the character of future citizens.

LITERATURE REVIEW

Learning in schools should be oriented to academic activities that tend to not only cognitive domains, but also the affective domain. These activities should target social competence, emotions, and ethics, because doing so will contribute to students' quality of life (Cheung & Lee, 2010; Cohen, 2006). This can be done by means of the scientific method, although the scientific method has generally been used only by science teachers. Learning by the scientific method involves students conducting observations, proposing a hypothesis, and testing that hypothesis by means of experimentation (Raven et al., 2008). The scientific method refers to a set

of assumptions, attitudes, and procedures used to investigate, pose questions, and draw conclusions (Hockenbury & Hockenbury, 2000; Mc Murry & Fay, 2008). The scientific method is a method of collecting data that relies on the assumption that knowledge is built from observation and that knowledge is a truth (Ferrante, 2008). Students using the method will make observations, ask questions, formulate hypotheses, search for the evidence to test hypotheses, and develop theories (Keyes, 2010; Wicander & Monroe, 2006). The scientific method will familiarize the students for scientific and critical thinking that begins with observation activities, proposing hypotheses, and experimenting.

Character education includes three aspects of knowledge (cognitive), feeling, and action. This is in accordance with Park's opinion (2017), that cognitive ability positively supports tripartite character, that is, interpersonal, intrapersonal, and intellectual personality. Zarinpoush's (2000); Blanchette (2010), and Smith (2017) research shows that reasoning and mood affect a person's moral behavior and enrich the understanding of moral education. Students with good behavior exhibit more moral and emotional sensitivity than children who engage in bad behavior. Furthermore, the empathy component is stronger in encouraging prosocial behavior and inhibiting antisocial measures than the cognitive component (Lonigro, 2014).

The moral dilemma raises judgment and affects reasoning, which in turn affects the process of moral judgment, requiring the empathy of teachers, and teachers to package the values of character education so as to accelerate the change of students' knowledge of the value (Barger, 2013; Beachum, 2013; Senland, 2013; Walker 2015).

Moral learning will shape the character of the child. The level of reasoning in view of the moral object will affect the feelings, goals, and actions. Teachers should remember this wisely, because knowledge of morals will affect the moral response that is awakened to the child. Moral learning should be interesting, so it will affect the habits and willingness to behave well (Nucci, 2014).

Kohlberg's theory of moral development explores the role of cognition and emotion, although the focus is cognition. Contemporary post-formal theory leads to the conclusion that skills resulting from cognitive affective integration facilitate consistency between moral judgment and moral behavior. The development model of the four moral components for development describes these skills in particular. Components, moral motivation, moral sensitivity, moral reasoning and moral character, operate as a multidimensional process that facilitates moral development and then encourages moral behavior (Morton, 2006).

METHODS

The research used was quasi-experimental in nature to evaluate the causal relationship between the scientific method with the character of elementary school students in

Lampung Province and assess what factors are dominant in the characters formation. This method reveals the causal relationship that is not determinative but is only a probability of increasing the probability of effect (Cook & Campbell, 1979; Shadish, 1995; Shadish et al., 2002).

This research methodology is used to answer the research question whether there is influence between the scientific method with the character of elementary school students in Lampung Province? And what factors are dominant in the formation of these characters?

The sample was determined by random sampling, which involved sampling the population with a random member of the population regardless of strata. Samples were obtained directly from the sampling unit; thus, each unit had the same opportunity to be sampled (Roscoe, 1975). The number of samples was determined by Stephen Isaac and William B. Michael (Isaac, 1981) with an error rate of 5%. The sample size was 40 students (22 girls and 18 boys) in fifth-grade elementary school with an average age of 12 years. The research was conducted during a single week.

Table 1
Aspects of the character questionnaire and the number of statement items

Aspect of Measurement	Number of Items
Reasoning	9 items
Feeling	6 items
Behavior	15 items
Total	30 items

Data on the character of the students were collected by means of questionnaires consisting of three aspects (Lickona, 1991) in which the statements were developed by the author: reasoning (9 statements, numbered as items 1 through 9), feelings (6 statements, numbered as items 10 to 15), and behavior (15 statements, numbered as items 16 to 30), as shown in Table 1.

Table 2 shows the value of the reliability of the questionnaires according to the aspect of students' character, in which reasoning was obtained with a Cronbach's Alpha value of 0.89, feelings with a Cronbach's Alpha value of 0.81, and behavior with a Cronbach's Alpha value of 0.93. Based on the reliability testing, all aspects have a Cronbach's Alpha value of 0.967, so that all items contained in the questionnaire were reliable and consistent throughout the test because the reliability was strong (Bonett & Wright, 2015; Maier et al., 2016; Sebastian, 2004).

Table 2
Reliability of the character aspects

Aspect of Measurement	Cronbach's Alpha Value
Reasoning	0.89
Feelings	0.81
Behavior	0.93
Total	0.967

Table 3 shows that all of the data were tested using a one-sample Kolmogorov-Smirnov score (Yu et al., 2006), which had a normal distribution. The Kolmogorov-Smirnov score for the reasoning aspect was

0.231 with a significant value of 0.200; the feelings aspect was 0.238 with a significant value of 0.200; and the behavioral aspect was 0.308 with a significant value of 0.077. This indicated that the samples were normally distributed.

Table 3
Results of the data normality test

Aspect of Measurement	Kolmogorov-Smirnov Score	Significant Value
Reasoning	0.231	0.200
Feelings	0.238	0.200
Behavior	0.308	0.077

Based on the homogeneity test using one-way ANOVA (Ary et al., 2010), the significant value was 0.100 > 0.05, which indicated that the sample was homogeneous. The data were analyzed using a paired sample *T*-test as the design (Ary et al., 2010). A step-by-step analysis of the data is shown in Table 4.

Table 4
Steps of the data analysis

Steps	Purpose	Analysis
1	Reliability assessment	Cronbach's alpha test
2	Relationships among variables	Correlation analysis
3	Differential tests before and after treatment	Paired sample t-test

RESULTS

Mean and Standard Deviation

The average and standard deviation of the three aspects of character were compared. Table 5 shows that the highest average was the reasoning aspect (2.556± 0.527), followed by feelings with an average of 2.17 ± 0.408, and behavior with an average of 2.00 ± 0.378. Of the three categories, the lowest was the behavioral aspect and the highest was the reasoning aspect.

Table 5
Mean and standard deviation (SD)

Character	Mean	SD
Reasoning	2.556	0.527
Feelings	2.17	0.408
Behavior	2.00	0.378

Inter-Correlation among the Aspects of Character

Three aspects of the character of students were analyzed by the correlation analysis. Table 6 shows how the character aspect was correlated with all other aspects. The results presented in Table 6 show that the reasoning aspect was significantly correlated with the behavioral aspect. Its correlation coefficient was 0.683 (r = 0.683) and its significant value was 0.043 (p < 0.005). The feelings aspect was significantly correlated with the behavioral aspect with r = 0.977 and p = 0.001 (p < 0.005). The aspects of character in this study were reasoning, feelings, and behavior. Correlation analysis between these two aspects cannot describe the correlation that is closest among the three, and thus further correlation analysis is required.

Table 6
Inter-correlation among the aspects of character

	Reasoning		Feeling		Behavior	
	R	Sig	*R*	Sig	*R*	Sig
Reasoning			0.720	0.107	0.683	0.043
Feeling	0.720	0.107			0.977	0.001
Behavior	0.683	0.043	0.977	0.001		

Regression Analysis of Variables

A regression analysis was performed to determine whether character can be predicted by reasoning and feelings, as well as to identify whether character is better predicted by either the reasoning or feelings variable. Regression was performed to determine the extent of the contribution of reasoning or feelings to character. Variables reasoning and feelings were used as independent variables for character. Tables 7 and 8 show that reasoning was a significant contributor to behavior to a significant degree, with values of 0.001 for less than 0.05. Given this significance, reasoning can be said to influence behavior. A significant contribution was made to behavior by the reasoning variable with a value of 0.786 or 78.6%, of which 21.4% of the behavior was influenced by other factors. The contribution made by the feelings variable towards behavior was 0.972, or 97.2%, of which 2.8% of the behavior was influenced by other factors.

Table 7
The constant of the reasoning and feelings aspects

Model	Unstandardized coefficient		Standardized coefficient	*T*	Sig.
	B	Std. error	Beta		
1 (Constant)	−5.308	15.249	0.887	−0.348	0.738
Reasoning	0.879	0.173		5.078	0.001
1 (Constant)	118.180	3.840	-0.986	30.775	0.000
Feeling	−0.540	0.046		−11.784	0.000

Knowing that the constant value of the reasoning aspect was −5.308 and that the reasoning aspect value was 0.879, we could thus obtain the regression equation of $y = -5.308 + 0.879x$. That is, when students obtained a score of 21.4 in reasoning, it could be predicted that the behavior score was $y = -5.308 + (0.879 \times 22) = -5.308 + 19.338 = 14.03$. While the constant of the feelings aspect was 118.180, the value of the feelings aspect was −0.540, giving us the following regression equation: $y = 118.180 + (-0.540x)$. That is, when the feelings of students obtained a score of 97.2, it could be predicted that the behavior score was $y = 118.180 + (-0.540 \times 97.2) = 118.180 + (-52.488) = 65.692$.

Table 8
The contribution of reasoning and feelings to behavior

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1 Reasoning	0.887	0.786	0.756	2.531
1 Feeling	0.986	0.972	0.965	0.529

The data in Table 9 describe how the variables contribute to the reasoning and feelings of character. The results of the analysis showed that these two variables were significant predictors of character. The most obvious contributions of variants were from feelings ($\beta = 0.986$, $p < 0.01$), followed by reasoning ($\beta = 0.887$, $p < 0.01$). It can be said that the feelings aspect contributed as a potential variable to the formation of character.

Table 9
Regression analysis of the reasoning and feelings variables

Variable	B	Std. error B	Beta (β)
Reasoning	0.879	0.172	0.887
Feeling	–0.540	0.046	–0.986

As discussed earlier, feelings and reasoning were significantly correlated with character ($r = 0.977$, $p < 0.01$ and $r = 0.683$, $p < 0.01$). To find out which of the two independent variables acted as a predictor of character, a multiple regression analysis with a stepwise approach was performed. As shown in Table 8, with two independent variables included in the equation, only the feelings variable was statistically significant in predicting character. Analysis showed that the feelings aspect was predicted as the best contributor to character ($\beta = 0.972$, $p < 0.01$). It was found that the same aspect accounted for 98% of the feelings aspect of reasoning. In particular, the variable aspect of feelings contributed 98% of character, and reasoning was not a significantly predictive aspect of character. The use of the feelings aspect was a very strong predictor of character. Reasoning can be understood as being directly related to character and not as a factor that has a direct effect on character. Aspects of the feelings of students predict their character and in turn, the feelings aspect of students is predicted to help build character.

Differences Pre- and Post-Test of the Character Values of Students

Table 10 shows the results of the descriptive statistical analysis. The table shows that the average pretest value was 47.62 ± 0.886 with a standard error of 0.886 and an average posttest value of 66.70 ± 0.868 with a standard error of 0.868.

Table 10
Paired samples statistics

	Mean	*N*	SD	Std. Error Mean
Pair 1 Pretest	47.62	40	5.601	0.886
Posttest	66.70	40	5.492	0.868

Table 11 shows the results of the correlation analysis between the pre- and posttest values. The correlation coefficient was 0.349 with a significance value of 0.27. This suggests that both sets of data were not correlated.

Table 11
Paired samples correlation

	N	Correlation	Sig.
Pair 1 Pretest and Posttest	40	0.349	0.027

Table 12 shows the results of the average difference between the pre- and posttest values. The results show that the *T* value was −19.058 with a significant value (two-tailed) of 0.000. This explains why there was a difference between the pre- and posttest values, and therefore the value of T was found to be negative, indicating that the posttest value was better than the pretest value. Thus, there were differences in the character education of students before and after learning with the scientific method. The fifth-grade elementary students in the social sciences who learned according to the scientific methods had better character education than before.

Table 12
Paired samples test

	Paired Differences					*T*	df	Sig. (two-tailed)
				95% Confidence Interval of the Difference				
	Mean	STD	Std. Error Mean	Lower	Upper			
Pair 1 Pretest and Posttest	−9.075	6.330	1.001	−21.099	−17.051	−19.058	39	0.000

DISCUSSION

Based on the analysis, it appears that the value of the character of students in social science subjects is higher after learning with the scientific method than before the use of the scientific method. Thus, the scientific method proved capable of forming students' character in social science subjects, although the social sciences material tends to exist on a cognitive

process dimension involving memory and understanding, and exists in the factual and conceptual knowledge dimension (Anderson & Krathwohl, 2001). The scientific method can improve character because learners are accustomed to observing and searching for a problem or symptom, and teaching is not enough, on its own, for explaining the material (Bernard, 1995). With the scientific method, students experience the process of diffusion and socialization, and will have a broader perspective of the area of science being taught to them. The application of scientific method in learning is conducted in groups and classical so that the process of socialization between students that can form the character and strengthen the knowledge.

Viewing is the process of overcoming conceptual misperception. Observation is the basis of scientific thinking, because learning is not "literal" or "mechanical." The results of student learning do not come from a textbook, but from the opinions of experts and other authorities. With the complexity of the scientific method, the material will be analyzed according to each variable. If the scientific method is used consistently, students will be taught to think critically and become powerful thinkers of the fields that they are studying (Keyes, 2010). The scientific method provides an opportunity for students to apply and develop an understanding of scientific ways of thinking and develop their character accordingly. Classes are formed in groups of four to six students to solve problems starting from observation, data collection, experimenting, and experimental presentation.

There are three aspects involved in the formation of character: reasoning, feelings, and behavior (Lickona, 1991). Table 4 shows that the feelings aspect is more dominant in forming behavior than the reasoning aspect that follows. The data also show that the relationship to feelings is higher than that to reasoning. The relationship between feelings and reasoning will affect students' character. The data also show that students' character is related to feelings and reasoning. Apparently, agreeing and disagreeing with students with regard to the object of character, and deciding to do things to make others happy, given that behavior depends on the situation, will make students interested in behaving better. This study indicated that students' character is formed by the feelings that teachers instill in them using the scientific method. Through the scientific method, students will be conditioned to handle the feelings that are often referred to as emotional intelligence. The steps of the scientific method are to train and organize emotions, because emotions are reactions to an object, rather than reactions to character or great feelings toward someone or something (Robbins & Judge, 2013).

An intelligence and emotional maturity will determine how well a person can use their skills and determine their attitude and behavior (Cooper & Ayman, 1998; Goleman, 1995). The ability to perceive, understand, and apply emotional sensitivity selectively as an energy source needs to be learned by students using the right method, which is powered by Mahasmeh

(2016)'s research. Thus, students will learn to recognize and appreciate their sense of self, to respond appropriately, and to implement this sense of self effectively in everyday life. Emotional intelligence refers to the range of skills, capabilities, and non-cognitive competencies that predispose a person to successfully meet the demands and environmental pressures of life (Robbins & Judge, 2013). Students who have a positive mood will be used to interacting socially, and will contribute to the good mood of others around them (Isen, 2003); thus, behavior will always be in character. Dimensional feeling has a role in the formation of character, so that all contents should be able to be interpreted in accordance with that feeling, because the purpose of education is reasoning and character development (Barak & Shakhman, 2008). To achieve these objectives, the students must be taught and empowered naturally. This is according to the research of Nunez (2015).

The findings of this study support Lawson (2009)'s finding that acquiring knowledge and skills with the scientific approach will accelerate the acquisition of yield, quality, and retention. Students who participate actively in class and learn the scientific method of finding the truth will understand the process of education, because students engage in dialogue with one another and play a role in their own education (Sanderse, 2013), and because learning is not only an individual endeavor (Chen, 2013). Modern society requires an efficient learning method. The scientific method will help learners to reason, solve problems, and conduct research based on empirical data rather than from the results of scientific findings (Hodson, 1986). Learning the scientific method would encourage moral reflection and teach students about conflict resolution, thus helping students to learn how to solve problems and encourage moral reasoning, self-control, and respect for others. The integration of character education is an important part of the success of academic activities. Character education will be effective if implemented with full commitment and scientific basis. Character education cannot be built in a purely academic way and does not occur instantly, but through habituation and conditioning it could be implemented continuously (Kristjánsson, 2014; Komalasari & Saripudin, 2015; Woolfolk, 2004).

Habituation can be achieved by following the work of a scientist and using the scientific method between friends and individuals, which will estimate students to respect one another, as well as be patient and honest in describing the results obtained. A method of character education using approaches and methods of indoctrination that are not reflectively and empirically integrated with the system and culture of the school is unlikely to succeed (Al Hamdani, 2016). Likewise, character education for children of primary school age is not possible because primary-school children are sensitive to the cultivation of character education at that age (Peterson, 2015).

CONCLUSION

The scientific method as a method of intervention to improve the character education of elementary school students is more directed to the affective domain in the field of social sciences. The scientific method, however, is not only used by natural science teachers that prefer the cognitive domain. Students' character is built from the aspects of feelings, behavior, and reasoning. Therefore, it is necessary to design and reformulate the syntax of the scientific method as an important variable in character education. Further research is also needed, especially to create a questionnaire to measure students' character that is more standardized and includes more comprehensive measures of character.

The discussion of the issues examined in this study is not yet complete because the relationships between the character-forming aspects can be measured separately as possible independent variables. The causal relationship of two variables requires further research in order to identify which of the variables change as a result of the relationship.

The empirical data of this study could not establish whether students' character generated by the scientific method changed over time. This study also did not prove how the three aspects of character formation significantly relate to character. The relationship between these three aspects as described in this study has been identified to explain how the aspects of character can produce a significant change in character.

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