UNIVERSITAS NUSA CENDANA

ICoSASTE

PROCEEDING

of the 3rd International Conference on Science, Applied Science, Teaching & Education (ICoSASTE)

organized by

THE FACULTY OF TEACHER TRAINING AND EDUCATIONAL SCIENCES

UNIVERSITAS NUSA CENDANA

UNDERGRADUATE PHYSICS EDUCATION STUDENTS' PERCEPTION ON SOIL POLLUTION: AN ACTION RESEARCH IN INDONESIAN UNIVERSITIES

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Abstract. The aim of the research is to find out the Indonesian undergraduate Physics education students' perception on soil pollution and climate change through watching a Netflix documentary about the first viable, low-cost way to reverse climate change through soil. Action research was conducted in Physics Education study program at two universities in East Nusa Tenggara Province, Indonesia. University 1 is a public university and university 2 is a private university. The number of students involved in university 1 and 2 were 36 and 7 students respectively. The research was conducted in the setting of Environmental Physics unit which was offered in both universities during February to June 2024. At university 1, the unit was offered for first year (second semester) students while the students enrolled for the unit at university 2 was second year (fourth semester) students. This paper focused on the 8th class meeting when students learned about soil pollution. The qualitative content analysis shows some points as follows. First, most students at university 1 and all students at university 1 felt worry, afraid, guilty about and angry at the people who cause soil pollution and climate change after watching the movie. Next, most students at university 1 and half of the students at university 2 do not feel bored when discussing about the soil pollution and climate change. Most students at university 1 and all students at university 2 felt hopeful that soil pollution and climate change can be minimized and felt empowered to take action to minimize soil pollution and climate change. When it comes to commitment to take personal action, most students at university 1 and all students at university 2 committed to make lifestyle choices that have minimal negative impacts on land pollution and climate change, to find out which products and services have minimal impact on soil pollution and climate change, to talk to friends and family about issues related to climate change so that we can all become aware of what needs to be done to address soil pollution and climate change, and to challenge politicians and businesses to do more to tackle soil pollution and climate change. In terms of taking group action, most students at university 1 and all students at university 2 stated their willingness to become member of local or national youth forums that promote to solve soil pollution and climate change issues, to seek opportunities to participate in national and international decision-making on soil pollution and climate change issues, and to participate in public demonstrations (e.g., climate strikes) to support movements to address soil pollution and climate change. However, it was very challenging for most students in both universities to elaborate their willingness to take group action since only very few students stated it. The process of using a documentary movie in teaching and learning activity for Physics education students was powerful to some degree since it encourages students to voice their mind and show their reaction.

Key words: soil pollution, climate change, students' perception, physics education, climate change education

1. Introduction

Human induced climate change is one of the most important problems facing humanity. Climate change is a change in temperature and rainfall over a period of time (usually at least 30 years). Natural processes like volcanoes or the Sun's radiation can cause climate change but human activities have influenced climate change through the atmosphere (e.g., increased carbon dioxide) and land use (e.g., deforestation). Although climate change has long been a question of interest in a range of fields, in recent years, there has been increasing interest in climate change related to adaptation (Ibrahim & Johansson, 2021; Pemberton et al., 2021), mitigation (De Giusti et al., 2019; Moerkerken et al., 2020), vulnerability (Adhikari et al., 2020; Lapola et al., 2020), extreme weather (Demski et al., 2017; Mann et al., 2017), denial (McDevitt, 2020; Petersen et al., 2019), and impacts (Karam et al., 2022; Raymond et al., 2020).

As human population have grown and living standards have risen, the requirements for agricultural products have increased enormously. More land has been brought under cultivation and vulnerable to degradation by such processes as erosion, pollution and salination. Soil pollution is the reduction in the productivity of soil due to the presence of soil pollutants. Soil pollutants have an adverse effect on the physical chemical and biological properties of the soil and reduce its productivity. Changes in the quantity of carbon stored in the soil can affect the global carbon cycle and alter carbon dioxide levels in the atmosphere. Thus, decreases in soil carbon may raise greenhouse gas levels in the atmosphere, thus contributing to climate change.

Education plays a crucial role in addressing climate change issues in the wider community, especially the next generation. Climate change education in schools and higher education is important because it can help young people to become aware of climate issues, look at them critically, respond to challenges in a meaningful and effective manner and make informed decisions (UNFCCC, 2023). Australian climate change education researchers (Stevenson et al., 2017) emphasized the importance of educating for change in behaviour rather than only focusing on science knowledge. Students are not exposed to hands-on and outdoor activities related to climate change even though teachers may have a good understanding of climate change concepts (Karim et al., 2022). Tolppanen et al. (2022) introduce a theoretical approach to climate change education in universities where it is not only the science of climate change but also students' knowledge, values, attitudes and willingness to mitigate actions. At some universities, such as the University of Barcelona in Spain, there has been a change in the paradigm of university education where all undergraduate and postgraduate students and academic staff have to take courses and training programmes related to climate change issues starting from 2024 (Burgen, 2022). Climate change curricula in schools in Turkey, South Africa, the Philippines, Malaysia, Finland and Hong Kong have also been focusing on both students' and teachers' knowledge, attitudes, and behaviour, as well as teaching approaches that impact students' knowledge and motivation (Chang & Pascua, 2017). In the latest Indonesian curriculum that is called "Merdeka" curriculum for junior high schools, climate change topics are covered in grade 7th science textbooks and are presented in the form of case studies that integrates the application of science and socioeconomics (Antika et al., 2022).

Due to its proneness to natural disaster and climate change impacts, the Indonesian government has been calling for the integration of climate change mitigation and adaptation into the school and university curriculum since 2010 (Dewi & Khoirunisa, 2018; Nugroho, 2020; Sofiyan et al., 2019). However, there is no exact model to be used as a guide for climate change education. Climate change education in Indonesia needs to be developed in universities for undergraduate students to support the curriculum that has been available for the last decade. In Indonesian universities, climate change education is taught to first-year undergraduate students through courses named "Climate Change Adaptation and Mitigation" for non-STEM students, "Climatology" for Agricultural students (FapertaUM, 2022) and integrated into "Environmental Physics" or "Knowledge of the Environment" course for STEM students (Sofiyan et al., 2019).

These courses are mainly about knowledge and neglect how the students should understand the impact of climate change and become actors of change in their communities. The topics covered in the Environmental Physics unit are contamination in water, air, soil and sound; weather and climate; natural disaster and renewable energy (Malau, 2019). These topics taught in Indonesian universities are mainly knowledge with few case studies and implementation.

The theoretical bicycle model for the climate change education developed in Finland (Cantell et al., 2019) has the potential be used to develop a curriculum for Indonesian undergraduate students, especially to undergraduate physics students. The scope of climate change is broad and so a holistic model is represented as a bicycle to portray one entity. The word 'holistic' means that a bicycle as a symbol for climate change education requires all of its parts to function together. The model was evaluated through group discussion by climate and sustainability educators, and through questionnaires by sustainability and climate change education researcher, schoolteachers, climate educators and environmental artists.

Each part of the bicycle in the 'bicycle model' represents an essential aspect of climate change education. To move forward, 'wheels' are needed so they represent knowledge and thinking skills. The bicycle's 'chains and pedals' depict the practical actions needed to mitigate and adapt to climate change. The foundation for climate change education is students' identity, values and worldview which are pictured by the 'frame'. The 'saddle' represents the learners' motivation and participation. Students can relate to climate change issues that are close to their life. The 'brakes' depict the many challenges and barriers coming from society that discourage students to take action towards climate change mitigation. Despite so many uncertainties and fears linked to students' learning and capacity building, there is hope and positivity in climate change education. This is symbolised by the 'lamp'. The 'handlebar' shows students' practice in decision-making to envision a possible positive future. In Finland, the bicycle model was implemented in a multidisciplinary course named *Climate.now* course and taught in three universities. In this particular paper, a teaching strategy was used to explore "the lamp" which is about the students' feelings towards climate change, such as worry, fear, sadness, guilt, hatred and hopelessness. Emotions have a significant impact on learning. Instead of negativity, climate change education should stimulate hope and compassion in people.

Perception is psychological processes through the experience gained by the five senses, individuals can process responses into positive or negative perceptions. Obtaining responses is obtained through the stages of selection, interpretation, and reaction. Otter described perception as a process of actions for acquiring information. That acquisition can stem from the environments to which students are exposed. Fieldman (1999) stated that perception is a constructive process by which we go beyond the stimuli that are presented to us and attempt to construct a meaningful situation. Whereas Morgan (1987) stated that perception refers to the way the work, sound, feel, tastes, or smell. In other works, perception can be defined as whatever is experienced by a person. This paper addresses a research question: "What is Indonesian undergraduate Physics education students' perception on soil pollution and climate change?". Students' perception acquired through watching a Netflix documentary that explores the first viable, low-cost way to reverse climate change through soil. A disruptive group of scientists, farmers, ranchers, activists, and government types are banding together in a global movement toward a new type of agriculture called "regenerative farming" that increases soil life, stores water and sequesters CO2. These people come from diverse backgrounds, but they share a common commitment to heal the world's soils before it's too late.

2. Methods

It is a part of an action research conducted in Physics Education study program at two universities in East Nusa Tenggara Province, Indonesia. University 1 is a public university and

university 2 is a private university. The number of students involved in university 1 and 2 were 36 and 7 students respectively. The research was conducted in the setting of Environmental Physics unit which was offered in both universities during February to June 2024. At university 1, the unit is offered for first year (second semester) students while the students enrolled for the unit at university 2 is second year (fourth semester) students.

This paper focused on the 8th class meeting when students learned about soil pollution and land degradation. The following were the activities in the classroom in each universities.

University 1

Students at university 1 were watching a movie titled "Kiss the Ground" on Netflix. All students (36 students) were present at the class meeting. They came to the class not knowing that they will be watching a movie. All they know was the topic for today's class is about soil and land pollution. The researcher sent the learning material in the form of a PowerPoint presentation a day before the class meeting so the students could read it. There was also a pre-class meeting activity that students should do before attending the class. However, none of the students do the pre- activity. So, the lecturer and the researcher remind the students to do the activity as the post-class meeting activity.

The lecturer opened the class meeting for a few minutes. After that, the lecturer and researcher handed over worksheets to each student and the lecturer asked the students to read the 4-page worksheet to understand the questions need to be answered after watching the movie. The lecturer then informed the students that they will be watching a movie about soil and its pollution titled "Kiss the Ground". He also mentioned the duration of the movie and the platform used to watch it (Netflix). The lecturer asked the students once again about their understanding about what to do today. Once everything is ready, the researcher played the movie. During the screening, the researcher saw some students recording some parts of the movie. But overall students were really into the movie. Some were taking notes while others showed some expression. When the movie finished, all students were really impressed, and a few female students even found crying. They were really into the movie. The lecturer then asked some students to give their comment about the movie. Three female students were explaining about what the movie is about and advice their classmates to protect the soil. One male student (the one who lead the opening prayer) asked a very interesting question. He tried to relate how soil pollution and land degradation as seen in the movie affect the agricultural (crop) production in his hometown. He tried to find scientific answers to his questions. The lecturer then gave feedback to the students and also made some key points that the movie delivers. He also answers the student's questions clearly. The researcher was also given the opportunity by the lecturer to respond to the student's comments and questions. The researcher was adding some detail explanation to answer the student's questions.

After the QnA session, the students were told to fill out the worksheet and submit it to the researcher after the class finished. The lecturer then made some conclusions about soil and land pollution.

University 2

Class activity at university 2 was similar to activity at university 1. There were about 6 students watching the "Kiss The Ground" movie. The key points of the movie "Kiss the Ground" are as follows:

1) Our top soils are disappearing
   Since chemical agriculture ramped up in the 70's, we have lost 1/3 of the world's topsoil. The rest is projected to be lost within 60 years. Unless we save our soils, we have 60 harvests left! No topsoils; no food! We need to act.

2) The planet is desertifying (more land is becoming desert)
   With topsoils disappearing and temperatures rising, about 2/3 of the world is desertifying. Every year 40m people are displaced as their farmlands become desert. By 2050, it is estimated that 1bn people will be refugees of soil desertification.
3) Carbon is not the bad guy!
   We are made of carbon (16%) and it's the element that life is based upon! It's the misbalance of carbon that is the issue. There is too much in the air now and too little in the earth (released by tilling and soil degradation and burning fossil fuels and plants/trees) causing global temperatures to rise.
4) Our modern farming methods are killing the soils
   Our modern farming methods are not concerned with soil longevity or quality and are significantly to blame for the destruction of the soils. There are also clear spikes in the CO2 levels in the atmosphere during the ploughing/tilling months with the lowest levels coinciding with maximum plant coverage before harvest.
5) Nature has invented the most sophisticated carbon capture method – photosynthesis
   Nature strives for balance, and has a system for reversing the carbon released into the atmosphere using the growth of plants and their relationship with soil microbes.
6) Soils are a huge potential carbon store
   By taking carbon dioxide from the air, and sending it down to soil microbes in exchange for nutrients, plants can not only remove carbon from the atmosphere, but store carbon in the soils. This is how the natural carbon cycle should work. Tilling and chemical agricultural methods have disrupted this cycle and increased the rate of carbon release. Healthy soils can store more carbon than all the trees and plants combined, so is more important than saving the rainforests or the ocean phytoplankton in reversing climate change!
7) Regenerative farming restores soils
   Regenerative farming restores soils; storing carbon and reducing the need for chemical help to improve yields by harnessing natural processes. The basic principles are: minimal tilling/ploughing, using cover crops, involving livestock in managed grazing, organic practices avoiding chemicals, composting, crop diversity and using trees and perennials as protection.
8) Regenerative farming can reverse climate change
   If we adopt regenerative farming practices, we can reverse carbon release into the atmosphere and stabilise the climate, and it won't take long! If we restore all the degraded land, we can return the earth to paradise, making room for biodiversity and feeding the world's population (with lowered animal protein consumption).

In the worksheet, students were given questions to explore their environmental concern and willingness to take personal and group action. The questions are open ended questions and was analysed using qualitative content analysis approach.

FINDINGS

The perception of the Indonesian Physics students in two universities regarding soil pollution can be analysed as follows:

1. How worried are you about soil pollution and the climate?

University 1

Data analysis revealed that 100% students worried about soil pollution after watching the movie. 64% students stated their reasons why they feel worry as follows:

- Soil pollution could damage the soil and will affect the climate.
- The microorganisms in the soil will decrease and cause the soil to be unhealthy.
- Land provides protection for us humans.

- Land pollution and climate change have a huge impact on the survival of humans, animals and even the earth itself.
- Land pollution and climate change which will cause or harm humans in their daily lives.
- If the land is polluted so much, it causes climate change that can have a negative impact on human life.
- If there is continuous soil pollution then the soil is unhealthy. Unhealthy soil makes me worry because if we plant plants they won't survive.
- Land pollution and climate change are very dangerous for the environment and the survival of humans and the ecosystem on earth.
- If there is soil pollution then the plants we plant will not be healthy plants.
- Land pollution and climate change can cause various disasters that are dangerous for human survival.
- How land pollution and climate change affect the civilization of living creatures, which brings negative impacts such as dust storms, hunger, drought, etc.
- If the land is not healthy then of course our lives are threatened because disasters could occur, there could also be famine and drought.
- Land itself is very important and very influential in the lives of living creatures so it needs to be used well so as not to cause new problems in climate change.
- Humans cultivate the land and it will cause environmental damage such as natural disasters.
- This land pollution is caused by humans so that climate change occurs and the consequences that occur in humans themselves are felt.
- If the land experiences pollution then it will also have an impact on human life and also the climate.
- In the future if land damage continues to increase it will cause disasters such as floods, tsunamis and so on.
- Land pollution and climate change have a big impact on our lives. Land pollution and climate change can cause many disasters that harm us, such as floods, tsunamis, droughts, dust storms and others.
- If we as humans cannot protect the soil then pollution/dust will occur and it can cause us as humans to get sick from soil dust.
- Land that was processed using modern tools with fertilizer actually made the soil more damaged and experienced land degradation, this could make a difference. Apart from that, open soil actually releases CO2 which further damages the earth. When the soil becomes dust where the soil releases CO2, in this event we can or get a good harvest and this is not only us who feel this but all creatures on earth, in this case the animals we care for (livestock).
- This land is where living creatures live. From the soil, food from water, iron from processing the soil.
- The climate is interconnected, pollution in the land can make the plants planted become infertile and cause carbon to be released and become dust, making the land barren and dry, making the place very cold at night and very hot during the day.
- What would happen if the soil which is our main source of oxygen can no longer function? What if most of the land producing healthy plants was reduced to desert? Automatically, drought, global warming will increase, hunger, poverty, disease and suffering will hit the world very frighteningly.

University 2

All students are worried about soil pollution and the climate for these reasons:

- Bad soil will produce bad plants, bad plants will have an impact on the living creatures that eat them, especially us humans. So soil plays a very important role in our health and life. Healthy soil, healthy plants, healthy animals, healthy humans, healthy water and healthy climate.
- Land pollution has serious consequences for ecosystems and human survival.
- Soil pollution is a serious environmental problem that can cause various negative consequences including loss of soil fertility and crop damage.
- Land pollution and climate change and I will take whatever action I can to help overcome environmental challenges.
- When land that has been treated using pesticides will kill the bacteria in the soil and make the land dry or barren.
- If the methods used by farmers can damage the soil microbes and the ecosystem in the soil, making the soil infertile and if humans consume food from the soil, for example corn, rice and others, it can cause diseases such as cancer and disability.
- If we don't control land pollution it will be problematic and cause climate change.

2. How afraid are you of soil pollution and climate change?

University 1

97% students feel afraid of the soil pollution and climate change and 61% of them stated their reasons as follows:

- in the film, it was even predicted that around 2050, many people would flee.
- Soil pollution can damage the soil ecosystem in the environment.
- land becomes unavailable for growing food crops.
- soil that is exposed to pollution will kill the microorganisms in the soil.
- land pollution and climate change will continue to increase.
- in the film, it was predicted that it would be around 2050 before people would flee as refugees.
- the impact of soil pollution on life is extraordinary.
- if we consume land incorrectly, it will have a negative impact on the lives of living creatures.
- land pollution and climate change will cause natural disasters such as tsunamis, floods and soil erosion.
- when there is land pollution in the places we live in, like deserts, land pollution will result in changes to the climate.
- There will be natural disasters that are not environmental, such as dust storms, damage to agricultural land, rivers and declining health. If this continues then humans will get sick and the earth will be damaged.
- land pollution and climate change can cause drought, environmental damage, decreased soil fertility, resulting in climate change.
- when soil pollution happens, it will affect the plants we plant.
- land pollution can cause dust storms, soil erosion and so on and land pollution can cause climate change.
- if the soil is not healthy there will be a disaster. If we pollute the land and use it incorrectly then our life and earth will be polluted and threatened.
- Soil pollution can cause damage and will also be a disaster for us humans.
- Soil pollution can have an impact on ecosystem life and also the climate on earth.

- Soil pollution has a very negative impact on water quality, soil fertility and also the health of the environmental ecosystem will become extinct.
- if soil pollution and climate change continue to increase, it will damage the earth and could also result in extinction on earth.
- the temperature could increase, and we won't be able to plant.
- if the land is not well looked after then there will only be 60 years left for the land to produce and the quality of the land does not really affect human health. One day, we will not change our way of dealing with climate change and land pollution. We will be sad about getting nutritious food from healthy soil and this will have an impact on our bodies which can cause chronic disease, when we cultivate the soil in a way that involves good plants.
- soil pollution can affect the plants planted because it contains unhealthy chemicals and can have an impact on our bodies and soil that is exposed to these substances will prevent carbon dioxide from entering the soil and cause irregular climate changes to cause disasters. natural conditions such as floods due to excessive rain and droughts because the groundwater cycle stops.

University 2

All students feel afraid of the soil pollution and climate change for these reasons:

- land pollution has a direct impact on human life. For example, pesticides cannot be used on plants because pesticides contain poison which can actually cause cancer.
- land pollution is very dangerous for the ecosystem.
- land pollution is very dangerous, for example contamination of ground water, ecosystems and soil fertility.
- soil contamination can enter groundwater and pollute drinking water sources. Climate change creates extreme weather events such as storms, floods and droughts.
- I realize that my health has been affected because the rice I consume is processed using pesticides to get large yields.
- land damage caused by human activities cannot be repaired, such as barren land, drought and that can be minimized again by replanting trees on barren land and grazing livestock around the barren land so that the manure from these animals can help fertilize the land.

3. How guilty are you about soil pollution and climate change?

University 1

97% students feel guilty of the soil pollution and climate change and 42% of them expressed their reasons as follows:

- consuming the wrong food.
- humans always damage the soil such as using fertilizer on the soil.
- throw rubbish carelessly without thinking anything.
- destroying the land, not using the land properly, throwing rubbish into the house.
- still throw plastic on the ground.
- throw rubbish carelessly so that it pollutes the environment and affects the soil.
- ignore the trash in my environment.
- gave red and black fertilizer
- throw away plastic rubbish
- pulling out grass by the roots actually damage soil fertility and have an impact on climate change, this is due to a lack of education regarding soil.
- most farmers use chemicals to fertilize plants even though this has a bad impact.

- the leftover trash and food that is thrown away is not recycled but burned.
- throw rubbish everywhere even though this rubbish can still be processed.
- use chemicals and pesticide fertilizers.
- throw inorganic waste into fertile soil.

University 2

All students feel afraid of the soil pollution and climate change for these reasons:

- the use of plastic. Plastic cannot be broken down by soil and is able to kill microbes in the soil.
- often throw plastic waste carelessly, for example when I run out of snacks, I don't throw the trash in the trash.
- often throw rubbish carelessly, for example when I finish my snack, the rubbish is not thrown in the rubbish bin.
- daily activities also cause soil pollution, namely cleaning the grass in the surrounding yard so that it looks clean even though grass plays an important role in capturing CO_2.
- use plastic items and other things, throwing them away carelessly and destroying the quality of the land and land ecosystem and the impact will return to humans.

A student could not express the reason of feeling guilty of causing land pollution.

4. How angry are you at the people who cause soil pollution and climate change?

University 1

97% students feel angry at the people who cause the soil pollution and climate change and only 42% of them expressed their reasons as follows:

- the use of substances or fertilizers that damage the soil.
- many people still pollute the environment.
- not processing waste to minimize the causes of land pollution and climate change.
- People polluted the soil without thinking about what would happen in the future and the impact it would have on their lives.
- People dumped much of the waste into rivers which can be harmful to the land and the environment.
- people still produced chemicals and pesticides that causes the land to become damaged and climate change occurs.
- Soil pollution will make the land infertile, causing drought and plants not growing well and resulting in climate change.
- actions taken can cause land pollution and climate change which causes damage and very fatal consequences.
- people who cause land pollution and climate change because these actions can affect fertile soil.
- People' actions can harm other people.
- actions that could damage the land and cause climate change.
- people who cause land pollution and climate change.
- the people who misuse the land, many of whom use the land even more by destroying the land for personal gain.
- people who cause land pollution and climate change because they cultivate all the land so that it has no burden and can cause helpless disasters.
- Fertilizer could have a negative impact but instead more and more people are using it.
- people who cause land pollution and climate change that they do this without thinking about what impacts it will have.
- people cause pollution through the use of pesticides which actually destroy soil fertility.

- people who cause land pollution and climate change that they don't think about what would happen if they broke the carbon cycle.
- many people who cause land pollution and climate change who don't know the impact, therefore people will continue to do the same things.
- do things like pulling out grass and improving the soil before planting seeds. Therefore I am also angry with myself.
- human behavior which continues to be selfish will be the impact, even though nature is a paradise which, when we cultivate it well, we will live a healthy, prosperous life away from all disasters.
- people who cause land pollution and climate change and I'm even angry at myself.
- not only are people destroying the land but they are also destroying the microorganisms in the soil. They are only concerned with their income without looking at/researching the land and also by polluting their land they are causing disaster for many people and their agriculture.

64% students pointed out that human behaviour is the main cause of soil pollution and climate change and this sparked anger in them.

University 2

All students feel angry at the people who cause the soil pollution and climate change for these reasons:

- human activities cause the most land pollution, deforestation can cause land pollution and climate change because 40% of the carbon is held so if many trees are cut down it will hinder the transpiration process which is important for life.
- Angry to myself who is the actor of polluting the soil.
- the problems people cause by polluting my land can have a significant impact on human health and the environment.
- when I see people who cause land pollution and climate change. Because without realizing it, they are polluting the surrounding environment and having a negative impact on the health of the people around them.
- people who cultivate agriculture using lots of pesticides which are said to be poisonous to microorganisms in the soil, causing the land to become infertile and dry.
- people who, after using plastic waste, throw the rubbish out of place and farmers who always use pesticides to fertilize the soil even though pesticides are actually poisons that can kill microbes in the soil.

1 student angry at him/herself while the rest of the students angry at the people's behaviour.

5. How bored are you of discussing soil pollution and climate change?

University 1

92% students do not feel bored when discussing the soil pollution and climate change and 42% of them expressed their reasons as follows:

- learn how to take good care of the soil and protect against climate change.
- can gain new understandings to prevent more serious land pollution.
- have a big influence on our lives.
- the things being discussed are also for our good.
- Looking at the facts about plants and plants on the ground that build cycles in order to overcome land pollution and climate change, it turns out that the soil and even feces that are considered dirty have a big impact in rebuilding the environment and even better than that.
- closely related to our human lives.

- can find out what has happened and is happening due to land population and climate change.
- talking or discussing about land is very important for us.
- land has a big influence on my life, I think land is my life because it is our food supply
- by obtaining information about land pollution and climate change, we can increase our insight or knowledge so that we as one of the causal factors can be part of the way to minimize this.
- Topics very interesting for our lives.
- these two things because they have an impact on our lives.
- it is part of the knowledge that can increase my knowledge and insight.
- can increase insight and understanding of the importance of land.
- closely related to human survival.
- can understand more clearly and more deeply about land, how to maintain soil fertility, the function and benefits of land for our life on this earth.
- exchanging ideas about this can help make people aware who are still often destroying the land and don't care about the problem of climate change.
- gain more insight into the nature in which we live and know what to do to prevent it.
- exchange opinions to find solutions to reduce land and climate change.
- discover the impact of this land pollution and also the solutions for caring for the land.
- can change or improve our views on what to do and find solutions so that land pollution and climate change do not occur.
- this is interesting material where soil is something extraordinary for life on earth. Healthy soil contributes to a healthy body.
- this is related to our lives. I myself also like to plant and help my mother when cleaning the garden.
- fertile soil will affect our survival because soil is the largest reservoir of carbon dioxide.
- this is what is happening, has happened and will happen in the future so that it can be prevented later.

University 2

Half of the students feel bored when discussing about the soil pollution and climate change. The other half who do not feel bored when discussing the land pollution and climate change expressed their reasons as follows:

- always think about solutions and how to overcome them but each person maintains their ideas.
- this brings awareness to environmental problems caused by human actions so that there needs to be sustainable action. The opportunity to discuss these topics helped me build a better understanding and drive appropriate solutions.
- we need to care for and protect our land from pesticides and plastic waste because it can damage the soil ecosystem because human life is supposed to depend on the soil.

6. How hopeful are you that soil pollution and climate change can be minimized?

University 1

94% students feel hopeful that soil pollution and climate change can be minimized and 75% of them expressed their hope as follows:

- in the future we can pay more attention to issues regarding land pollution and climate change so that disasters can be avoided.
- Soil pollution can be minimized for the survival of living creatures.

- can cultivate the land well.
- many efforts that can be made to minimize this.
- protecting soil or collecting rubbish so that it can become fertile soil.
- recycling waste to produce natural fertilizer.
- humans must protect and care for our land so that damage and other things don't occur.
- minimize soil pollution so human life can get better.
- not to take land for granted because we are very dependent on land. Good soil will produce all good things.
- Soil pollution can be minimized or soil restored to normal.
- can share the information with the community or local friends regarding this matter.
- in the coming days there will be more and less land pollution because more and more dry land will cause harm to humans.
- soil pollution and climate change can be minimized so that life can slowly change from previously very worrying to become safe again.
- don't create chemicals for us to use in our daily lives. If it's like this, the earth will remain naturally healthy.
- pollution can be minimized so that the land becomes healthy, people become healthy and the climate on earth runs well.
- humans must be able to manage or maintain this land in order to achieve these results.
- Soil pollution and climate change can be minimized so that it does not have a huge influence or impact on the environment and the survival of humans and the earth's ecosystem.
- Soil pollution and climate change can be minimized so that the land we live on now can be fertile and healthy again.
- By minimizing land pollution and climate change we can save the earth from various disasters.
- taking simple actions that do not bring new problems.
- reduce the use of chemicals on the soil so that our soil remains healthy and allow our soil to recover and develop naturally.
- humans must protect and preserve the soil well so that Pollution doesn't happen again.
- processing agricultural materials by not mixing chemicals but using compost to make it more fertile and also never leaving the land empty.
- using humus or using compost from garbage and food waste which is directly recycled. There is also the use of fertilizer from livestock manure (organic waste).
- using compost from food waste, animal waste, human waste because compost can minimize good soil changes.
- The soil will return to life and be fertile because of the making of compost, selection of organic waste, growers of various types of cover crops leave livestock to grazing. These things are simple steps we can take for the soil.
- the regional government can find out about this so that it can be explained to the public or that the public can learn about this because it is very important for future or current generations.

University 2

All students feel hopeful that soil pollution and climate change can be minimized and they explained their understanding as follows:

- improving lifestyle, having awareness of the importance of soil health, this can lead to land pollution and climate change.

- the government and individuals can take steps starting from the behavior of each individual. Even though the challenges are great, with increased awareness and strong cooperation we can create a cleaner future.
- increase awareness, share responsibility and develop new technologies, for example new technologies emerge that promise to help clean up contaminated land and prevent soil pollution in the future.
- People around the world are increasingly aware of land pollution and climate change and they are demanding action. There is significant technological hesitation in the development of new energy sources and energy-saving technologies. There is a growing global movement to address land pollution and climate change. This movement includes individual organizations and governments working together to find solutions and take action.
- increasing awareness and appropriate action, collaboration is needed starting from ourselves, government and industry to achieve this goal. Even though the challenges are great, with hard work and commitment positive change can occur.
- People will not throw plastic waste carelessly and reduce the use of pesticides on plants and soil.

7. How empowered are you to take action to minimize soil pollution and climate change?

University 1

69% students feel empowered to take action to minimize soil pollution and climate change and 42% of them put forwarded what they can do as follows:

- throwing rubbish in its place.
- protect or collect waste.
- start letting wild plants at home and Using leftover food, animal feces to make fertilizer.
- using appropriate organic waste in the environment I live in.
- to plant trees and reduce using pesticides.
- recycling rubbish into compost.
- plant lots of trees so that the soil is healthy and don't throw rubbish carelessly by throwing it away in the right place.
- reforestation, reducing the use of pesticides, sorting organic and inorganic waste and carrying out regenerative agriculture.
- separating inorganic and organic waste
- sorting organic waste that is thrown away to be used as animal feed.
- using natural resources more efficiently
- utilizing organic waste for recycling and producing fertile soil.
- throwing rubbish in the right place and not throwing rubbish on the ground
- recycling organic waste at home and only mowing the grass without removing the roots so that the soil remains loose/fertile
- Using organic waste in the right place, after some time, plant several small trees or useful plants in the front yard and back yard.

University 2

83% students feel empowered to take action to minimize soil pollution and climate change and half of students put forwarded what they can do as follows:

- raise awarenes
- provide tips/ways on how individuals and businesses can reduce their carbon footprint and also help people find ways to get involved in environmental activities.
- disposing of rubbish in places and being able to maintain and produce healthy food.

8. Will students make lifestyle choices that have minimal negative impacts on soil pollution and climate change? Explain your answer

University 1

92% students committed to make lifestyle choices that have minimal negative impacts on land pollution and climate change. However, only 11% students can explain what the choices are as follows:

- not to litter.
- throwing away rubbish and not sorting it, using chemicals, cutting down trees, etc. It can affect the land as well as climate change.
- choose an environmentally friendly lifestyle such as organic fertilizer.
- reducing meat consumption because now the meat we consume comes from many industrial processes which can potentially cause diseases because some are unhealthy.

University 2

All students committed to make lifestyle choices that have minimal negative impacts on land pollution and climate change and 67% students can explain what the choices are as follows:

- reducing the use of plastic waste.
- planting trees (trees help absorb carbon dioxide from the atmosphere and slow climate change) and recycling (recycling can reduce the amount of waste thrown into landfills)
- not using single use products
- throwing rubbish in its place.
- Not disposing rubbish not in the right place

9. Will students find out which products and services have minimal impact on soil pollution and climate change? Explain your answer

University 1

97% students committed to find out which products and services have minimal impact on soil pollution and climate change. However, only 8% students can explain how to do it as follows:

- search on the internet.
- looking for fertilizer that is good and beneficial for the soil and the lives of us and the farmers.
- look for more information from the internet and other sources to help me participate in minimizing soil pollution.

University 2

All students committed to find out which products and services have minimal impact on soil pollution and climate change and only 33% students can explain how to do it as follows:

- Choose products that have a lower carbon footprint than imported products because they don't need to be transported as far. Apart from that, choose local products. We support businesses in the community.
- conduct research and seek information about production practices, raw materials and company policies to understand the environmental impact of the products and services they use.

10. Will students talk to friends and family about issues related to climate change so that we can all become aware of what needs to be done to address soil pollution and climate change? Explain your answer

University 1

94% students committed to talk to friends and family about issues related to climate change so that we can all become aware of what needs to be done to address soil pollution and climate change. However, only 47% students can explain what they will talk about as follows:

- the impact of land pollution so that it does not damage the land system.
- not to do negative things that have an impact on land pollution and climate change.
- more aware of what must be done to overcome land pollution and climate change.
- protect the environment together.
- planting more trees and not cutting down trees carelessly.
- have awareness within ourselves to protect the soil
- the negative impacts of soil pollution on humans.
- consequences of land pollution and climate change.
- plant more trees and not litter.
- actions in caring for plants and not giving excessive chemicals.
- Raise awareness
- work together to protect and care for the soil and also do what is good and avoid actions that are detrimental and pollute the soil.
- Raise awareness
- not cultivating the soil carelessly
- what to do to overcome soil pollution resulting from the use of synthetic fertilizers.
- telling dangerous thingsabout soil pollution to raise awareness when we don't take good care of this environment.
- Farmers should reduce the use of chemical fertilizers.

University 2

All students committed to talk to friends and family about issues related to climate change so that we can all become aware of what needs to be done to address soil pollution and climate change. All students can explain what they will talk about as follows:

- Impact of soil pollution
- Desire to take action and Belief that they can make a difference
- reducing greenhouse gas emissions and effective waste management.
- share knowledge and raise awareness in the related environment to expand understanding and effective action to overcome these challenges.
- Raise awareness
- protect the land and preserve the environment from rubbish and excessive use of pesticides so that society can overcome the problem of climate change pollution.\

11. Will students challenge politicians and businesses to do more to tackle soil pollution and climate change? Explain your answer

University 1

58% students committed to challenge politicians and businesses to do more to tackle soil pollution and climate change. However, only 17% students can explain how they will do it as follows:

- represent community complaints and aspirations to influence policies and business practices that are more environmentally friendly.
- held a large-scale demonstration against the government
- participate in the business world to be able to overcome the problems we are currently experiencing.
- not buying products that damage the land and making petitions.

- not using products that can pollute the land and being someone who can oppose it with petitions regarding actions that can reduce climate change.
- participating in the political world and fight for the right things.

University 2

All students committed to challenge politicians and businesses to do more to tackle soil pollution and climate change. However, only 1 student can explain how they will do it as follows:

- organizing campaigns and demonstrations to pressure governments and companies to take stronger action on environmental issues and also through social media and other platforms to raise public awareness and increase pressure on political leaders to act.

12. Will students become member of local or national youth forums that promote to solve soil pollution and climate change issues? Explain your answer

University 1

97% students stated their willingness to become member of local or national youth forums that promote to solve soil pollution and climate change issues. However, none of the students can mention what the forums are.

University 2

97% students stated their willingness to become member of local or national youth forums that promote to solve soil pollution and climate change issues. Even though none of the students can mention what the forums are, 2 students explained the activities they carry out if they are a member of a youth forum:

- a volunteer in activities that tackle the problems of land pollution and climate change.
- carry out various methods such as social action, raising funds for environmental projects and even volunteering in environmental cleaning activities because through these activities students can learn from other people and together create a positive impact in efforts to overcome these problems.

13. Will students seek opportunities to participate in national and international decision-making on soil pollution and climate change issues? Explain your answer

University 1

94% students stated their willingness to seek opportunities to participate in national and international decision-making on soil pollution and climate change issues. However, only 1 student can explain how they will do it as follows:

- learn more from people who are more experienced or look for internet networks that exist in the world of soil and climate change.

University 2

94% students stated their willingness to seek opportunities to participate in national and international decision-making on soil pollution and climate change issues. However, only 2 students can explain how they will do it as follows:

- involved in public consultation and participation in drafting regulations.
- involved in student organizations, environmental advocacy groups or political campaigns which aim to influence public policy regarding the environment. Apart from that, students can also join non-governmental organizations that participate in international conferences and meetings that discuss environmental issues.

14. Will students participate in public demonstrations (e.g., climate strikes) to support movements to address soil pollution and climate change? Explain your answer

University 1
92% students stated their willingness to participate in public demonstrations (e.g., climate strikes) to support movements to address soil pollution and climate change. However, none of the students can explain how they will do it.
University 2
All students stated their willingness to participate in public demonstrations (e.g., climate strikes) to support movements to address soil pollution and climate change. However, only 1 student can explain how they will do it as follows:

- working together to clean up an environment full of rubbish and limiting the use of pesticides and fertilizers on the soil.

3. Limitation

Some limitations of this study warrant mentioning. The lecturer and researcher did not really equip the students with the definition of each feelings (worry, afraid, guilty, angry, bored, hopeful and empowered) so the students interpret the questions related to the feelings individually.

There was no deep discussion before filling out questions in the worksheet so the answers was purely relied on students' focus and memory while watching movie. Since the worksheet was handed out just before watching the movie, it could be assumed that some students probably did not really look into the question.

4. Conclusion

Soil pollution and climate change are a very serious and complex issue. In general, this study reveals that most students feel worry, afraid, angry, guilty, bored, hopeful and empowered to take action after watching the movie. Most students show their concern on the soil pollution. Furthermore, they can express their reasoning behind their feelings. However, when it comes to their willingness to take personal and group action, most students tend to make a strong statement, but they could not back up their willingness by not explaining clearly what they are trying to do.

The process of using a documentary movie in teaching and learning activity for Physics education students was powerful to some degree since it encourages students to voice their mind and show their reaction. There is difference in answers between university 1 and 2. It is revealed that students at university 2 which is second year students had more deep understanding to the topic reflected in their strong answers than students at university 1 which is first year students. This is an interesting note to the policy maker regarding in which semester the topic and the unit can be offered by the study program to the students.

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