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Relationship between knowledge of energy concepts, lifestyle and personal norms with energy saving behavior

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Abstract---The main objective of this study is to present the relationship between knowledge of energy concepts, lifestyle and personal norms with energy-saving behavior in elementary school teacher education students in Banten Province, Indonesia. The method opposed is quantitative research and correlational method with a sample of 447 students of Muhammadiyah University of Jakarta Elementary School Teacher Education Study Program, Indonesia. The validation results show that the relationship between knowledge of energy-saving concepts and energy-saving behavior shows a high significance value and the relationship between lifestyle and energy-saving behavior shows a high significance value. Furthermore, the relationship between personal norms and energy-saving behavior shows a high significance value. Finally, the relationship between knowledge of energy concepts, lifestyle and personal norms together with energy-saving behavior shows a high significance value. The relationship between knowledge of energy-saving concepts, lifestyle and personal norms either partially or jointly has a high significance value with energy-saving behavior. For further research, we recommend examining other variables that can relate or

influence the formation of wise behavior towards the environment such as gender and environmental sensitivity.

Keywords---energy saving behavior, knowledge energy concepts, lifestyle, personal norms.

Introduction

The impact of burning fossil fuels is the increase in free radicals, acid rain, pollution of the soil and water environment, greenhouse effect and climate change (Zou et al., 2006; Perera et al., 2019; Kuncoro et al., 2020; Hiron et al., 2021). Pro-environmental behavior is a person's actions towards the environment by avoiding its negative impacts (Lange and Dewitte, 2019; Fuji, 2006; Esfandiar et al., 2022). These behaviors can include reducing consumption of resources and energy, using non-toxic materials, and reducing waste production, (Shah et al., 2021; Muhammad et al., 2021).

The knowledge of energy concepts, lifestyle and personal norms is the main focus in this work. The environmental knowledge and the intensity of parental guidance affect student's environmental awareness (Wihardjo et al., 2017). Furthermore, Liu and Gou (2018) discussed the correlation between environmental education, environmental knowledge, and environmental values, which aims to determine the effect of environmental education on people's environmental knowledge. They found that the research results show positive and significant between environmental education with education knowledge, environmental value with environmental knowledge, environmental value with environmental knowledge. Moreover, the environmental knowledge has a positive effect on environmental attitudes, subjective norms and perceptions of behavioral control have a positive effect on ecological behavior (Liu et al., 2020; Dewulf et al., 2020).

One way to strengthen these aspects is through environmental education (Ardoin et al., 2018; Boca and Sarach, 2019). Environmental education is directed to create people's knowledge, attitudes and behavior in order to have conservation insight which leads to increase in the quality of life of the students themselves (Ardoin et al., 2020; Rahmayanti et al., 2020). The application of environmental education through schools aims to enable the younger generation to have knowledge, awareness and positive attitudes towards efforts to improve environmental quality (Casas et al., 2021). The formation of knowledge about the environment in children from an early age in a sustainable manner program will create people who care about the environment (Safitri et al., 2021).

Sia and Jose (2019) investigated to predict the behavioral intention to build eco-friendly houses among adult house owners of Kerala using the theory of planned behavior variables with norm activation model. They show that the relationship between subjective norm and behavioral intention to construct eco-friendly houses was fully mediated by personal norm. Van der Werff et al., (2019) studied influence of a private commitment strategy with energy saving behavior in the Netherlands. They found that the private commitment only influenced energy saving behavior when the behavior was perceived to be relatively effortful. Lopez

et al., (2019) presented the critical factors of industrial worker behavior with relation to energy saving in an industrial organization. They found that the two factors of the adjusted SEM model are not statistically significant. That is subjective norms and performance shaping factors. Zeiske et al., (2021) tested to what extent the value identity personal norm model is relevant in explaining a range of energy saving behavior among children. They found that the VIP model is normative considerations are related to energy saving behavior of children and adults. However, researchers cannot explain the relationship between knowledge, norms and lifestyle together. In addition, overseas sampling is household. Meanwhile, in this research, the sample is students in the age range of 17-22 years.

In this paper, the relationship between knowledge of energy concepts, lifestyle and personal norms with energy saving behavior in elementary school teacher education students in Banten province, Indonesia is reported. Following are the main contribution of the paper:

- a. The knowledge of energy concepts with Energy Saving Behavior has a positive relationship. This associated with the level of difficulty test to see the category of questions in the variable of knowledge of energy concepts, the contribution level to the variable of knowledge of student's energy concepts becomes very significant.
- b. There is a positive relationship between lifestyle of energy saving behavior. These findings indicate that lifestyle factors are positively related to energy-saving behavior of students.
- c. There is a positive relationship between Energy Saving Behavior with personal norms. These findings indicate that the students' energy-saving behavior with Personal Norm factor is positively related.
- d. There is a positive relationship between knowledge of energy concepts, Personal Norms, and Lifestyle with Energy Saving Behavior. This finding shows that the knowledge of energy concepts, Personal Norms, and Lifestyle factors have a positive relationship with students Energy Saving Behavior.

Methodology

Research Design

The descriptive correlation design is a research that seeks to find relationship among variable in situations where the researchers have no control over the independent variable (Zhou et al., 2021). This method is applied by measuring the relationship between knowledge of energy-saving concepts, lifestyle, and personal norms as the independent variable (X) and energy-saving behavior as the dependent variable (Y).

Participant

The population of this study is student of Elementary School Teacher Education in Banten Province, Indonesia. Sampling was done by means of multistage random sampling, with the following steps: 1) Determining the population are of the entire Banten Province by simple random sampling, the results is South

Tangerang City, 2) Selecting sub-districts in South Tangerang City by simple random sampling, the results is Ciputat sub-district, 3) Choosing a university that has an Education Study Program Elementary School teacher in Ciputat sub-district through purposive sampling, the results is the University of Muhammadiyah of Jakarta, 4) selecting the class that will be used as research samples by cluster random sampling from the 2016 until 2020, where the sample taken was 447 students of the Elementary School Teacher Education Study Program.

Data Collection Tools

This study uses four instruments to determine the relationship between the variable of energy-saving knowledge, lifestyle and personal norms with energy-saving behavior. The four instruments were compiled based on a theoretical framework, then conceptual and operational definitions were made. Next, a grid of search instrument was compiled along with questions and statements. The statements are put forward using a Likert scale with five alternative answer choices, namely: a) always, b) often, c) sometimes, d) rarely, and e) never. Assessment of answers is done by giving a score of 5-1 for answers to positive question and a score of 1-5 for answers to negative questions.

Data Analysis

This data analysis includes data processing, data presentation, calculations to describe the data, and hypothesis testing using statistical test. Inferential analysis is used to test the hypothesis by using correlational analysis which includes the correlation coefficient and partial correlation coefficient. All hypothesis testing was performed using $\alpha = 0,05$. Before testing the hypothesis, we will test the normality of the estimated regression error using the Lilliefors technique, test the homogeneity of variance, and test the significance and linearity of a simple linear regression model according to the relationship model between variable formulated in the theoretical research model using Analysis of Variance (ANOVA). Calculations are carried out with computer aids. The program used is the Data Analysis package contained in Microsoft Excel and SPSS.

Results

The Correlation Coefficient Between The Variables of Knowledge of Energy Concepts (X_1), Lifestyle (X_2), and Personal Norms (X_3), With Energy Saving Behavior (Y)

In general, this study aims to determine the relationship between knowledge of energy concepts (X_1), lifestyle (X_2), and personal norms (X_3) with energy saving behavior (Y) as presented in table 1. This study succeeded in proving four hypotheses, proposed and the results of the correlational analysis show that the hypothesis testing that has been carried out in this study can be accepted as follows: 1) There is a relationship between knowledge of energy concepts and energy saving behavior, 2) There is a relationship between lifestyle and energy saving behavior, 3) There is a relationship between personal norms and energy

saving behavior, and 4) There is a relationship between knowledge of energy concepts, lifestyle and personal norms together with energy saving behavior.

Table 1
The Correlation Coefficient Between The Variables of Knowledge of Energy Concepts (X_1), Lifestyle (X_2), and Personal Norms (X_3), With Energy Saving Behavior (Y)

		Correlations			
		X_1	X_2	X_3	Y
X_1	Pearson	1	.910**	.940**	.948**
	Correlation				
	Sig. (2-tailed)		.000	.000	.000
	N	447	447	447	447
X_2	Pearson	.910**	1	.942**	.961**
	Correlation				
	Sig. 2-tailed)	.000		.000	.000
	N	447	447	447	447
X_3	Pearson	.940**	.942**	1	.991**
	Correlation				
	Sig. 2-tailed)	.000	.000		.000
	N	447	447	447	447
Y	Pearson	.948**	.961**	.991**	1
	Correlation				
	Sig. 2-tailed)	.000	.000	.000	
	N	447	447	447	447

** Correlation is significant at the 0.01 level (2-tailed)

Relationship of Knowledge of Energy Concept (X_1) with Energy Saving Behavior (Y)

Table 2 shows that the R square value obtained is 0.899. This value indicates that the variable knowledge of energy concepts (X_1) has a contribution effect of 89% on the Energy Saving Behavior variable (Y) and the other 11% is influenced by other factors outside the variable knowledge of energy concepts (X_1). In addition, the knowledge factors of student's energy concepts is positively related to student's energy-saving behavior. If the knowledge of energy concepts is higher, the energy-saving behavior will also be better. The concept of energy applied in technology also has a positive impact in controlling environmental impacts and economic benefits.

Table 2
ANOVA for The Test of Significance and Linearity
of The Regression Model $Y = 28.457 + 3.656 X_1$

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.948 ^a	.899	.899	3.74055

a. Predictors : (Constant), X_1

Relationship of Lifestyle (X₂) with Energy Saving Behavior (Y)

Table 3 shows that the relationship between the two research variable is in the strong category. The R square value shows the regression model formed by the interaction of lifestyle and energy-saving behavior. The R square value obtained is 0.924, it is interpreted that the lifestyle variable (X₂) has a 92% contribution effect on the energy saving behavior variable (Y) and the other 8% is influenced by other factors outside the lifestyle variable (X₂). In addition, lifestyle factors are positively related to student energy-saving behavior. This shows that if the lifestyle is more accurate, the energy-saving behavior will also be better.

Table 3
ANOVA for The Test of Significance and Linearity
of The Regression Model $Y = 6.284 + 0.847X_2$

Model	R	R Square	Model Summary	
			Adjusted R Square	Std. Error of the Estimate
1	.961 ^a	.924	.924	3.24677

a. Predictors : (Constant), X₂

Relationship of Personal Norms (X₃) with Energy Saving Behavior (Y)

Table 4 shows that the R square value obtained is 0.983, his is interpreted that the personal norm variable (X₃) has a contribution effect of 98% on the energy saving behavior variable (Y) and the other 2% is influenced by other factors outside the personal norms variable (X₃). These findings indicate that the personal norm, the higher the energy saving behavior will be. The personal norms are included in the main lifestyle that affects organizational behavior. The personal norms are one of the important variable contained in the empowerment variable and its development to achieve the behavior of citizens who behave in energy saving.

Table 4
ANOVA for The Test of Significance and Linearity
of The Regression Model $Y = 1.499 + 1.284X_3$

Model	R	R Square	Model Summary	
			Adjusted R Square	Std. Error of the Estimate
1	.991 ^a	.983	.983	1.54899

a. Predictors : (Constant), X₃

Relationship Between Personal Norms (X₃), Lifestyle (X₂), and Personal Norms (X₃) with Energy Saving Behavior (Y)

Table 5 shows that the R square value obtained is 0.993, this is interpreted that the variables knowledge concepts of energy (X₁), lifestyle (X₂), and personal norms (X₃) have a 99% contribution effect on the behavior variable. The energy saving (Y) and the other 1% is influenced by other factors outside the three variables. This

finding shows that the knowledge of energy concepts, personal norms, and lifestyle factors have a positive relationship with student's energy saving behavior.

Table 5
ANOVA For Multiple Regression Model Regression
 $Y = 2.845 + 0.368X_1 + 0.194X_2 + 0.899X_3$

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.995 ^a	.990	.990	1.16792

a. Predictors : (Constant), X_3 , X_1 , X_2

Discussion

The knowledge of energy concepts is defined as the ability to influence other to get things done. This research in line with Yang et al., (2020). They studied factors of difficult for college students to realize their energy-saving behavior potential. Also, the found that the economic cost, group pressure, and propaganda education have significant effects on perceived self-efficacy and perceptual control. Du and Pan (2021) investigated energy saving behaviors using student's dormitories as the case from a social psychological perspective. They show that the student's energy saving intentions are positively related to their behaviors. Personal moral norms has the greatest impact on energy saving intention, followed by perceived behavioral control and attitude, while the impact of subjective norm is insignificant.

The discussion about relationship big five personality has been intensively investigated by various scientists. This research in line with Liu et al. (2021). They investigate explore the effects of Big Five personality traits on the energy-saving behavior of residents based on the extended theory of planned behavior. Furthermore, Dai and Chen (2021) studied of the effects of five individual personality differences that is consideration of future consequences, environmental value orientation, individualism and collectivism, regulatory focus, and self-monitoring) on young Millennials' and Gen Z's attitudes, perceived norms, perceived control, and intention to switch light bulbs. In addition, Pletzer et al., (2021) investigated provide a meta-analytic overview of all HEXACO domain-and facet-level relations with organizational citizenship behavior. They found that the current meta-analytic results demonstrate that all HEXACO domains except for emotionally significantly predict organizational citizenship behavior. Based on the findings and several relevant studies that discuss the role of lifestyle. We can conclude that the more accurate the student's lifestyle, the more positive the student's energy-saving behavior.

The relationship between personal norms and energy saving behavior has been studied by various scientists. Hsia and Tseng (2016) validated the effects of conscientiousness, openness to experience, and extraversion on elementary teacher's use of an educational portal. They found that the found that conscientiousness, openness to experiences, and extraversion can influence teachers use of an educational portal through beliefs (perceived playfulness and

perceived usefulness). Also, Du and Pan (2021) explained that the greatest impact on energy-saving intentions is personal moral norms, which are then followed by perceived behavioral and attitude control.

Table 6
Comparative Analysis for Energy-Saving Behavior

Authors	Titles	Methods	Factors (Variables)
Wang et al., (2018)	Analysis of factors influencing residents habitual energy-saving behavior based on NAM and TPB models : Egoism or altruism ?	Structural Equation Model (SEM)	Social norms, policy environment, personal norms, and energy-saving behavior
Lopez et al., (2019)	A new model for assessing industrial worker behavior regarding energy saving considering the theory of planned behavior, norm activation model and human reliability	Structural Equation Model (SEM)	Theory of planned behavior, norm activation model, human reliability and energy-saving behavior
Yang et al., (2020)	The influence of Information Intervention Cognition on College Students Energy-Saving Behavior Intentions	Structural Equation Model (SEM)	Perceived self-efficacy, perceptual control and energy-saving behavior intention
Du and Pan (2021)	Examining energy saving behaviors in student dormitories using an expanded theory of planned behavior	Structural Equation Model (SEM)	Attitude, subjective norm, perceived behavioral control, intention and behavior, personal moral norm and energy-saving behavior
This Work	Relationship Between Knowledge of Energy Concepts, Lifestyle and Personal Norms with Energy Saving Behavior	Descriptive Correlational Method	Energy Concepts, Lifestyle, Personal Norms and Energy Saving Behavior

Conclusion

In this paper, we have studied the relationship between knowledge of energy concepts, lifestyle and personal norms with energy-saving behavior in elementary

school teacher education students in Banten Province, Indonesia. The results show that the knowledge of instructional energy concepts, lifestyle, and personal norms has a positive relationship with energy saving behavior, this means that increasing knowledge of instructional energy concepts, lifestyles, and personal norms can improve energy saving behavior independently or together. Therefore, if you want to improve students' energy saving behavior, then these three variable need to be considered.

The implication of this research is the policy for students to have energy saving behavior as a provision in shaping the pro-environmental society character, so the thing that needs to be considered the need to strengthen students' knowledge of instructional energy concepts. In addition, the students can maximize their role not only in teaching, but also in teaching, also to educate and to shape the students character by implementing the integration of lifestyle education and personal norms with school subjects.

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