Awareness of environmental and energy issue in Indonesia K-12 education system

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Abstract. Indonesia is one of the countries that have a strong commitment to reducing greenhouse gases. The transition to the next-generation also plays a significant role in order to ensure the continuation of the world issue, reducing greenhouse gases, and using renewable energy resources. The author does a survey limited to three schools in Medan to understand how far the students in these schools have been taught about the implementation of environmentally friendly energy resources. From the samples taken, only 13% of these students apply technology and prototyping in the energy field. About 87% of these students claimed that they never apply technology and prototyping in the energy field. The result is then tested through hypothesis testing, and within a 10% significant level, there is enough evidence to say that the students are not being exposed to the implementation of these topics optimally. From the same group of samples, the author then offers two courses that cover the application of technology and programming in STEM (Science, Technology, Engineering, and Mathematics) education. For technology and prototyping purposes, a micro bit is used. While for programming, python is used. After the class ends, another survey was carried out, and 80% of these students claimed that those classes give them insight into the application of STEM in real life and motivate them to be a young scientist. Students who claimed have learned these during school lessons are going through the topics by themselves because the schools required them to run a science fair. This study implied that our education department should pay more attention and should include environmental and renewable energy as one of the compulsory lessons at schools.

1. Introduction

The education system in Indonesia is K-12 based, which means students are required to finish a 12 year program of education from primary to high school or junior college. From IDN Research Institute, Indonesia would have a demographic bonus in 2020 and probably will end in 2045. The fact is that most of the students are being exposed to the old-fashioned syllabus. However, Mr. Nadiem has encouraged teachers to apply critical thinking and learning at schools. According to Hasan Chabibie, ex-head of the center for data and information in the education department of Indonesia stated that among 220 000 schools, there are 41 000 schools do not have internet services. The application of technology and big data will help further understanding of the implementation of environmentally friendly and renewable energy resources in real life. While from the data provided, it shows that besides the old-fashioned curriculum, another problem that the government should pay attention to is the availability of internet services.

Zhao [1] outlines five core assumptions which can be used to guide what a school should teach: skills and knowledge that is not available at a lower price in another country; creativity, to make new
things and to adapt; new skills and knowledge that are needed in the global living world; high-level cognitive skills such as problem-solving and critical thinking; emotional intelligence (p.150-151). One way, Drake [2] suggested, the increasing the relevance of students’ learning while maintaining rigor and accountability is to adopt an integrated approach. This is where the design process can come into play. Design thinking is one method of learning which allows children to come with their ideas and to work on their ideas, which include prototyping. In a report put together by the Research in Education and Design Lab team at Stanford, was recommended that design thinking be integrated into academic content; for a while, it may stand alone, its power as a tool for learning comes in the ways it can support a diverse range of interdisciplinary academic content [3].

The author observed that the implementation of design thinking in Indonesian schools is far from satisfying. It is being shown by the surveys taken in Medan. It will be challenging for us to raise the awareness of generation Z if they have never been exposed to energy and environmental issues during their K-12 schools period. Extant research provides consistent evidence that design thinking may be beneficial for business and casts light on the increasing relevance of design thinking for the practice of management and management innovation. This makes the author believes a strong correlation between students’ experience in school and their future role in society. The education department in Indonesia has issued a policy, Number 23/2017, one of the points is school should conduct co-curricular lessons which include writing scientific paper/journal or could be scientific experiments [4]. Unfortunately, many schools do not seem to implement this regulation. It has been showing by data collected and processed in this paper.

2. Method
The limitation of this research is samples are taken from schools located in Medan and Jakarta. Students who participate in this survey are year 10 to year 12 students. Students are coming from four schools, three schools from Medan (top 100 schools in Indonesia), and one from Jakarta (top 10 schools in Jakarta) and randomly chosen. [www.international-schools-database.com] After the first survey about the exposure of technology and prototype in environmentally friendly and renewable energy resources, samples are being given a chance to participate in a micro bit and python class.

There are 52 students who have taken the survey. Seven of the students claimed that they had direct experience in prototyping environmentally friendly and renewable sources of energy, which include hydroelectric power plant, Tesla coils, and simple dynamo and turbine system. Forty-five of the students claimed that they never have experience in prototyping during school time.

Due to the limitation of data from other regions in Indonesia, the author takes secondary data by comparing National Teachers’ Competency Result with the assumption that if teachers from regions with the higher score, in this case, Medan and Jakarta, do not expose the students to environmentally friendly and renewable energy prototypes, it could be concluded that teachers with a lower score from other regions also do not expose the students to the same field.

The binomial distribution is being used since there are n trials with two outcomes. The author decides to carry out hypothesis testing to check if there is enough evidence to say that the students in Indonesia do not have enough exposure to prototyping and design thinking to support further understanding of the environmentally friendly and renewable source of energy.

\[ X \sim B(52, 0.5) \]
\[ H_0: p = 0.5 \]
\[ H_1: p > 0.5 \]

Since both np and nq are more significant than 5.

\[ X \sim N(26, 13) \]
\[ P(X > 46) = 0 \]
For proper hypothesis testing, the author takes the National Teachers’ Competency Test to check further if the claim that the Indonesia K-12 education system does not raise awareness of students regarding environmental and energy issues.

By another chance, the author conducted two applied technologies classes for the same group of students, but only 25 of them have taken participation. One of the classes is the micro bit session, while another one is the Python programming language. After those classes, another survey is taken to check if the classes help the students in prototyping and giving them insight into the implementation of STEM, 20 of them voted yes, and 5 of them voted [5].

\[ Y \sim B(25,0.5) \]
\[ H_0: p = 0.5 \]
\[ H_1: p > 0.5 \]

Since both np and nq are more significant than 5.

\[ Y \sim N(12.5,6.25) \]
\[ P(Y > 19) = 0.5026 \]

There are 14 provinces which have lower teachers’ competency test result compared to North Sumatera. Another test is carried out to check if the claim is justified.

\[ W \sim B(34,0.5) \]
\[ H_0: p = 0.5 \]
\[ H_1: p < 0.5 \]

There are 34 provinces across Indonesia. As the np and nq both are greater than 5.

\[ W \sim N(17,8.5) \]
\[ P(W < 16) = 0.1915 \]

3. Results and Discussions

From the first distribution, \( X \), we can see that even at 0% significant level, there is enough evidence to say that most of the students are not familiar with the prototyping and implementation of knowledge in this field. It supports the idea to make a new policy regarding compulsory lessons at schools and may include design thinking in the Indonesian syllabus.

**Figure 1** Proportion of Students in Exposure to Technology and Prototyping
Further than that, based on the National Competency Test for Teachers the data is shown in Figure 2. From the Distribution of W, there is not enough evidence at a 10% significant level to claim that less than half of the province in Indonesia do better than North Sumatera in prototyping and design thinking, which means in another word, there are more than half of Indonesia province do not expose the students with an experience of prototyping and design thinking.

![Figure 2 The results of national competency test for teachers](image)

From the Distribution of Y, it can be concluded that at either 5 or 10% significant level test, there is enough evidence to say that exposure of technology and design thinking will encourage the students to be an innovator in the future. Prototyping is an activity core to designing and engineering, through an activity that has traditionally been under-examined. Engineering Thinking is one of the categories in prototyping. The micro bit is a device that allows users to plan and think using a flow chart. Python is a programming language that can be synchronized with hardware such as a micro bit or raspberry pi. Students who learn both lessons will not face many difficulties in dealing with the prototyping process. The application of an environmentally friendly and renewable source of energy at the K-12 level is related to the ability to make prototypes. It could be a mini hydroelectric power plant, mini windmills, or solar cells. Students with poor knowledge of programming will not be able to build a good prototype.

![Figure 3 Rate of Growth of Coding in Several Countries is 2017](image)
In prototyping, the device is closely related to middle and advanced programming skills. Without this skill, students will be able to design by drawing or sketching but will not be able to build the hardware. It could be observed that many countries are growing and expanding their computer science syllabus at school. Unfortunately, Indonesia is not on the list [7].

From the Energy Transition Index 2020, there is a correlation between the rate of growth of coding and the readiness of a country to face the energy transition [8].

| Country | Rank |
|---------|------|
| Malaysia | 38 |
| Brunei | 40 |
| Vietnam | 65 |
| Indonesia | 70 |

4. Conclusions
There is a relation between the ability of students to do coding, or computer science, prototyping with technology and readiness of a country to transform its energy resources. Ministry of Education should consider changing the content of the syllabus, which is no longer relevant to worldwide issues nowadays. The education department should consider having an MoU with a private company or local talents to deal with this issue. The fact that the regulation has encouraged schools to teach scientific paper writing or to conduct scientific experiments is good, but the implementation of this regulation is weak. Therefore, control within this point is highly recommended. Besides that, the author encourages the education department to approach villages to spend the fund granted to each village to provide internet services. The cost of each balloon is approximately $18,000.

If this issue is not solved, the demographic bonus in Indonesia will not bring any advantage. Besides that, it will be difficult for us to expect more young people will work on energy issues due to a lack of knowledge during their K-12 school. However, the research is limited since the samples are taken from schools in Medan. Also, secondary data is used from the online journal, newspaper, or website as an approach to other regions in Indonesia.

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