



# Environmental STEM (E-STEM) in Building Climate-Resilient Communities in Aceh: Students' Awareness

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**Abstract:** The environmental STEM (E-STEM) approach helps students to understand problems related to the environment and solutions to overcome the issues. Many studies show how applying the E-STEM approach in education increase students' awareness of protecting the environment and being adaptive and resilient to the impact of climate change. This paper explains the findings of E-STEM learning activities and outcomes in a school setting (grade XI) in Aceh. Qualitative approach with Focus Group Discussion (FGD) with 11 senior high school students taught about the environmental issue using the E-STEM. Students have low environmental awareness of the impact of climate change. Furthermore, students' unwise behavior in using electricity and transportation and lack of waste management indicate a gap in implementing the E-STEM approach within the current National Independent Learning Curriculum. Despite the shortcoming of the learning activities and outcomes, the study highlights the importance of introducing natural connectedness through E-STEM learning at an early age to be adaptive and resilient to the impact of climate change.

**Keywords:** Aceh; High school students; E-STEM; Climate change; Learning outcomes

## Introduction

Environmental-based education is significant in mitigating and adapting to the impacts of climate change. Thus, introducing and cultivating the awareness of protecting the environment and adapting to climate change's impact must start from an early age or school age. Several studies have demonstrated the benefits and advantages of environmental-based education at an early age, such as increasing students' knowledge and awareness about protecting the environment; offering alternative learning for students who are accustomed and conditioned to studying indoors (especially during a pandemic). Enabling students in outdoor activities help them understand what is happening with nature and find ways to solve environmental problem; improving students' health or providing a solution for a better healthy lifestyle. For example, during the pandemic, studying from home (SFH) has contributed to students' lack of physical activities. As a result, they become more susceptible to being obese and have

mental health disorders; developing students' ability to focus, particularly for children with attention-deficit disorder, being connected to nature helps to improve their cognitive abilities and manage their lack of focus; enhancing students' critical thinking, including the skills of asking, investigating, defining problems, analyzing, interpreting, reasoning, developing conclusions, and solving problems; and supporting a creative learning environment through applying STEM (Science, Technology, Engineering, and Mathematics) approach (Sustainable Forestry Initiative, 2019).

Students can learn faster through the STEM because the logical steps of STEM and multidisciplinary contents helps students to have meaningful learning to master the knowledge and skills (Tseng et al., 2013). The result of exploring concepts in traditional STEM disciplines is the E-STEM discipline, which refers to learning involving students or individuals in the environment (Fraser et al., 2013). The E-STEM approach offers the opportunity to combine environmental education (EE) and science education (SE). Enhancing the mutualistic relationship

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between both fields of studies can be achieved by advancing learning outcomes in both fields. For instance, the learning outcomes need to assess knowledge about the environment as a conceptual topic and a physical context. At the same time, learning outcomes of E-STEM need to provide activities that stimulate problem-solving to handle the ecological challenges (Gupta et al., 2018). Meanwhile, the success of the STEM approach implementation would be supported through environmental education (Candan-Helvaci, 2021).

E-STEM is in line with four leading educational best practices that involve students deeply, namely hands-on practice, natural themes, namely environments that combine broader learning topics in science, technology, engineering, and mathematics, aligned with interests, namely environments that are consistently rated as one of the children's main areas of interest, and fostering achievement and empowerment is that projects generate real impact created by students, sparking inspiration and a sense of accomplishment (Fraser et al., 2013). Furthermore, environmentally-based STEM learning applied to students, apart from being able to provide exciting and interactive science learning opportunities (Gupta et al., 2018), also has a positive impact on students' views of STEM disciplines and environmental variables such as environmental awareness, attitudes, and environmentally friendly behavior (Gupta et al., 2018; Helvaci & Helvaci, 2019).

Environmental-based education requires environmental literacy, sustainable development, and environmental awareness. Therefore, environmental awareness is the focal point of developing and changing the E-STEM approach. Candan-Helvaci (2021) argues that there is a target for developing environmental awareness because of the scope of environmental education. For instance, action-related environmental knowledge is not only about engineering-based problem-solving skills and competencies. However, it involves other skills such as relevance-building, engineering-based design, communication, innovation, digital competencies, collaboration with STEM skills, creativity, and environmental literacy (Candan-Helvaci, 2021).

*First*, environmental literacy refers to environmental education as knowledge about environmental ecology and knowledge of socio-political systems, disposition (enthusiasm, sympathy, responsibility for the environment), the context (attentiveness of the environmental issues in local context, regional and global), and competence (understanding to the environmental problems, offering solutions, taking action for solutions). In addition, environmental problems require desired and expected behavior through individual or collaborative efforts to

solve environmental problems (Hollweg et al., 2011). *Second*, sustainable development refers to an orientation to solve environmental issues based on an anthropocentric ethical approach, consisting of three dimensions: environmental, economic, and social (Harris, 2000). *Third*, environmental awareness consists of three basic dimensions interconnected environmental knowledge, positive attitudes, and beneficial behavior toward the environment, which gradually form within the individual (Candan-Helvaci, 2021).

Environmental-based education focusing on school age is significant in Indonesia. The country is not only famous for its rich biodiversity but recently well-known for the increasing destruction of its environment due to massive deforestation. In addition, many studies have shown the impact of environmental damage on climate change (Djalante et al., 2021; Faure & Wibisana, 2013; Herawati & Santoso, 2011). Indonesia is one of the countries most vulnerable to climate change (Group & Bank, 2021). Its geographical situation on the equator, between the Indian and Pacific Oceans, and its low-lying coastal archipelago make it very susceptible to flooding and rising sea levels. At the same time, the emitted massive amounts of CO<sub>2</sub> (cause to the forest fire and deforestation), making the country one of the largest GHG emitters. Although it is still challenging to predict the magnitude of the impact that will cause and its impact on the community and the surrounding environment, the economic impact is expected to be even greater. Several studies show that in Indonesia in 2100, it is predicted that financial losses due to climate change, both directly and indirectly, will reach 2.5% (percent) of Gross Domestic Product (GDP), which is approximately four times the global average GDP loss due to climate change (Bappenas, 2012). By increasing public understanding, developing mitigation and adaptation programs, we would be able to diminish the negative impact of climate change on the economy, and increase resilience communities to climate change.

Numerous endeavors have been undertaken to comprehend and tackle the challenges of climate change mitigation and adaptation within the confines of this nation. Spearheaded by the Ministry of Environment and Forestry, the central government has promulgated official documents such as the National Action Plan on Climate Change, constituting a proactive response. Furthermore, collaborative efforts involving international organizations and indigenous stakeholders diligently enhance policymaking processes while implementing tangible measures to fortify community resilience. These efforts, notably underscored by innovative strategies for climate change adaptation and the transition toward an ecologically sustainable economy, collectively strive to address the multifaceted impacts of climate change.

Preeminent among these undertakings is the Climate Village Program, commonly referred to as Proklim, a regulatory framework entrenched within the auspices of the Regulation of the Minister of Environment and Forestry, designated as Number P.84/MENLHK-SETJEN/KIM.1/11/2006. Proklim is designed with the overarching objective of engendering heightened engagement from communities and stakeholders. It seeks to bolster the adaptive capacities required to manage the repercussions of climate change, concurrently curbing greenhouse gas emissions. Proklim serves to improve the well-being of local and regional communities by honoring and acknowledging endeavors in climate change adaptation and mitigation. The operational ambit of the Climate Village Program encompasses locales spanning the lowest echelons of administrative divisions, encompassing community units and hamlets, and extends upward to kelurahans or village levels. Additionally, its purview extends to regions where communities are steadfastly engaged in ongoing efforts toward climate change adaptation and mitigation (Kehutanan, 2016). It is worth noting that this initiative also holds pertinence for the region of Aceh.

Aceh is a province in Indonesia located at the northern tip of the island of Sumatra and is the westernmost province in Indonesia. The capital city is Banda Aceh. The total population of this province is around 4,500,000 people, with an area of 5,795,600 ha (57,956 km<sup>2</sup>) (Province, 2016). Research shows that around 62 percent of Aceh Province's villages are vulnerable to climate change impacts. For example, villages in coastal areas are predicted to experience a more extended dry season, which affects agriculture and is also vulnerable to rising sea levels. Meanwhile, villages in mountainous areas where much forest has been cut down are vulnerable to disasters such as floods and landslides caused by relatively above-normal rainfall (Bank, 2016).

Many studies have been conducted to evaluate this government program, which shows that the implementation of *Proklim* is still weak, especially in building community resilience to the impacts of climate change (Rosemary & Roesa, 2022; Safrina & Roesa, 2020; Santoso & Rahaju, 2020). One of the reasons is that community involvement in implementing *Proklim* is not yet optimized. Community participation is the main motor driving of the national program. Moreover, the community's attitude towards their environment represents the behavior of individuals or groups and vice versa. Therefore, school-based education becomes significant for shaping positive *behaviors* towards the environment. Environmental-based education implemented at schools is a practical approach to students' behavioral change towards the environment, including increasing awareness to protect the

environment and prevent it from damaging nature. Behavioral change through the educational process helps students to be adaptive and resilient to the impacts of climate change.

Indonesia's current national education curriculum applies an independent learning system. Students can choose what they want to learn or *Merdeka Belajar* (Independent Learning). This new curriculum provides diverse intra-curricular learning where the content will be more optimal, giving students enough time to explore concepts and strengthen competencies (Kemendikbud, 2022c). The Independent Learning Curriculum is a policy that was launched to return the authority of education management to schools and local governments, where it provides flexibility to schools and local governments in planning, implementing, and evaluating educational programs implemented in schools.

The central government sets learning to achieve national education goals (Kemendikbud, 2022a). Izza et al. (2020) state that teachers have the freedom to translate the curriculum before it is explained to students independently (Izza et al., 2020). Thus, teachers can answer each student's needs during the learning process. The Ministry of Education and Culture launched the Independent Learning Curriculum to overcome the learning crisis (Kemendikbud, 2022b). This curriculum comes from the learning crisis and the lack of optimality in learning during the Covid-19 pandemic. This crisis resulted in a loss of communication sensitivity between teachers and students in collaborating actively in the learning process (Suhandi & Robi'ah, 2022).

Environmental STEM (Science, Technology, Engineering, and Mathematics) or E-STEM approach has been implemented in Indonesia's national school curriculum since 2013. Several changes occurred from the 2013 curriculum to the Independent Learning curriculum, namely: the use of Learning Outcomes (CP), which is equivalent to Core Competency (KI) and Basic competency (KD) in the 2013 Curriculum. Students with special needs refer to as those with mental problems, and students with special education without intellectual barriers refer to those general students. For example, in the 2013 Curriculum, KI and KD are prepared for students with specific disabilities. However, in the Independent Curriculum, there is only one Learning outcome (CP) for all types of disabilities (Kemendikbud, 2022). The essence of the difference between the new curriculum and the 2013 curriculum is in the mandate or structure of the two curricula. The 2013 curriculum carries the mandate of a science-based approach (Scientific Approach), while the Independent Learning curriculum is a Project Based Learning (Kemendikbud, 2022; Suhandi & Robi'ah, 2022).



The Independent Curriculum has several advantages; namely, it is more superficial and more profound because it focuses on essential material and the development of student competencies in its phase. Furthermore, educators and students will be more independent, students can have subjects according to their interests, talents, and aspirations, and teachers can teach according to their needs. Moreover, regarding student achievement and development, the school has the authority to develop and manage curriculum and learning according to the characteristics of the education unit and students (Kemendikbud, 2022b).

Furthermore, the implementation of an Independent Curriculum holds greater significance within an academic context, exhibiting heightened relevance and interactivity. Through engagement in project-based endeavors, students gain expanded avenues for the exploration of tangible societal concerns encompassing areas such as the environment, health, and other pertinent subjects. This approach facilitates the cultivation of both characters and competencies among students. Thus, it will indirectly foster environmental concern (Kemendikbud, 2022b). It is further stated that students have the opportunity to study important themes or issues such as climate change, anti-radicalism, mental health, and others so that they can inspire students to contribute and have an impact on the surrounding environment (Kemendikbud, 2022b).

Although many studies have evaluated the role of E-STEM in environmental-based education, they have not explored how e-stem activities in learning in schools are accompanied by changes in student behavior, significantly increasing awareness of the importance of protecting the environment to prevent the impact of environmental change. Moreover, an initial survey was conducted on a group of school students related to implementing STEM learning based on environmental and ecological issues with student motivation. The question items in the student motivation survey refer to Keller's ARCS indicator (Tseng et al., 2013). Of the 29 students who participated in the survey, the results showed that students had a suitable category of motivation for implementing environmental and ecological-based STEM-based learning. In detail, the number of students who have motivation in the excellent category range for each aspect of the Attention, Relevance, Confidence, and Satisfaction indicators, namely 97%, 79%, 86%, and 69%, respectively. From these results, it can be concluded that more than 20 people stated that environmental and ecological-based STEM learning was able to motivate them in learning activities. The factors that support motivation are using

Student Worksheets based on STEM projects designed to be hands-on, creative, and engaging.

This paper aims to analyze environmental awareness and the impact of climate change through E-STEM activities in schools for grade XI students. This paper draws from Environmental-STEM (E-STEM) activity in one school that may have different results if carried out in other settings. However, this small study provides worthwhile information about applying E-STEM in environmental-based education, particularly responding to the novel Learning Curriculum implemented during the struggle of the pandemic period.

## Method

This study uses a qualitative approach with the Focus Group Discussion (FGD) method. The population of this study was generally high school students who had received an E-STEM learning intervention (n=60 students) by prospective teachers for one semester in the previous learning year. Therefore, this study's sample number was 11 students grade XI selected purposively, that is SMA 11. The selection criteria were based on the recommendation of teachers and school principal. The FGD process conducted around one hour in the principal office and was also accompanied by one teacher for the safety and confidential process (Figure 1). Moreover, the FGD was recorded, then transcribed into a script and analyzed into relevant themes.



Figure 1. The FGD process

The FGD instrument used in this study was adopted and modified from the research instrument of (Armel et al., 2011). Four questions related to environmental awareness and the impact of climate change became the question protocol in the FGD, including the use of electricity and transport, waste management, and food packaging (See Table 1). This FGD instrument has been validated by one expert in ecology and environment, one in language, and one in disaster and mitigation.

**Table 1.** FGD Instrument (Armel et al., 2011)

Aspect	Questions
Electricity	<ul style="list-style-type: none"> <li>• Do you use the washing machine? On average, how many loads of laundry do you wash per week?</li> <li>• How many times per week do you usually shower? On average, in minutes, how long is each shower (the number of dip water in the bucket)?</li> <li>• Do you use AC/Fan? How many days per week would you use air conditioning at your residence for any part of the day or night? <ul style="list-style-type: none"> <li>• How often would you use air conditioning when driving or riding in a car? <ul style="list-style-type: none"> <li>• How many hours of television do you watch on a typical day?</li> </ul> </li> <li>• How many hours of video games or computer games do you play on a typical day? <ul style="list-style-type: none"> <li>• How many hours do you spend on a computer on a typical day?</li> </ul> </li> </ul> </li> <li>• For the following questions, please note what percent of the time you currently do each of the following activities instead of their alternatives. <ul style="list-style-type: none"> <li>○ Turn off the TV when leaving the room.</li> <li>○ Shut off lights when leaving the room</li> </ul> </li> </ul>
Transport	<ul style="list-style-type: none"> <li>• How do you go to school? (Walking, riding a bicycle, riding bike/car)</li> <li>• How often do you use your vehicle in a week? (school and somewhere else) <ul style="list-style-type: none"> <li>• How often do you use public transportation?</li> </ul> </li> </ul>
Waste	<ul style="list-style-type: none"> <li>• How much trash do you personally produce each week in the place where you live? Estimate how many plastic grocery bags of trash you would fill.</li> <li>• How much trash (plastic/paper/cans) do you personally produce at school weekly?</li> <li>• How many times (in average) currently do each of the following activities instead of their alternatives. <ul style="list-style-type: none"> <li>○ Reuse paper as scratch</li> <li>○ Use both sides of the paper. <ul style="list-style-type: none"> <li>○ Tissue usage</li> </ul> </li> <li>○ Dry hands-on towel or clothes rather than with a paper towel <ul style="list-style-type: none"> <li>○ Recycle white paper</li> <li>○ Recycle newspaper and coloured paper <ul style="list-style-type: none"> <li>○ Recycle glass bottles</li> <li>○ Recycle aluminum and steel cans</li> <li>○ Recycle plastic containers and packaging.</li> </ul> </li> </ul> </li> </ul> </li> <li>○ Do you separate organic and inorganic waste? What will you do with the organic waste?</li> </ul>
Food Packaging	<ul style="list-style-type: none"> <li>• For the following questions, please note what average of the time you currently do each of the following activities instead of their alternatives. <ul style="list-style-type: none"> <li>○ Reuse old bags when shopping for food.</li> <li>○ Bring a reusable cup to cafes, eateries, etc.</li> <li>○ Avoid using Styrofoam packaging.</li> </ul> </li> </ul>

## Result and Discussion

The results of the FGD data were analyzed by determining the relevant themes following the environmental education framework used and focusing on action-related knowledge and effectiveness knowledge that produced intermediate outcomes and influenced environmental behavior (Krasny, 2020).

The paper focuses on action-related and practical knowledge. Themes are derived based on intermediate outcomes of the program activities in the school setting. There were three main findings to be highlighted in this study. Those three themes were (1) no electricity user friendly, (2) moderate use of transportation, and (3) high food-packaging consumption.

### *Electricity Unfriendly Users*

Through the FGD, our study found that concerning water, there are still many who are not efficient in using water, whether bathing using water in the bath or shower—characterized by the number of people who spend much time in the bathroom or who shower more than 14 times. The use of water in Indonesia in two ways, *Perusahaan Air Minum* (industry providing drinking water) and wells whose distribution is by using a pump engine that uses electricity. Moreover, students admitted that they regularly do the laundry using a washing machine (which includes both water and electricity) twice a week. Similarly, some still do not know about saving on electricity usage. For example, some turn on the TV 24 hours, whether it is available or not being

used/watched. This practice doubled during the pandemic.

However, some students understand that saving electricity includes unplugging all sockets when not used because the electric current is still working. As for using electronic devices, students use mobile gadgets more, approximately a whole day (24 hours). Furthermore, students understanding of the relationship between saving electricity and climate change is more to the excessive use of internet data, "we know that the process of sharing information through social media may likely exacerbate the power (electricity) that cause climate change" (Student B, FGD).

#### *The Moderate Use of Transportation*

During the Covid-19 pandemic, the Aceh government issued the social distancing policy and instructed the closure of schools; students learned from home and through daring (online method). Since they rarely use transportation, the level of Co2 in Aceh has decreased sometimes. However, when traveling around the city using four-wheeled vehicles, students said they could not avoid air conditioning in their cars and rarely open the window instead of using AC.

#### *High Food Packaging Consumption*

Even though students are conditioned to study from home during the pandemic, there was an increase in the consumption of food in plastic packaging purchased, mainly ordered through the Go Food application. In addition to the high volume of food packaging, there is an indirect increase in the volume of non-organic waste. Some students have used plastic boxes more than single-use. Only a few students are used to sorting waste properly, and no one has carried out a proper 3-R (Reduce, Reuse, Recycle) and alternatively prefer to manage the waste (both organic and non-organic by burning them).

Three themes emerged from the program activities, all of which indicated the remaining low level of learning outcomes that determined which knowledge was adequate and valid (effectiveness knowledge) in influencing student behavior towards the environment. In other words, even though action-related knowledge has been carried out optimally, there is a missing link between the components of action-related knowledge of the environment and effectiveness knowledge which is considered a significant contributor to changes in student behavior towards the environment. The findings resonate with a previous study examining middle and high school students' conceptions of climate change mitigation and adaptation strategies. The study found that adolescent middle and high school students are likely to combine the unrelated issue of environmental with climate change mitigation and are less likely to

understand how to adapt to the impact of climate change effectively (Bofferding & Kloser, 2015). This finding demonstrates that most research on environmental-based education, particularly climate change, remains focused on mitigating the issue's impact and tends to undermine the adaptation process and skills students need to face the implications of climate change. Therefore, creative learning approaches become necessary to introduce environmental issues into more effective and practical knowledge for students, especially in Indonesia.

The integration of STEM learning into the curriculum in Indonesia is not a complicated process. The flexibility of the curriculum in Indonesia towards the development of knowledge and learning models has accommodated the application of STEM in science subjects at school. Moreover, environment-based STEM (E-STEM) learning can be integrated into Biology subjects, especially in basic ecology or ecosystems and environmental changes. In addition, E-STEM learning can also be applied to other basic competencies (KD) by using the surrounding environment as a learning resource. However, it cannot be denied that applying E-STEM in the school curriculum also has its challenges.

STEM learning allows students to understand real-world problems (Dugger, 2010). Environment-based STEM learning will provide students with engineering-based problem-solving skills, skills to build relevance, engineering-based design skills, innovation skills, digital competencies, creativity, communication and collaboration, and especially environmental literacy – these skills and competencies targeted by E-STEM (Candan-Helvacı, 2021).

Through E STEM learning, students also have the opportunity to learn interesting and interactive science, where students participate in scientific exploration, observe nature, understand the interrelationships of natural systems, and develop as environmental stewards (Gupta et al., 2018). Furthermore, when students are actively involved in meaningful activities, this will also affect improving self-quality where students' motivation and interest will increase, students tend to persist in completing complex tasks, creative students are more willing to take risks, and begin to tend to choose more challenging tasks (Pintrich, 2003; Schneider et al., 2002).

Based on the results of several studies related to the implementation of STEM in schools and the results of the training/service that has been carried out, the integration and application of STEM, especially environmental STEM (E-STEM), in the curriculum and learning in secondary schools also have its challenges. The following are some challenges faced. First is the lack of training knowledge and training on E-STEM for teachers, so they do not quite understand how to plan

lessons and carry out learning actions in the classroom. Second, the readiness of students to participate in the E-STEM-based learning process is also a challenge. Students tend to follow the work instructions designed by the teacher on the Student Worksheet without understanding the essence of E-STEM-based learning itself. Students can also experience learning shock. They are accustomed to listening to teachers' explanations, while the E-STEM approach requires critical thinking and problem-solving. Thus, students are expected to have independent learning.

Third, the time required to implement E-STEM learning is prolonged, resulting in teachers becoming anxious about the outcome of the learning process. Mainly when specific learning indicators and objectives must be achieved. Finally, schools and the community have low involvement in the environment-based STEM learning process. Therefore, the learning process remains inadequate and in need of extensive resources. In addition, teachers are unfamiliar with websites for E-STEM learning, for instance, *BMKG or Badan Meteorologi, Klimatologi, dan Geofisika* – the meteorology, climatology, and geophysics board which is a helpful website to observe rainfall forecasts and other related sources on environment-based learning. Some of these challenges are similarly found in research examining the implementation of entrepreneurial practices into STEM Education in the high school curriculum (Eltanahy et al., 2020).

Furthermore, De & Arguello (2020) describe some of the challenges in the application of environment-based STEM learning, including: (1) students who learn STEM need to understand complex knowledge in the learning process, considering what is learned is a combination of several the concept of science and also the relationship with mathematical concepts so that it can be the basis for them to carry out engineering in learning activities by using certain technologies; (2) students need availability and access to real-life problems to get hands-on learning experiences. In this case, the teacher needs to provide teaching materials with a social and narrative context; (3) the availability of Professional Development for teaching staff is also an essential issue in the implementation of STEM learning; and (4) the readiness to replace conventional learning methods into STEM Education requires cost-effective and innovative learning platforms (De & Arguello, 2020).

Nevertheless, according to the results of this study, the challenges in E-STEM implementation, including the gap between mitigation and adaptation learning outcomes to be resilient to the impact of climate change, can be anticipated by natural connectedness (Krasny, 2020). The introduction of the environment from an early age is an effort to build students' sense of closeness

to nature and the environment, which will further encourage environmental awareness efforts and adaptation to climate change, like in Aceh. Early education about the environment and adaptation to the impact of climate change is not only theory-based but needs to be more focused and emphasizes practical activities (action-related and affective knowledge). The E-STEM approach is encouraged to be applied in school programs and activities. The E-STEM approach needs to improve how students learn about environmental concepts by providing more contextual learning that emphasizes the benefits and impacts of the learning (effectiveness knowledge). Likewise, the approach must encourage students to find solutions to the environmental problems that drive the impact of climate change (Helvacı & Helvacı, 2019). The results of E-STEM activities must be followed up through student involvement in community service, starting from the family as part of the community.

## Conclusion

This paper aims to analyze environmental awareness and the impact of climate change through E-STEM activities in schools for grade XI students. The implementation of environmentally-based STEM learning to students is able to provide exciting and interactive science learning opportunities and positive impact on students' views of STEM disciplines. However, teachers need to promote students comprehensive understanding on the connection of learning content to daily life problems to improve students' awareness. By applying an E-STEM approach in learning activities, students are expected to have great awareness on environmental problems as a prior stage in building climate resilient communities.

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## Author Contributions

Wiwit Artika and Rizanna Rosemary: writing original paper, conceptualization, methodology, formal analysis, investigation, resources, writing – review and editing.

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## Conflicts of Interest

The authors declare no conflict of interest.

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