Needs Analysis of Students’ Pro–Environmental Behavior for Climate Change Books

Diana Vivanti Sigit1*, Eka Putri Azrai1, Ade Suryanda1, Ilmi Zauji Ichsan2, Michael B. Cahapay3, Md. Mehadi Rahman4, Paulo Weslem Portal Gomes5, and Rosa Susanti2

1Lecturer, Universitas Negeri Jakarta, Indonesia
2Lecturer, Universitas Mohammad Husni Thamrin, Indonesia
3Lecturer, Mindanao State University – General Santos, Philippines
4Alumni, University of Dhaka, Bangladesh
5Lecturer, University of Campinas, Brazil

ABSTRACT

Background and objective: Climate change is a current issue that need to be solved by innovation in environmental education. However, efforts specifically to develop a teaching material based on the learning needs of the students related to climate change has not been given attention. This study aims to describe the Pro–Environmental Behavior (PEB) of students as basis for the development of an educational material to be known as Climate Change Book Series (CCBS–US).

Methods: It entailed a descriptive research design and survey method, involving a sample of 642 students in Jakarta and Semarang, Indonesia. The data were treated using descriptive statistics. Data analysis using ANOVA test to see the significant of the difference between each group.

Results: The results indicate that the university students’ PEB score is high while the high school students’ PEB score is moderate. The lowest average score is found in aspects related to efforts in reducing garbage and recycling. Details of average score were Junior high school students (74.49), senior high school students (66.28), Faculty of Math and Science university students (73.69), Non–Faculty Math and Science university students (72.27).

Conclusion: It is along these inputs that the CCBS–US must be developed as a learning material in environmental education. It is hoped that the results of this study, the developed CCBS–US can significantly empower students’ PEB scores in classroom learning.

Keywords: digital learning, environmental education, higher education

Introduction

21st century education raises several environmental issues and important problems to bring up learning more (Chen et al., 2015; Muthukrishnan and Kelley, 2017). Climate change is one of the issues that has become a focus in recent years due to common efforts from several parties to prevent climate change through a variety of global-scale programs. The rise in global temperature has been one of the main problems of climate change and has caused the melting of polar ice caps and consequently the rise of sea level. Countries globally suffered great damage, namely yellow dust and fine dust which is the result of industry in Indonesia (Pramana et al., 2020). In addition, climate change has a negative impact on people in urban and rural areas, and can cause death (Park and Park, 2020). Efforts...
must be taken to avert more severe events or impacts of climate change.

About all of the Middle East and North Africa (MENA) countries are located in semi-arid and arid regions that are extremely exposed to climatic changes. Because most of the countries have agriculture and oil related needs for their economy; so they are highly impacted by climate change, in addition to the corrective policies used to reduce oil dependence (Zakaria et al., 2013). To minimize the adverse impacts of climate change, disaster mitigation strategies need to be community-accepted as well as concrete actions to address disaster, energy and food problems in many parts of the world, including the MENA region and the Eastern Mediterranean. (Lelieveld et al., 2012).

According to Lelieveld et al. (2016) in the recent past observations indicate that heat extremes in the MENA region is consistently increasing, while the results of climate models predict the continuation of a further increase in average temperature through the end of the 21st century. Due to the “urban heat island effect”, the average temperature for the urban area will be 2-3 °C higher than the surrounding countryside (Yang et al., 2016). This will have an impact on water availability in the MENA region, for example, an extension of the dry season in most of the MENA countries. In Jordan, water availability is expected to fall below the threshold of 50 m$^3$ per capita/year, which is the minimum amount needed for the community in the area (Chenoweth et al., 2011).

Some studies predict that the impacts of climate change associated with deforestation may cause the contraction of the Amazon rainforest combined with the expansion of the Brazilian central savanna (Cerrado) (Anadon et al., 2014; Davidson et al., 2012; Lapola et al., 2009). The "savannization" of the Amazon may be of concern to biodiversity conservation, since the rainforest plays a fundamental role in climate regulation in South America (Lawrence and Vandecar, 2014). The Brazilian legal Amazon rainforest is known for its important role in the global carbon stock, in this region there are also the largest mangroves in the world (Magris and Barreto, 2010; Nascimento et al., 2013). However, mangrove conservation is worrisome, since the rapid urban population expansion in coastal areas has caused the degeneration of these ecosystems (Sigit et al., 2020). The loss of mangroves affects not only biodiversity, but also climate change by global warming, since mangroves play a key role in the carbon stock of the atmosphere. In the mangroves of the Legal Amazon, Kauffman et al. (2016) found that in the Amazon, each hectare of mangrove contains a carbon amount twice as large as the same area of the rainforest.

In this context, educational practices should be focused on raising awareness and motivation of students, such as changing consumption habits to reduce greenhouse gas emissions. Thus, environmental education broadens ecological awareness and consequently social and environmental responsibility, making students move from a diluted responsibility to concrete action (Jacobi, 2005). Discussing environmental issues in an environmental learning framework is important to provide students with knowledge about efforts to prevent climate change. Students and university students must have the capability of adapting the various climate change concepts and implement them in the form of Pro-Environmental Behavior (PEB). PEB is simply defined as a behavior to forestall various impacts of environmental issues occurred (Hong and Park, 2018). PEB can be implemented in several forms and one of them is PEB in preventing climate change impacts.

Previous studies concern about efforts in developing teaching materials and media to stave environmental damage off (Reyna et al., 2018). Moreover, numerous measurements of university students’ and students’ skills in Higher Order Thinking Skills (HOTS) realms have been conducted (Ichsan et al., 2019). An educational model to prevent the deterioration of various ecosystems in mangrove and coral reefs has also been developed (Sigit et al., 2020). Further, in terms of PEB, several measurements have been carried out to various levels of students and communities (Truelove and Gillis, 2018). Studies on climate change, however, are still related to people’s behavior in general. Based on this explanation about students behavior, the study aims to measure students’ PEB to prevent climate change.
Research Methods

Research design

This study used a descriptive research design. It is a research design that aims to describe the current status of a phenomenon at a particular time without an intent to manipulate (Mertler, 2014). Thus, based on this information, a descriptive research design is considered appropriate for this study which has the main purpose to describe the PEB of the students as basis for the development of CCBS-US.

Sample

This study involved a sample of 636 students. This sample consists of 133 junior high school students, 233 senior high school students, 102 university students of faculty math and science, 168 university students of non-faculty math and science. They were from Jakarta and Semarang during the school year 2020-2021. They were chosen regardless of their academic standing and socioeconomic condition.

Instrument

The questionnaires used in the study was specifically created to measure the PEB of students related to efforts in averting climate change. The questionnaires indicators were developed from Kaiser and Wilson (2004) that consisted of six main components, namely: (1) utilize environmentally friendly energy sources; (2) prioritize using low-emission vehicles; (3) avoid burning waste to reduce greenhouse gas emission; (4) utilize low greenhouse gas-content products; (5) perform waste recycling activities, and (6) invite the communities to prevent global warming. A detail of the item distribution under these main components is illustrated in the instrument grids presented in Table 1.

Reliability and validity

The psychometric properties of the PEB instrument were established through pilot test. The result of the reliability analysis of PEB indicators yielded a Cronbach alpha of 0.80. This implies that the PEB instrument has good internal consistency and can be used for research purpose. Furthermore, two validity tests were employed. The first validity test is concurrent validity undertaken by statistically associating PEB indicators to a hypothetically related variable of climate change. All the items generated statistically significant correlation score between 0.118 to 0.674, indicating that PEB instrument has concurrent validity. The second validity test is construct validity through the process of factor analysis. It was noted that all the PEB items have a minimum factor loading between 0.303 and 0.748. The factor analysis further showed that the PEB items loaded on components based on the six factors as adapted from Kaiser and Wilson (2004) intended for the PEB instrument.

Data analysis

Once the reliability and validity of the PEB instrument were completed, the data were calculated using descriptive statistics such as frequency count and mean score. The mean scores were then categorized according to arbitrary scale that ranged from very high (X > 81.28), high (70.64 < X ≤ 81.28), moderate (49.36 < X ≤ 70.64), low (38.72 < X ≤ 49.36), and very low (X ≤ 38.72). This category according to Pro-Environmental Behavior previous research by Sigit et al. (2020). After that, the data was then tested using the ANOVA test to see the significant of the difference between each group.

Results and Discussion

The study results implied that the lowest PEB scores of the students and university students were in the 8th item.

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Utilize environmentally friendly energy sources</td>
<td>1,2,3</td>
</tr>
<tr>
<td>2</td>
<td>Prioritize using low-emission vehicles</td>
<td>4,5,6</td>
</tr>
<tr>
<td>3</td>
<td>Avoid burning waste to reduce greenhouse gas emission</td>
<td>7,8,9</td>
</tr>
<tr>
<td>4</td>
<td>Utilize low greenhouse gas-content products</td>
<td>10,11,12</td>
</tr>
<tr>
<td>5</td>
<td>Perform waste recycling activities</td>
<td>13,14,15</td>
</tr>
<tr>
<td>6</td>
<td>Invite the communities to prevent global warming</td>
<td>16,17,18</td>
</tr>
</tbody>
</table>
The item was regarding conducting household waste composting and processing (see Table 2). The low score for the item was due to the students and university students were seldom conducting the activities. In this sense, an additional evaluation was proposed for the development of a book functioning as enhancing knowledge of climate change.

The test results with ANOVA showed that the value of sig < .000 which means that the average score between the 4 groups of students has a significant difference. The full results can be seen in Table 3. The ANOVA test has a function to measure the magnitude of the difference between groups.

The score for each indicator also suggested that students and university students had not yet capable of maximizing their efforts to reduce activities of burning waste and to decrease gas emission. The table indicates that the lowest score was the third indicator. The first indicator also received the lowest score, which is related to the utilization

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Mean score of JHS</th>
<th>Mean score of SHS</th>
<th>Mean score of FMS</th>
<th>Mean score of NFMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I use the sunlight for drying my clothes</td>
<td>4.92</td>
<td>4.80</td>
<td>4.88</td>
<td>4.84</td>
</tr>
<tr>
<td>2</td>
<td>I use energy-saving lamps (LED) at home</td>
<td>4.44</td>
<td>4.01</td>
<td>4.23</td>
<td>4.18</td>
</tr>
<tr>
<td>3</td>
<td>I unplug my phone charger to save energy to prevent climate change</td>
<td>4.43</td>
<td>4.01</td>
<td>4.29</td>
<td>4.24</td>
</tr>
<tr>
<td>4</td>
<td>I prefer to walk to nearby places (500 m)</td>
<td>4.08</td>
<td>3.57</td>
<td>4.13</td>
<td>4.05</td>
</tr>
<tr>
<td>5</td>
<td>I use low-emission vehicles to prevent climate change</td>
<td>3.82</td>
<td>3.07</td>
<td>3.44</td>
<td>3.47</td>
</tr>
<tr>
<td>6</td>
<td>I check my vehicle regularly to maintain its environmentally-friendly best performance</td>
<td>3.99</td>
<td>3.75</td>
<td>3.81</td>
<td>3.76</td>
</tr>
<tr>
<td>7</td>
<td>I follow shows and news on efforts in minimizing waste</td>
<td>3.67</td>
<td>3.19</td>
<td>3.85</td>
<td>3.54</td>
</tr>
<tr>
<td>8</td>
<td>I perform household waste composting at home</td>
<td>2.88</td>
<td>2.14</td>
<td>2.30</td>
<td>2.54</td>
</tr>
<tr>
<td>9</td>
<td>I reprimand my neighbors who burn their waste</td>
<td>3.13</td>
<td>2.33</td>
<td>2.60</td>
<td>2.71</td>
</tr>
<tr>
<td>10</td>
<td>I buy non-CFC products for daily needs</td>
<td>3.33</td>
<td>3.03</td>
<td>3.59</td>
<td>3.40</td>
</tr>
<tr>
<td>11</td>
<td>I carry my shopping bags from home</td>
<td>3.83</td>
<td>4.08</td>
<td>4.33</td>
<td>4.17</td>
</tr>
<tr>
<td>12</td>
<td>I reduce Freon utilization as it damages the ozone</td>
<td>3.39</td>
<td>3.36</td>
<td>3.90</td>
<td>3.67</td>
</tr>
<tr>
<td>13</td>
<td>I collect plastic waste and give them to the cleaning officers or garbage collectors for recycling</td>
<td>3.48</td>
<td>2.87</td>
<td>3.15</td>
<td>3.28</td>
</tr>
<tr>
<td>14</td>
<td>I reuse scrap papers to reduce the effects of global warming</td>
<td>3.51</td>
<td>3.20</td>
<td>3.87</td>
<td>3.61</td>
</tr>
<tr>
<td>15</td>
<td>I sort wet and dry garbage at home</td>
<td>3.48</td>
<td>2.77</td>
<td>3.07</td>
<td>3.18</td>
</tr>
<tr>
<td>16</td>
<td>I ask my family/friends to travel together in one vehicle to save energy (during normal condition or before a pandemic)</td>
<td>4.03</td>
<td>3.96</td>
<td>4.06</td>
<td>4.07</td>
</tr>
<tr>
<td>17</td>
<td>I remind my friends of the impact of global warming on humans</td>
<td>3.44</td>
<td>2.98</td>
<td>3.45</td>
<td>3.29</td>
</tr>
<tr>
<td>18</td>
<td>I invite my friends to plant trees to decrease global warming</td>
<td>3.19</td>
<td>2.53</td>
<td>3.37</td>
<td>3.04</td>
</tr>
</tbody>
</table>

Average Score: 74.49 (High); 66.28 (Moderate); 73.69 (High); 72.27 (High)

Note. JHS: junior high school students; SHS: senior high school students; FMS: faculty of math and science students; NFMS: non-faculty math and science students.

<table>
<thead>
<tr>
<th>Group</th>
<th>Sum of squares</th>
<th>df</th>
<th>Mean square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6326.056</td>
<td>3</td>
<td>2108.685</td>
<td>22.458</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>59341.157</td>
<td>632</td>
<td>93.894</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>65667.212</td>
<td>635</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
of environmentally friendly energy sources (Table 4).

The study results implied that the PEB scores overall were in a high category, except for senior high school students that were in a moderate category. The lowest score was in terms of efforts in reducing waste and greenhouse effects. This may have occurred due to teachers' lack of knowledge about climate change. Liu et al. (2015) mentioned that teachers hold misconceptions about the causes and the consequences of climate change. The most commonly observed misconception among teachers is a confusion between the greenhouse effect and global warming (Herman et al., 2015). The efforts are necessary to anticipate the accumulation of waste in the surrounding environment. Garbage that pollutes the environment must be averted so that various materials containing in the garbage will not pollute the environment. Therefore, it is vital to educate the communities on waste management and efforts to process the waste. The reason is that most people do not know about waste processing, especially its impacts on climate change. Waste processing becomes one of the environmental issues in large cities that require a solution (Amarasinghe and Fernando, 2014).

Wachholz et al. (2014) found that most of the students stated that they focused on solving problems related to climate change; however, students still have misconceptions related to climate change that is happening globally. Climate change education involves learning that should change students' attitudes and behavior because attitudes are the central dimension of human identity (Rahman, 2019) which imitates how students monitor the environment and what they have to deal with environmental problems (Masud et al., 2013). Pro-environmental behavior can reduce the harm caused by humans to the environment and is a mitigation of the impacts of climate change. Students with pro-environmental knowledge are willing to behave more environmentally friendly to contribute to solving environmental problems (Masud et al., 2013).

Another important point of the study was the lack of student behavior in the socialization of climate-change prevention efforts. Positive socialization strengthens pro-environmental behavior with high levels of particular traits. In contrast, students who scored low on personality experienced poorer social norms, which negatively impacted their pro-environmental behavior. Yu and Yu (2017) suggested that pro-environmental behavior can be improved swiftly with increased socialization and different activities may influence students' norms. For example, students' improvements to sustainable concerns and environmental concerns, changes in pro-environmental understanding and attitudes (e.g., habits of reducing gas emissions and environmental friendliness), support and commitment of various social characters and norms. Students who participate in such activities can help in preventing climate change. The prevention efforts should be carried out through various channels, such as websites, social media, and learning applications. The utilization of technology in preventing climate change impacts is thus crucial. This is due to the significant roles of technology in disseminating information related to current issues in the societies (Reyna et al., 2018). For example, websites from various government agents, environmental activists, or other non-profit organizations. Websites play an important role in providing information about cli-

<p>| Table 4. Scores of students’ and university students’ PEB to prevent climate change in each indicator |
|-----------------------------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>No</th>
<th>Indicator</th>
<th>Mean score of JHS</th>
<th>Mean score of SHS</th>
<th>Mean score of FMS</th>
<th>Mean score of NFMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Utilize environmentally friendly energy sources</td>
<td>4.60</td>
<td>4.27</td>
<td>4.47</td>
<td>4.42</td>
</tr>
<tr>
<td>2</td>
<td>Prioritize using low-emission vehicles</td>
<td>3.96</td>
<td>3.46</td>
<td>3.79</td>
<td>3.76</td>
</tr>
<tr>
<td>3</td>
<td>Avoid burning waste to reduce greenhouse gas emission</td>
<td>3.23</td>
<td>2.55</td>
<td>2.92</td>
<td>2.93</td>
</tr>
<tr>
<td>4</td>
<td>Utilize low greenhouse gas-content products</td>
<td>3.52</td>
<td>3.49</td>
<td>3.94</td>
<td>3.75</td>
</tr>
<tr>
<td>5</td>
<td>Perform waste recycling activities</td>
<td>3.49</td>
<td>2.95</td>
<td>3.36</td>
<td>3.36</td>
</tr>
<tr>
<td>6</td>
<td>Invite the communities to prevent global warming</td>
<td>3.55</td>
<td>3.16</td>
<td>3.63</td>
<td>3.47</td>
</tr>
</tbody>
</table>

JHS: junior high school students; SHS: senior high school students; FMS: faculty of math and science students; NFMS: non-faculty math and science students.
mate change.

In addition to the climate-change prevention efforts, it is necessary to have a contribution through the education world. Climate change education is aimed at empowering the education system to facilitate climate change learning. Students need to learn new knowledge and skills and make significant behavioral changes in order to be able to manage problems related to climate change and reduce problems in society against various threats in natural disasters (Mochizuki and Bryan, 2015). Innovation that can be developed, regarding the contribution, is by developing a variety of teaching materials in the form of books, PowerPoint slides, or documents related to climate change information (Kelman et al., 2016; Lane et al., 2015).

Climate change education engages students through narratives, lectures, and environmental projects, and building climate communication research can deliver positive change among students. In addition, field visits, school field construction projects, and developing community collaboration to be able to collaborate between schools (Siegner and Stapert, 2019). Textbooks can be an option for innovative teaching materials. The textbook to be developed is called the Climate change Book Series for University Students (CCBS-US). The book is intended for university student level as a party that can be a role model for the societies. The book, however, can also be used as a supplement for students in primary and secondary school levels. This book contains various explanations related to the concept of climate change and the impacts of climate change. Impacts such as acid rain, global warming, and ozone destruction are interesting topics discussed in this book. The results of this study illustrate that the CCBS-US book developed must be contextual in accordance with the relevant topic, namely climate change.

According to Stevenson et al., (2017) climate change is not just a scientific phenomenon. It is a complex socio-scientific issue that demands more than the teaching of content. Therefore, numerous aspects of climate change make it a challenging topic to teach (Monroe et al., 2017). The urgency of the study is that there have been no efforts to develop a teaching material specific to climate change. Therefore, the development of teaching material to prevent climate change must be carried out.

Conclusion

The study inferred that the students’ and university students’ PEB was still in a moderate and high category, respectively. It indicates that efforts are required to improve the PEB, especially those related to climate change. Various tools are developable regarding this matter. One of the tools is CCBS-US for university students. Details of average score were Junior high school students (74.49), senior high school students (66.28), Faculty of Math and Science university students (73.69), Non-Faculty Math and Science university students (72.27). The CCBS-US could also be utilized for students and the public as a form of innovation in environmental learning media. The implication of this research is that the results of this study can be used as a reference for teachers and lecturers in developing students' PEB. The limitation of this research is that the number of student samples taken is still relatively small, making it difficult to generalize to a wider area.

Based on the analysis results, the CCBS-US to be developed should be based on strengthening the aspects of students’ and university students’ PEB. Aspects that should be reinforced are those related to reducing waste in the environment, recycling activities, and socialization on climate-change prevention efforts through various technology media. The reinforcement of the aspects is necessary as they could consolidate the low students’ and university students’ PEB. The CCBS-US must contain contents related to climate change and an invitation to avert the climate change in the form of PEB.

PEB, in this case, plays an important role as an indicator in the implementation of various climate-change prevention programs. It is important since students and university students are not only required to understand the climate change concepts but also apply them in the form of PEB that is reflected in their behavior. The role of environmental learning in improving the PEB can be done by, one of them, developing CCBS-US as an option of teaching materials for use in environmental learning.
References


