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EFFECT OF STEM-5E LEARNING CYCLE (AM-STEM KIDS MODULE) IN FOSTERING NOBLE VALUES AMONG ELEMENTARY SCHOOL CHILDREN

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Abstract: The purpose of this study is to investigate the effect of STEM-5E learning cycle intervention (AM-STEM Kids module) in fostering noble values among elementary school children. The element of noble values consists of: (i) being thankful to God, (ii) being cooperative, (iii) thinking rationally, (iv) appreciating the contribution of science and technology, and (v) being fair and just. This study employed a quasi-experiment with non-equivalent pretest and posttest control group design. A total of 116 fifth-grade children from two schools were selected as respondents and each of the school was treated as treatment and control group. The treatment group using AM-STEM Kids module while the control group experienced conventional inquiry teaching approach. Questionnaires were used to examine the perception of noble values by the children before and after the designed learning activities. MANOVA repeated measure and paired sample t-test were used to identify the effect and the existence of significant changes in the children's noble values between treatment and control group. The finding of the study revealed that there was a significant change in the mean score for treatment and control group in term of appreciating the contribution of science and technology, and being fair and just. Data also shows the effect size of the treatment group is higher as compared to the control group. The result of this study concludes that, AM-STEM Kids module is effective in fostering children's noble values and hence could be used as teaching resources in fostering noble values in the science classroom.

Keywords: Noble values, STEM, 5E learning cycle, inquiry based learning

Introduction

Value education is not new in the education system. History related to the value education in western countries such as in the United States indicate, it has begun since the 16th century. The aim of the value education at that time is to produce children with moral, diligent and can contribute to the development of state and society (Mabary, 2017). In addition, value education arises formally in the education system and implemented across disciplines particularly in science. For instance, in Australia, value education was introduced and applied in school after the intensive study featuring a variety of best practices and approaches to apply values in the teaching and learning process ((Australian Goverment Department of Education 2005)).

In Malaysia, the development of value education begins when the Ministry of Education (MOE) makes a comprehensive reform starting 1980s. Through the reform, in 1983 the elements of noble values were emphasized in the New Curriculum of Primary Schools (KBSR). The element of noble value continues to be emphasized in the new curriculum transformation called a Primary School Standard Curriculum (KSSR) in 2011. This curriculum applied the skills and values that are relevant to the children to prepare them with the needs as the 21st century learner (MOE, 2011).

Preservation of noble value practice in curriculum demonstrated the application of noble values in teaching and learning is an important agenda in the national education system (Hasan, Hamzah, & Awang, 2014). In fact, it helps children to develop a good character value not only for themselves and family, but to the environment and the society. This is based on the aspiration of the Malaysian National Philosophy of Education that aims towards "developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious" (MOE, 2012).

There are many definitions regarding the 'value' term depends on the usage (Seah & Bishop, 2000). According to Clement (2013), value of inner belief of an individual is associated with social value that will guide to the social actions and practices. The term of noble values can be defined as a practice or conduct of human life consisting of positive and civilized attributes which lead to a high culture in the lives (Hasan et al., 2014)). However, the value practice should not surpass the religious boundary and must follow the norm and spiritual value. In Malaysia context which has the multiracial society, the value is universal and accepted by all religion.

Although the cultivation of noble value was emphasized in the education system, however the inculcation of noble values implemented by teachers is still in moderate level (Ismail et al., 2007; Şahinkayasi & Kelleci, 2013). The possibility reason why it take place because cognitive domain are more emphasized compared to affective domain (Main, 1992; Pa & Tapsir, 2013; Seah & Bishop, 2000). This is due to the lack of evaluation or assessment regarding affective domain particularly values aspect either is formative or summative test (Ismail et al., 2007). In addition, previous research also found, the cultivation of values was mostly less implemented in science subject compared to others disciplines (Nik Yaacob, 2007)). Conjecture of this absence maybe because of lack of experience by science teachers to develop and plan the instructional systematically (Hasan et al., 2014; Şahinkayasi & Kelleci, 2013).

It is indicated that, a systematic instructional to cultivate the noble values in science teaching and learning should be developed especially in a elementary school setting. Since in the early age, the development of cognitive and affective aspect among children is growing (Hurlock, 1990). At this stage, children simply accepted what is being delivered and infuse for them in interactive learning environment.

Methods

Quasi-experimental design with Non-equivalent Pretest and Posttest Control Group type was used in this study. Based on this type of design, both groups (control and treatment) were given a pre-test and post-test. The study was conducted in the field for four weeks according the teachers schedule teaching plan on the energy's topic. Before the implementation, teachers in the treatment group were briefed and trained how to use AM-STEM Kids module.

Participants

A total of 116 5th grade children from two elementary schools in Selangor districted, Malaysia were selected as respondents. Each of the school was treated as treatment (N = 56) and control group (N = 58). The treatment group used AM-STEM Kids module while the control group experienced conventional inquiry teaching approach.

Instruments and Procedures

The instrument used in this research is a set of questionnaire of noble values which employed the 5-point agreement of Likert type response (1= strongly not agree to 5= strongly agree). The instrument was adapted from Abu Saad, (2007) and Nik Yaacob (2007) which takes into consideration the noble values's elements of the Malaysian science curriculum, namely (i) be thankful to God, (ii) cooperative, (iii) rational, (iv) Appreciation to nature and the contribution of science and technology, and (v) fair and just. This instrument has been verified by experts in term of construct and content validation. The reliability of the instrument indicates Cronbach's Alpha value for all constructs were between 0.5-0.7. Although it was not considered good internal consistency (George & Mallery, 2003) however, it is still acceptable since the number of the items in each construct is very small and it is no less than 0.4 the critical value (Nunnally & Bernstein, 1994). Table 1 shows the example of the items.

Table 1. Example of items for noble values elements

Elements	Items	Number of item
Be thankful to God	I am thankful to be able to realize the nature of God's creation through science.	3
Cooperative	I solved science tasks through discussion in the group.	3
Rational	I will think good or bad of a science solution before make a decision.	3
Appreciating to nature and the contribution of science and technology	I will turn off the electric device (e.g. television) if I find no one using it. I feel guilty if I accidentally destruction the plant.	4
Fair and just	I agree that students scored in science through their own efforts not because of their good relationships with teachers.	3

Development of AM-STEM Kids Module

Research procedure in developing instructional design of AM-STEM Kids module was based on ADDIE model. This model has a structured and systematic process and convenient for a novice designer. ADDIE model consist of five phases, namely need analysis, design, development, implementation and assessment. During need analysis phase, problems and gap were identified to ensure the development of intervention was a neccesity for the target group and able to solve the problem as well fill in the identified gap. From need analysis, energy topic was selected and the instruction was designed with the systematic planning on inculcation of noble value. In designing and developing of AM-STEM Kids module, STEM approach was used involved the integration of content and skills of STEM disciplines. Strategy regarding inculcate of noble values in the module imply the interaction of God-nature-human. These approaches and strategy were used in compliance with 5E learning cycle. Activities of each phase in the 5E learning cycle (Baybee et al., 2006) as describe below:

Engagement Phase (Observe)

Children do the simple activity to generate their interest and curiosity about the new concept of energy. The activity will help children to promote them to stimulate their thinking and access prior knowledge. The main processes in this activity involve children to make the observation, develop meaning from their observation and make a pre-hypothesis. First stage to inculcate the noble value is promotes children to recognize the God creation through the observation of nature in the activity and making a reflection.
Interaction activity:

- God – Children recognize the god creation through the source of energy that has been created.
- Nature – Children observe surroundings and develop appreciation to nature.
- Human – Children will make the observation in a pair to generate pre-hypothesis regarding the definition of energy and record the data. The teacher will raise questions on the topic related to energy and encourage children to responses rationally.

Exploration Phase (Investigate & Create)

In this phase, children involved with the investigation activity and creation of product. Through exploration experienced, children can identify and challenge their prior knowledge, including misconception if any, and pre-hypothesis they have make. The investigation activity required children to verify their pre-hypothesis by search the source of energy around their surroundings and investigate the transformation of energy form. Meanwhile, creation of a product activities involved children to create a product to solve society issues using engineering design process steps. Second stage to inculcate the noble values in this phase is making children to understand of God creation. Children will be assisted to realize the existence of God based on the certain phenomenon through the exploration activity.
Interaction activity:

- God – Children understand the God creation through the creation of the sun as a main of energy source. Phenomenon from the sun shines is it can be used as a solar energy to generate electricity.

- Nature – Children appreciate of nature, science and technology through the relationship of science and engineering in design activity. They need to think rationally to solve the given problems.
- Human – Children work in a team to do the investigation and communicate effectively to solve the problem.

Explanation Phase (Present & Rectify)

Children will present their finding of exploration activity in a group or individually. Through the presentation, children will show their knowledge and communication skills. In this phase teacher guided children to explain about the concept and definition of energy in their own words. In the same time the misconception raised by the children will rectifying by the teacher through the questioning session. Second stage to inculcate the noble values is making children to believe in God through the application of knowledge.
Interaction activity:

- God – thankful to God and reflect what happen if there is no source of energy.
- Nature –appreciate of nature, science and technology
- Human – work in a team.

Elaboration Phase

Children making an improvement of their finding and design activity regarding the definitions and scientific concepts of energy and energy model that they have been created.

Evaluation Phase

Evaluation was applied in each of learning cycle phase. The teacher will assess child's knowledge and understanding through this phase. Evaluation activities involved formative test, for example, working task, activities score using a rubric such as in producing a product, reflection journal and test of each sub-topic of energy. Summative test to assess children practices of noble values using a set of questionnaire (pre-test and post-test).

Data Analysis

The data gathered from the instrument are quantitative data and were analysed using SPSS 21.0 at the significant level of .05. Analysis data involve descriptive statistic and inferential analysis employ MANOVA repeated measure and paired sample t-test. These analyses were used to identify the significant changes between the control and treatment group.

Research Question

The main purpose of this study is to develop a systematic teaching and learning activities for the topic of energy in 5th grade elementary school children called 'AM-STEM kids module'. The module developed according to the characteristics of STEM 5E learning cycle and focusing on embedded with the noble values. The aim of this study also is to investigate the effectiveness of the module in fostering the noble values among children. The research questions are as follows:
1) What is the noble value level among children?
2) Is there any difference between control and treatment group?

Results and Findings

Findings from the pre and post-tests were used to answer the research questions, as well examine the effects of STEM 5E learning cycle used in AM-STEM kids module in fostering the noble values among elementary school children. The results and findings as below:

What is the noble value level among children?

Descriptive statistic involved means score were used for the first research question to determine the level of noble values among children. Figure 1 showed the finding of the descriptive analysis. From the result, the noble value mean score for both groups and achiever level were increased across time period (pre-test and post-test). These result indicate, children will foster their noble value when they involve in the learning process. The finding also presented the children had a high level of noble values since the mean score level was above 3.68 (Wiersma, 1995).
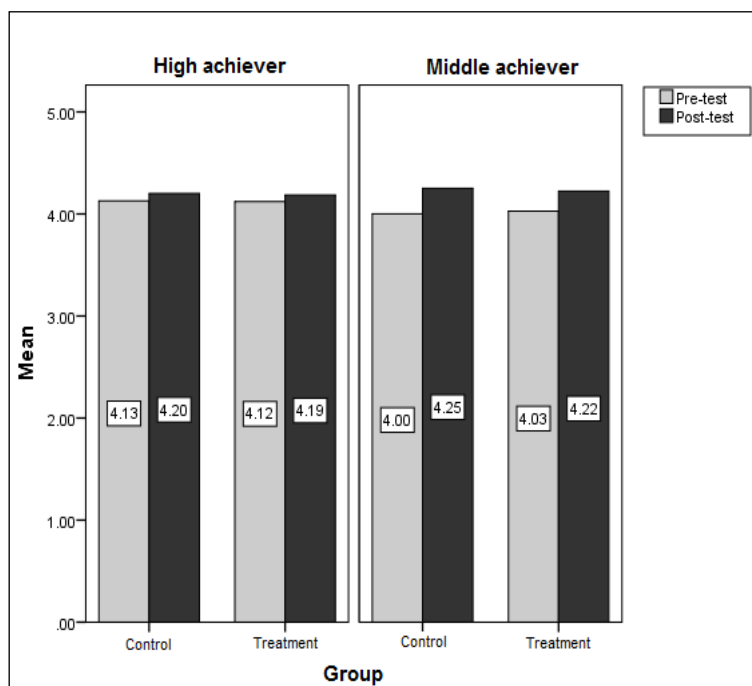

Figure 1. Descriptive analysis

Is there any difference between control and treatment group?

For this second research question, analysis using MANOVA repeated measure (2×2×2×5) was implemented. It was analysis repeatedly towards two groups (control and treatment), two category of achiever's level (high achiever and middle achiever), two times measurement (pre-test and post-test) and five elements of noble values. The main effects and the interaction effects as shown in Table 2 which was obtain from multivariate test.

Table 2. Multivariate test

Effect	Nilai Pillai's trace	F	df1	df2	Sig.	Partial Eta Squared
Group	0.08	1.80	5	108	0.12	0.08
Level	0.10	2.52	5	108	**0.03**	0.10
Group*Level	0.07	1.60	5	108	0.17	0.07
Time	0.19	4.92	5	108	**0.00**	0.19
Time*Group	0.14	3.66	5	108	**0.00**	0.14
Time*Level	0.05	1.03	5	108	0.41	0.05
Time*Group*Level	0.03	0.72	5	108	0.61	0.03

Significant level = 0.05

Based on the multivariate test in Table 2, the impact of the intervention (conventional inquiry and AM-STEM Kids module) on children's mean score on the noble values questionnaire, across two time periods (pre-test and post-test) was assess. There was no significant main effect comparing the two types of intervention, $F_{(5,108)}$ = 1.80, p = 0.12, partial eta squared 0.08. Meanwhile, there was a significant main effect comparing two types of achiever [$F_{(5,108)}$ = 2.52, p = 0.03, partial eta squared 0.10] and across two time period [$F_{(5,108)}$ = 4.92, p = 0.00, partial eta squared 0.19]. These main effects shows, an increasing of noble values across the types of achiever and time period if measured separately. The interaction between the intervention and achiever, time

periods and achiever and time period, intervention and achiever shows no significant interaction. However, there was significant interaction between the time period and the intervention, $F_{(5,108)} = 3.66$, $p = 0.00$, partial eta squared 0.14. This finding indicated there was a different in the effectiveness of two group interventions in fostering the noble values.

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According to above result, further analysis was employed using a paired sample t-test. This analysis was used to compare the mean score of both groups from pre-tests with the mean score from post-tests. Five elements of noble value were tested namely: (i) be thankful to God, (ii) cooperative, (iii) rational, (iv) appreciation to nature and the contribution of science and technology, and (v) fair and just. Table 3 shows the comparison of mean score and the effect size (r) for both groups across time period.

Table 3. Paired sample t-test

Elements	Group	Time	μ	σ	t	df	Sig.	r
Thankful	Control	Pre-post	-0.10	0.49	-1.50	56	0.14	-0.10
	Treatment	Pre-post	0.05	0.41	0.95	58	0.35	0.05
Cooperative	Control	Pre-post	-0.25	0.51	-3.75	56	**0.00**	0.52
	Treatment	Pre-post	-0.12	0.65	-1.43	58	0.16	0.19
Rational	Control	Pre-post	-0.18	0.86	-1.61	56	0.11	-0.18
	Treatment	Pre-post	0.00	0.96	0.00	58	1.00	0.00
Appretiation	Control	Pre-post	-0.22	0.60	-2.80	56	**0.01**	0.38
	Treatment	Pre-post	-0.33	0.72	-3.58	58	**0.00**	0.49
Fair and just	Control	Pre-post	0.00	0.81	0.00	56	1.00	0.00
	Treatment	Pre-post	-0.25	0.81	-2.42	58	**0.02**	0.32

Significant level = 0.05

Based on Table 3, both group shows significant value on appreciation element [(control group: t=-2.80, dk = 56, P < 0.05) (treatment group: t=-3.58, dk = 58, P < 0.05)]. However, compared the effect size of this elements, treatment group shows the larger effect size (r = 0.49) than control group (r = 0.38). Meanwhile, there was significant difference for element cooperative in control group instead of treatment group [(control group: t=-3.75, dk = 56, P < 0.05) (treatment group: t=-1.43, dk = 58, P > 0.05)]. Element fair and just shows a significant value for treatment group (t=-2.42, dk = 58, P < 0.05)] with large effect size (r = 0.32). This can be concluded, the treatment group using AM-STEM Kids module was effective than conventional inquiry teaching approach in fostering the appreciation to nature and the contribution of science and technology and the element of fair and just. However, control group was more effective in fostering cooperative element among children.

Discussion and Conclusion

The intervention called AM-STEM Kids module that compliance with STEM 5E learning cycle was developed to the 5th grade elementary school children to investigate the impact of the module in fostering children noble value. This research was applied a quasi-experimental study with involved two groups (conventional inquiry approach and AM-STEM Kids module) and two group achiever (high and low achiever). It is found that, the noble value practiced by children in both groups had a high mean score before and after the treatment. In addition, after the treatments were given for both groups it shows improvement of the noble value practice. Statistically, teaching approach between using a module and conventional inquiry gave a same impact in term of fostering noble values among children. The resulted from this finding parallel with the study conducted by Nik Yaacob (2007). This condition indicate, affective component such as value needs an adequate time and continues stimulation if we want to see the changes take effect.

One of the goals in science education is to develop children with the character of Noble value (MOE, 2013). Selected elements in noble values were used to compare the differences between control and treatment group. The result shows, elements appreciation to nature and the contribution of science and technology demonstrated a large effect size than a control group. The effectiveness of the module, due to the fact that the opportunity given to the child to interact with nature. Aktepe (2015) found, through the observation and making children love to the environment can develop them to appreciate the nature. Fair and just element also shows the larger effect size when using a module compared to conventional inquiry. This result was consistent with the study by Vaughn, Schumm, Niarhos, and Gordon (1993), that is students prefered teacher who give the same favor and task among them.

İn conclusion, eventhough the module less impresive to foster all aspects of noble values with regards of time factor, despite of that AM-STEM Kids module is still effective in fostering children's noble values. Hence, it could be used as teaching resources in fostering noble values in the science classroom.

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