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Relationship Between Academic Ability and Environmental Problem-Solving Skill: A Case Study at Adiwiyata Schools in Tangerang City, Indonesia

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Abstract

The environmental problem-solving skill is influenced by many factors, including academic ability. This study aims to analyze the relationship between academic ability and environmental problem-solving skill. The research method employed for this study was quantitative descriptive with survey technique. The number of respondents consisted of 245 Grade 11 science students from three Adiwiyata Senior High Schools in Tangerang City, Indonesia. Academic ability was measured by using the National Examination score of students in Junior High School, while environmental problem-solving skill was measured by way of an essay test. The results showed a weak positive relationship through the regression model ($= 6.596 + .520X$). The correlation coefficient obtained was .340 and the determination coefficient was 11.6%. Higher academic ability scores indicate better environmental problem-solving skills of the students. Based on the results of the study, other Indonesian schools should also implement the Adiwiyata programs in order to improve their students' academic ability and environmental problem-solving skills.

Keywords: Adiwiyata school, environmental problem-solving skill, academic ability.



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Introduction

Problem solving is defined as a cognitive process at a higher level used to find solutions to problems or to find pathways in order to achieve certain goals (Wang & Chiew, 2010). Problem-solving skill requires complex mental activities because it not only requires the use of basic thinking skills, but also various cognitive skills and problem-solving procedures (Sigit, Ernawati, & Qibtiah, 2017). Jonassen (2011) categorized the factors that influence problem solving, namely external factors (characteristics and complexity of problems) and internal factors (experience, knowledge, and cognitive skills). Problem-solving skills are needed by students in an effort to overcome some of today's environmental problems.

Nowadays, environmental problems are a global concern. The average temperature of the Earth is projected to increase during the 21st century, with the possibility of such increases even exceeding 3° Celsius (Purba, Saitri, & Adianti, 2017). Greenhouse gas emissions and the use of various materials containing ozone-depleting substances from human activities are among the factors driving global warming (Shahzad, 2015). Industrial activities, population growth, urbanization, and deforestation are the main factors affecting a decrease in the quality of the environment (Chopra, 2016). The negative impacts include decreased standards of health and increased mortality rates each year (Rani, 2016). Environmental problems occur in almost every region of Indonesia, including Banten Province.

Banten Province is one of the industrial areas which is potentially a cause of various environmental problems. Industrial activities tend to produce hazardous chemical waste which has a negative impact on the health of living beings and the environmental balance (Chopra, 2016). Banten Province consists of several regions. The highest population density is in Tangerang City, with 13,602 inhabitants per km² (Dinas Lingkungan Hidup & Kehutanan Provinsi Banten [Banten Province Environmental & Forestry Service], 2017). Such a large population density forces the exploitation of natural resources in order to sustain humanity's daily needs to such a level that we are seeing the depletion of natural resources as well as causing various environmental problems (Gutti, Aji, & Magaji, 2012). Therefore, an effort is needed to minimize or overcome these negative environmental and health impacts so that the sustainability of environmental functions can be maintained. Environmental education is one part of the solution, helping to foster a population that cares and takes responsibility for the environment (Saito, 2013).

Environmental education is a way of developing individuals' knowledge, understanding, values, attitudes, skills, and awareness of environmental protection (Abbas & Singh, 2012; Erharbor & Don, 2016; Istiana & Awaludin, 2018). Environmental education is characterized as a learning process with the primary goal to educate and encourage individuals to engage in more sustainable and environmentally responsible practices (Biedenweg, Monroe, & Wojcik, 2013). Environmental education is seen as a process of incorporating environmental content into education in order to increase individual awareness about environmental issues at all levels of education. Environmental education provides opportunities for students to form an understanding that involves experience and challenges, so as to instill positive attitudes and behaviors towards the environment.

In Indonesia, environmental education can be integrated into schools through the Adiwiyata program (Adela, Sukarno, & Indriayu, 2018; Maryono, 2015). Adiwiyata is a program from the Ministry of Environment to encourage the creation of knowledge and

awareness of school communities in environmental protection (Azrai, Sigit, & Puji, 2017; Maryono, 2015; Rachman & Maryani, 2017). The program is based on schools activities such as the application of waste banks, bio pore holes, and the generating of compost, in order that students can create a healthier environment and help address and avoid negative impacts on the environment. The results have shown that the Adiwiyata program positively impacts on the development of caring characteristics in students, focusing on classroom cleanliness and the school environment, saving electricity and water usage, managing school waste, and preserving biodiversity (Caddafie, Martuti, & Rudyatmi, 2017). The involvement of students who are active in various environmental activities shows that students already have a level of environmental awareness. The better the environmental awareness, the greater the participation of students as seen in the Go Green School activities (Azrai et al., 2017). Students with environmental awareness have sensitivity to environmental problems (Loganayaki & Ranjitha, 2014).

Tackling environmental problems can be supported through academic ability (Suhirman, 2012), which is defined as an educational outcome that describes the extent to which a student has achieved certain educational goals (Noteborn, Dailey-Hebert, Carbonell, & Gijsselaers, 2014). Academic ability is the accumulation of students' knowledge and experience that can influence their learning outcomes. Knowledge that students already have must be used meaningfully through decision making, problem solving, discovery, experimental inquiry, and investigation (Kostova & Atasoy, 2008). Academic ability has been shown to develop if students use their knowledge and experience in solving environmental problems through the Adiwiyata program.

Studies have shown that age has a positive relationship with academic ability (Naderi, Abdullah, Aizan, Sharir, & Kumar, 2009; Yousef, 2011). As long as the motivation is consistent, as age increases, so does experience and knowledge in order that academic skills may increase. Motivation is a fundamental factor for academic success as it stimulates individuals to continue to be interested and committed, and to try to achieve goals (Amrai, Motlagh, Zalani, & Parhon, 2011; Gbollie & Keamu, 2017; Kusurkar, Cate, Vos, Westers, & Croiset, 2013). Students with good academic success have higher motivation, which in turn influences their problem-solving abilities (Guss, Burger, & Dörner, 2017).

Environmental problem-solving skill is an important proficiency to be developed, because today's students are the next generation that will maintain the sustainability of tomorrow's environmental functions. Problem-solving skill can be developed and supported through academic abilities. Implementation of the Adiwiyata Program in several Schools in Tangerang City develops student participation in environmental activities in order that they can better shape and tackle environmental problems. Therefore, the current study focuses on the relationship between academic ability and environmental problem-solving skill at schools with the Adiwiyata program in Tangerang City. It is hoped that this study will help confirm whether or not environmental problem-solving skill can be inculcated through improved academic abilities as expected from the Adiwiyata Program.

Methodology

Population and sample

The method used in this research was the descriptive quantitative method. The sample of the study was Grade 11 science students, selected by using simple random sampling technique and the Slovin formula. The obtained sample consists of 245 students from an available pool of 637. This research was conducted at SMAN 2, SMAN 4, and SMAN 5 schools in Tangerang City, which had each implemented the Adiwiyata program. The research was conducted in August 2018, in the odd semester of the 2018/2019 academic year.

Academic ability

The academic ability of the students was measured using the National Examination scores of the Junior High School students. The scores and academic abilities were categorized according to the criteria shown in Table 1.

Table 1. Interpretation Criteria Academic Ability Score

Score Range	Criteria
0-49	Low
50-74	Moderate
75-100	High

(Source: Ganyaupfu, 2013)

Environmental problem-solving skill

Environmental problem-solving skill was measured using essay tests that consisted of 20 questions. The instrument was developed based on four aspects; namely, exploring and understanding, representing and formulating, planning and implementing, and monitoring and reflection (Organization for Economic Cooperation and Development, 2017). The instruments grid for environmental problem-solving skill is shown as Table 2.

Table 2. Environmental Problem-Solving Skill Instruments Grid

No.	Aspect	Indicator	Number of Items
1	Exploring & understanding	Identify environmental problems	5
2	Representing & formulating	Linking known information to compile new information	5
3	Planning & implementing	Planning solutions for solving environmental problems	5
4	Monitoring & reflection	Planning a form of monitoring or supervision	5
Total			20

(Source: Organization for Economic Cooperation and Development, 2017)

The answer score was assessed based on the criteria in the assessment rubric. The score of the environmental problem-solving skill obtained was then categorized according to Table 3.

Table 3. Interpretation Criteria Environmental Problem-Solving Skill Score

Score Range	Criteria
0-20	Very poor
21-40	Poor
41-60	Adequate
61-80	Good
81-100	Very Good

(Source: Riduwan, 2009)

The validity of solving the environmental problem-solving skills test used Pearson Product Moment formula, while reliability used the Cronbach Alpha formula (Sugiyono, 2017).

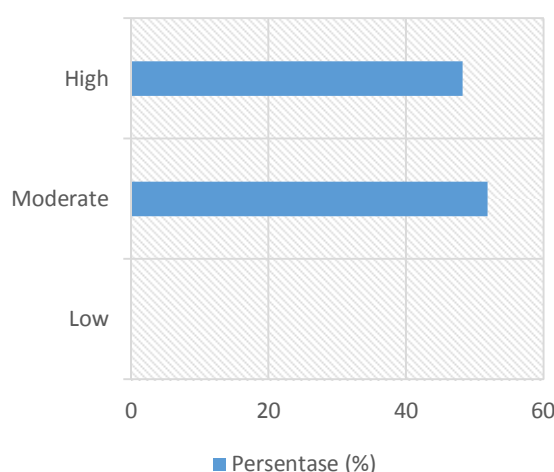
Data analysis

The prerequisite test for the analysis to be conducted was the normality test (Kolmogorov Smirnov test at $\alpha = .05$) and homogeneity test (Bartlett test at $\alpha = .05$). The research hypothesis test used a linear regression test (F-Test at $\alpha = .05$) and correlation (calculating the correlation coefficient at $\alpha = .05$ with Pearson Product Moment formula). The process of data analysis was performed using IBM SPSS 20 statistical software. The next step was to determine the coefficient of determination through the formula: $rx^2 \times 100$.

Results

Data description of academic ability

Based on the results of the study, the highest academic ability score was 95, the lowest score was 53, and the average score was 74. The majority of students had an academic ability score placed within the Moderate category ($n = 127$, 51.84%). Notably, none of the 245 students' scores were in the Low category ($n = 0$, 0%). It can therefore be concluded that the majority of students at SMAN 2, SMAN 4, and SMAN 5 Tangerang City under the Adiwiyata program have Moderate level academic ability scores. The academic ability score categories are as shown in Figure 1.

**Figure 1.** Percentage of Academic Ability Score Category

Data description of environmental problem-solving skill

Based on the results of the study, the highest score for environmental problem-solving skill was 83, the lowest score was 5, and the average score was 45. The majority of students' scores for environmental problem-solving skill were in the Adequate category ($n = 122$, 49.8%); however, only one student (0.41%) out of 245 students was in the Very good category. It can be concluded that the majority of students at SMAN 2, SMAN 4, and SMAN 5 Tangerang City schools with the Adiwiyata program have Adequate level environmental problem solving-skills. The score categories for environmental problem-solving skills are as illustrated in Figure 2.

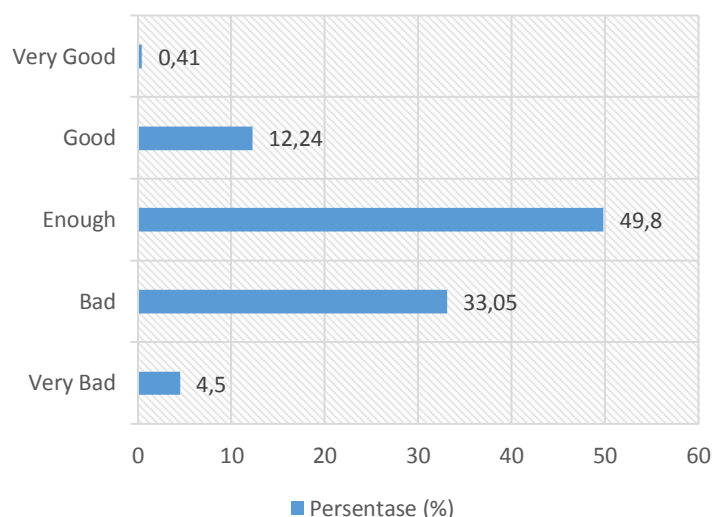


Figure 2. Percentage of Environmental Problem-Solving Skill Score Category

Correlation between academic ability and environmental problem-solving skill

Based on Figure 3, the regression equation model was formulated as being $\hat{Y} = 6.596 + .520X$. In the regression test, the data was found to have a regression coefficient that was significant, based on $(p) < \alpha$ and $.000 > .05$. In the linearity test, the data was found to be significant based on $(p) < \alpha$ and $.000 > .05$, according to the linear regression equation model. The model shows that the X score (academic ability) affects the Y score (environmental problem-solving skill).

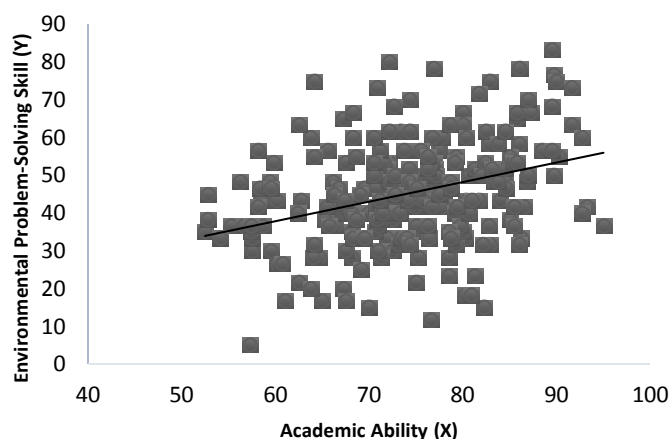


Figure 3. Linearity Model of Academic Ability and Environmental Problem-Solving Skill

The strength of the relationship is obtained through the calculation of the correlation coefficient from the academic ability and environmental problem-solving skill variables, resulting in a correlation coefficient of $r_{xy} = .340$. The criteria for the strength of the relationship data was found to be weak. The significance score of the relationship obtained was .000, which is smaller than the alpha value of .05, meaning that there is a significant relationship. The test result of the coefficient of determination was 11.6%. This means that as much as 11.6% of academic ability contributes to environmental problem-solving skill.

Table 4. Results of Testing Correlation Hypotheses

		Academic ability	Environmental problem-solving skill
Academic ability	Pearson Correlation	1	.340 ^{**}
	Sig. (2-tailed)		.000
	N	245	245
Environmental problem-solving skill	Pearson Correlation	.340 ^{**}	1
	Sig. (2-tailed)	.000	
	N	245	245

Discussion and Conclusion

Based on the research data, the majority of students have a moderate academic ability score. This result may be related to age. The student participants in the current study were aged between 15 and 17 years old. Students at this age still have many opportunities to improve their insight and experience. As long as their motivation is consistent, as their age increases they will gain in experience and knowledge pertinent to gaining in academic ability. The results of the study found that age has a positive relationship with academic ability (Naderi et al., 2009; Yousef, 2011).

Those students with adequate environmental problem-solving skills shows that they are able to utilize their own environmental knowledge. This indicates that the implementation of the Adiwiyata program within the three schools is functioning well. One component of implementing the Adiwiyata program is developing students' environmental knowledge (Iswari & Utomo, 2017). Some of the attributes needed to be a successful problem solver are having motivation, intellectual guile (problem-solving strategies), being able to plan and monitor progress whilst problem solving, as well as an adequate level of knowledge (Portoles & Lopez, 2008).

Problem-solving skills commonly applied in schools tend to be community-based student projects. This will likely positively impact the conditions of the local community within and around the school environment if students possess adequate problem-solving skills. It can also be used as an important indicator of the success of a learning process when students are able to apply what they have learned in daily life (Cremin, 2009; Djamahar, Ristanto, Sartono, Ichsan, & Muhlisin, 2018; Ristanto, 2009). The three schools developed students' abilities in solving various environmental issues through participation in various school environment-focused maintenance activities; and in doing so, the students are able to apply these abilities in aid of their local community. This matches to the objectives of the Adiwiyata program, namely that each school member becomes involved in school activities focused towards environmental health and take accountability for environmental conservation and protection through good school governance in supporting sustainable development (Desfandi, Maryani, & Disman, 2017).

The results of the current study show the existence of a positive relationship between academic ability and environmental problem-solving skill. Knowledge is part of the academic ability. The existence of such knowledge can help make students environmentally friendly in a way that the students can find solutions to problems of environmental pollution. The results of previous studies also indicate a significant positive relationship between environmental knowledge and environmental pollution problem-solving skill (Sigit et al., 2107). In the current study, the development of the students' environmental knowledge can be attributed to the three schools integrating environmental and related subjects in order that students develop better environmental problem-solving skills. For example, activities such as plant maintenance and waste recycling as Biology subjects. One indicator of the Adiwiyata program is the development of an environment-based curriculum (Maryono, 2010).

Problem-solving activities involve the activity of the hippocampus and the neocortex. The hippocampus is the part of the cerebrum located in the temporal lobe, while the neocortex is a piece of tissue that forms the outer surface of the brain. Over time, information from certain memories is temporarily stored in the hippocampus and can be transferred to the neocortex as general knowledge and occurs while sleeping (Kalat, 2009). This knowledge is more meaningful depending on changes in the strength of neural connections called synapses. The connection is stronger or weaker depending on when and how often synapses are activated. The more often it is activated, the more likely it is to be stronger, while if not used it will likely become weaker and eventually disappear (Sah, 2018). Students will likely have meaningful knowledge if this knowledge is used often in problem-solving activities to create effective solutions.

Students can improve their environmental problem-solving skill when supported by a good level of academic ability. This is because students with good academic abilities have better thinking processes in understanding a concept or problem. Students who have a better understanding of a concept will likely be more effective when involved in solving problems during class activities (Ganyaupfu, 2013). Academic ability can be developed by involving students actively in various environmental activities. The environmental activities conducted by the three schools in the current study include the making of a bio pore, planting trees, and sorting waste materials. These activities aim to provide students with improved experience, knowledge, and understanding. One indicator of the Adiwiyata program is the development of participatory-based environmental activities (Kementerian Lingkungan Hidup [Ministry of Environment], 2010).

Academic ability contributes to environmental problem-solving skill. The results of this study are reinforced by previous research that reported adult students as having the cognitive abilities needed to develop problem-solving skills (Beyazsacılı, 2016). The results of other studies revealed that increasing problem-solving abilities led to an increase in school success (Uyar & Bal, 2015).

The results showed a weak positive relationship between academic ability and environmental problem-solving skill. Based on the results of the study, other schools should also implement the Adiwiyata programs in order to improve their students' academic abilities and environmental problem-solving abilities.

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Notes

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