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Editorial

We are happy to celebrate the fourth year of our journal with you. Journal of STEAM Education was found in 2017 and started to be published in 2018. Ethical rules are respected in our journal, where each article is comprehensively reviewed by two referees. We have published seven issues and 28 articles in our journal in four years. We firmly believe that these articles related to STEM fields will contribute to the world of science and education. Our journal has been published entirely in English since 2021. Six articles published in this last issue are written in English. The remaining 22 articles were published in Turkish. Articles about subjects related to science, mathematics, technology, engineering, and art are included. These articles, which include practical research with students, try to include current studies in our journal. At this point, I would like to thank our journal's editorial board and scientific board for their efforts and work. We will continue to work with all our strength to make our journal more visible in the international arena and contribute to the scientific world.

Kind regards,

Editor-in-Chief

Assoc. Prof. Şahin İDİN

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PRE-SERVICE PRIMARY SCHOOL TEACHERS' KNOWLEDGE OF SCIENCE PROCESS SKILLS AND HOW THEY INTEGRATE THESE SKILLS INTO LESSONS

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ABSTRACT

The purpose of this study is to monitor the development of pre-service primary school teachers' knowledge of science process skills and how they integrate these skills into their lessons. Towards this end, the study was designed with the method of the interpretive case study. The sample of the study consists of 3 pre-service teachers who are studying in their last semester and attending primary school within the teaching practice course. In the study, the focus group interview was held with the pre-service teachers twice before and after the process. Finally, changes in lectures have been observed in the direction of informing the pre-service teachers about science process skills. Content analysis was used for the qualitative data obtained in the study. In the study, it was seen that the pre-service teachers' knowledge levels towards science process skills increased and they were progressing in integrating these skills into their courses.

Keywords: Pre-service primary school teachers, Science process skills, Interpretive case study.

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INTRODUCTION

Technology and knowledge have undeniably improved in recent years. These developments affect every aspect of life. Education, which is an important element of life, has received a large share from these developments. With the advancement of technology and knowledge, it has become an important issue to train individuals who adapt to these innovations and to transfer competencies to use skills. The change in the education system brought along skills such as critical thinking, questioning, problem-solving, and conveying the events that take place in daily life. These skills shaped the science curriculum.

One of the goals of the science curriculum is to take responsibility for the problems encountered in daily life and to use knowledge, science process skills (SPS) and other life skills in solving these problems (Ministry of National Education [MoNE], 2013). In this curriculum, it is often emphasized the importance of raising individuals having SPS with scientific literacy and the use of teachers' questioning method as a teaching method during the lesson. While dealing with questioning, students explain objects and events, ask questions, make explanations, test these explanations against existing scientific knowledge, and share their ideas with others. They determine their assumptions, use critical and logical thinking, and think of alternative explanations. Thus, students actively develop their understanding of science by combining scientific knowledge with reasoning and thinking skills (National Research Council [NRC], 1996). Anderson (2002) states that SPS constitute an important part of scientific inquiry and improve scientific literacy in students accordingly. It enables students to learn SPS and to transfer them to daily life permanently. Testing the knowledge in every field gives students self-confidence and prevents possible misconceptions thanks to looking at the subject critically. As well as students, teachers and pre-service teachers need to master SPS. Michaels, Shouse and Schweingruber (2008) argued that teachers should create scientific learning opportunities for their students and be able to relate science language and learning life to real life events. Also, teachers should encourage their students to use these skills. Chiappetta (1997) stated that acquiring and using these skills can help students become more equipped to solve problems, learn on their own and appreciate science.

On the other hand, raising scientifically literate individuals is not possible by transferring information directly to them, but by enabling them to access scientific information themselves. In this context, SPS are important in terms of teaching ways to access information (Yuenyong & Narjaikaew, 2009). It is also very important to encourage students to use SPS. Science process skills should be taught to students not only as a discipline but also as a lifelong skill and its importance should be emphasized. Teachers and pre-service teachers must have an effective level of knowledge in teaching these skills. Because, if the teachers and pre-service teachers do not fully master this information, they may convey missing or incorrect information to the students.

Ornstein (2006) stated that the importance given to teaching SPS depends on the importance teachers put onto the SPS. The most important factor achieving the desired student development is the quality of the teacher, the teaching method and the assessment of the teacher. Therefore, it is necessary to plan the education process well for teachers to gain competence in comprehension and curriculum development, teaching management, assessment and evaluation activities. Therefore, pre-service teachers must gain experience in teaching science and meet the needs of students while transferring information. Warnich and Meyer (2013) think that

general skills and SPS are equally important for teacher education. Hence, both skill groups should be included in teacher education. From this point of view, it can be concluded that teachers should have a high level of SPS. Teaching the SPS and their importance to the pre-service primary school teachers fully enables them to convey the skills they will teach in the best way possible. For this reason, future teachers should improve these skills efficiently. Also, SPS form the basis of science. It enables individuals to conduct research and draw conclusions. It is thought that putting these skills into practice in the class and training pre-service teachers in this area haven't been realized yet (Tifi, Natale and Lombardi, 2006). In this context, this research is important in terms of teaching pre-service teachers the SPS and putting them into practice.

Pre-service teachers can adapt their conceptual understanding to new and daily life situations that include SPS. On the other hand, it is important for pre-service teachers to have a solid conceptual understanding and to be able to properly perform test items containing new aspects of SPS to effectively create an atmosphere supporting development among their students (Chabalengula, Mumba & Mbewe, 2012). Therefore, this study aims to monitor the development of pre-service primary school teachers' knowledge of science process skills and how they integrate these skills into their lessons.

METHOD

Research Design

The research was designed with the interpretive case study method, which is one of the qualitative research designs. Schwartz-Shea (2006) explained it as follows:

"A central goal of interpretive approaches is understanding human meaning making; issues of causality are not necessarily excluded but are understood much differently than in the variables gestalt…. Being attuned to meaning making involves a recognition of, and sensitivity to, the ambiguities of human experience; researchers presuppose that meanings are negotiated and constructed, and they often deliberately investigate efforts to promulgate or resist particular meanings, at the same time that they explore the variation of meanings across contexts (p. 123)."

Study Group

The study group of the research consists of 3 pre-service teachers (2 females, 1 male) who are studying in the last year of a public university. Purposeful sampling method was used in the study. First of all, while selecting the study group, 10 pre-service teachers who went to primary school were chosen within the scope of teaching practice course because of the high level of emphasis on SPS within the context of science course. Then, 3 volunteer pre-service teachers were included in the study.

Data Collection Tools

Semi-structured "Focus Group Interview Form", "Lesson Plans" and "Observation Form" were used as data collection tools in the research.

Semi-structured focus group interviews were made with pre-service teachers before and after the process. After examining the pre-service teachers' knowledge on the subject; questions were created, examined by three field experts, and they were asked to pre-service teachers in their final form.

In order to determine the knowledge of pre-service teachers, they were asked to select a subject from the 4th-grade unit and topics and to prepare a lesson plan at the beginning of the study. This lesson plan helped to determine the problem status of pre-service teachers. Lesson plans were analyzed to determine whether pre-service teachers used SPS during the lessons.

An observation form was created for the lessons in the university and elementary school, and the pre-service teachers were observed while teaching at the macro and micro level. After giving the final form to the observation form examined by three field experts, pre-service teachers were observed by the practitioner during the lessons. The skills used by pre-service teachers were written in detail in the observation forms during each lesson.

Data Collection Process

The applied front focus group interview was recorded with the camera. After these practices, pre-service teachers were asked to prepare a lesson plan and integrate their SPS into their plans to see how they transferred their SPS to the science course and what level of knowledge they had about the application. Lesson plans were examined, and a plan was created regarding the information provided to the pre-service teachers. Pre-service teachers were informed about SPS with slides and videos. After the information provided, pre-service teachers started to transfer lessons, in which they integrate their SPS in the university environment. The researcher observed pre-service teachers one by one recorded the lessons with the camera and used the observation form during the lessons. The lesson, the shortcomings and the things to be done were discussed and information was given at the missing points again at the end of each lesson.

After the lessons in the university environment were finished, the pre-service teachers, who were given feedback and tried to be perfected, continued their lessons at the primary school where they are practicing teaching. Each pre-service teacher was given one course hour and the practice lasted 3 weeks. All of the lessons were recorded on the camera and examined with an observation form.

After briefings and lessons, the focus group discussion was made and changes in the process were tried to be taken into account. The last focus group interview was also recorded on the camera by the researcher.

Data Analysis

Content analysis from qualitative research method was used to analyze the data obtained in the research. Content analysis is typically textual analysis of a data set that includes comparison, contrasting and categorizing data, and dividing them with differently defined themes and concepts (Fraenkel & Wallen, 2000).

The data were tried to be analyzed by combining similar data within the framework of certain concepts and themes in the focus group interviews. Answers were examined by 3 field experts

and the common answers were analyzed. Important points in the analysis of focus group interviews, knowledge levels of pre-service teachers concerning SPS, and to the degree of using them in the lessons were taken into consideration, and the data expressed in full were collected as adequate. The answers given with incomplete and inaccurate expressions were taken as inadequate.

In order for the research to be reliable, it is necessary to constantly participate in the working environment and the process, and to monitor the process in person and observe. Additionally, it is necessary to obtain information from other researchers and experts to compare various data sources and to control them in different ways, to collect data, to provide documentation, video and audio recording, and to provide structural support and consistency (Mills, 2007). A number of measures have been taken to ensure the validity and reliability of the study.

To ensure internal validity, the researcher needs to be consistent in analyzing and interpreting the data collection process and how this consistency is achieved. More than one data collection tool was used to ensure internal validity in this study. Interview data were analyzed with the help of field experts. Expert opinions were taken for the interview and observation forms developed in the research. It was noted that the findings are meaningful and consistent in themselves and that the data obtained from different data sources form a whole.

The results were compared by analyzing the data with the help of two field experts to ensure internal reliability. The data obtained in observation and interview are explained directly with quotations. Findings obtained with different data collection tools were compared and evaluated.

Participants in the study, the research environment and the process have been described in detail to compare them with other samples to ensure external reliability. Besides, data collection and analysis methods are mentioned in detail. Moreover, it was explained in detail how to interpret the findings and how to reach the results.

FINDINGS

Focus Group Interviews

Regarding the purpose of the research, a focus group interview was held to pre-service teachers before the process. After the process was completed, a focus group interview was held again to examine how the ideas about information and concepts changed. The findings were examined under two different headings.

First interview about SPS

Regarding SPS, Ali said: "*I have no knowledge, but I have an opinion. It is mostly used in science. I think SPS were to prove our questions with some experiments within certain systems. It is important to make the student active in the process."* He also stated that he did not teach the course by considering the SPS, but that it is important and useful to associate a problem with daily life.

Duru mentioned that she was not very sure about SPS, but she remembered that there should be a problem, and a goal should be determined to solve the problem, hypothesising,

experimenting, code and law. Respecting the lesson plan she prepared, she gave the following answer:

"I set out with the goal of what I want to give them. Then I tried to give them examples with questions and examples. Based on the example, they would separate them into mixed and pure substances."

Irmak stated that she remembered prediction and observation among SPS. She added that she paid attention to problem-solving and experimenting while preparing the lesson plan.

Considering the answers given at the end of the first focus group interview, it is seen that the pre-service primary school teachers do not fully master the SPS. In terms of their knowledge about SPS and deficiencies in transferring SPS to the lesson plan, they were found to be inadequate. This showed that their command of SPS was insufficient. It was determined that they did not realize whether they applied SPS in the classes. They are thought to confuse or forget SPS. In this regard, it is seen that pre-service classroom teachers have little knowledge of SPS.

Second interview about SPS

Ali saw the differences between the first lesson plan he prepared and the last lesson plan he prepared.

"At least I know what to do, how to put them in order. I can handle my lesson by sticking to the lesson plan more. I have no question mark in my mind whether there's a learning outcome or not. Also, children give very good feedback. I noticed that the question marks in their minds disappear over time."

He emphasized that it is important to allow students to make operational definition. He also added that he focused on observing and experimenting, classification, and operational definition while preparing the lesson plan.

Duru was asked about her views concerning the process, in which she was informed about SPS and got to make practice.

"At first I realized that I did not know what SPS were. I was not aware that I did not know. I can give the lesson plan to the children better and easier when I prepare the lesson according to SPS and I think students understand it better this way. I can also make the teaching order of the lesson more accurate. I haven't even known what measuring is. I've learned what that is."

While preparing the lesson plan, she stated that she tried to use prediction, observation and classification more which helped her to prepare a better and understandable lesson plan.

Irmak declared that she did not know the SPS and realized that she had insufficient information.

"I realized that I didn't know anything about SPS because we couldn't answer the questions about SPS. It only occurred to us making hypothesis and experimenting. First, we saw here which ones are missing, how and where they are used. We didn't know any of them. As Ali said, I realized that it was very different when we paid attention to these. Inference, observation,

prediction are applied. Both students are active, and you get answers, thoughts and everything from them. I think it's better in every way."

Irmak mentioned that she used operational definition a lot and that she had not allowed students to make a definition before that. Concerning the lesson plan, she was careful to use classification, observation, inference, and experiment. Regarding the pros and cons of this process, which aims to integrate SPS into lessons, she gave the following response:

"We were ashamed of our previous knowledge. We learned many things we had not known. From now on, it will help us a lot in planning a lesson."

Considering the answers to the second focus group meeting, it is seen that this process was effective for pre-service teachers. Pre-service teachers applied SPS with awareness both while learning and integrating the course. It was observed that they showed a positive development in transferring knowledge regarding SPS and definitions. In line with these answers, it is seen that pre-service teachers learned the SPS at a sufficient level. Because pre-service teachers could only express 3 of the SPS at the first focus group meeting. The last focus group interview revealed that they were able to express almost all of the SPS.

Observations

The lessons of the pre-service teachers were examined in detail with observation forms and camera recording. The findings were analyzed under two different titles as the integration into the courses in the preliminary assessment and the integration into the courses in the final assessment.

Pre-service teachers' integration of SPS to their lessons in first lessons

The first lessons of pre-service teachers showed that they made little use of SPS. It is seen that they used the skills of making experiments and predictions, operational definition and classification. As it is understood from the first focus group interviews, pre-service teachers also focused on experimenting skills in lessons as they defined SPS as skills such as experimenting and problem-solving. They prepared an experiment-oriented course and conducted their courses within the framework of these experiments. The ability to make predictions was used for the results of the experiments.

The opinions of all pre-service teachers were collected on what was done about the lesson, which skills were missing and what other SPS could be used in this lesson at the end of each lesson. In line with these, recommendations were given on the SPS used by pre-service teachers incomplete or incorrect, and information was provided over the examples for the pre-service teachers to understand the SPS better. It was found that pre-service teachers were not at a sufficient level to integrate SPS into their lessons.

Pre-service teachers' integration of SPS to their lessons in second lessons

Considering the SPS used in the second lesson, it is observed that there is a great increase. It is seen that the skills such as communication, inference, operational definition, measurement that are not used in the first lesson began to be used after the process. As the pre-service teachers

understand the knowledge of the concepts better, these skills were transferred to their lessons better, and these skills were transferred better with the correction of deficiencies and mistakes as a result of the applications. Thanks for explaining how the skills that they did not use before should be transferred and giving examples, they use the skills better in the lessons. The results indicated that Ali and Irmak can transfer sufficient SPS to their lessons, while Duru has integrated it at an intermediate level.

DISCUSSION AND CONCLUSION

It was found that pre-service teachers' knowledge of SPS were very low and there were many misconceptions about these skills. It was found that this misconception was in the measurement skill. The Pre-service teachers said they think that measuring is done to measure students' level of knowledge. They were relieved of this error when explained measurement is through standard or non-standard measurement tool of the weight, length and volumes. Increase in their knowledge on practices during lessons and absence of misconceptions were to be realized at the second focus group.

In the first focus group meeting with pre-service teachers, it was found that their knowledge of SPS was incorrect or incomplete. When asked what they know about the SPS, they mentioned the skills such as observation, experiment, hypothesis, as well as offering solutions, reaching the law through theories. However, it was determined that their knowledge about SPS was incomplete. Mbewe, Chabalengula and Mumba (2010) found in a study that almost all pre-service teachers were unable to accurately describe and explain the basic and integrated SPS, but the majority of them were partially correct and incorrect. It was observed that the pre-service teachers in the study did not have enough information to help future students understand the SPS in a meaningful way.

Pre-service teachers were asked to make a lesson plan suitable for SPS. When asked which science process skill's stages they paid attention, they said that the lesson should include giving examples, posing problems and problem-solving stages. In the plans they prepared with the imperfect knowledge, it was seen that they were not aware of exactly what they should pay attention to, that is, they did not have complete knowledge of SPS. Işık and Nakipoğlu (2012) also found that teachers do not have a good command of SPS and do not receive training on SPS. Similarly, Turkmen and Kandemir (2011) found that teachers do not have clear knowledge about SPS, which are widely included in the 4th and 5th-grade science curriculum. It is observed that pre-service teachers who graduated with insufficient and incorrect information by creating a domino effect in the education system cannot fully apply the SPS and even the knowledge is incomplete when they become teachers.

When asked if they used SPS in lessons, they said they might have used it without realizing. It was also noticed that pre-service teachers were inadequate in transferring SPS to daily life. The reason for asking this question is to make pre-service teachers realize that SPS are not only skills used in science. Harlen (1999) defined these skills as not only specific to science, but general cognitive skills that can be acquired when people engage in ordinary everyday activities. Therefore, directing pre-service teachers to the teaching and use of these skills throughout their future lives and teaching careers is important.

After the process was completed, a focus group meeting was held with pre-service teachers again. When asked how pre-service teachers were affected by the process, it was observed that they realized they did not know the SPS, but afterwards, they were comfortable in the lesson process and the students were more active in the lesson. Based on this result, it is seen that pre-service teachers are positively affected by the practices.

When asked about the stages of SPS, it was observed that they reached more correct concepts even though they had few deficiencies, and they were more confident in saying these. When asked about which stages, they paid attention to in the process, they realized that they had misconceptions in the measurement phase and said that it was an important step to let the students make definitions. Thus, it is seen that they learn these stages better. Also, it is seen that pre-service teachers remember the skills they use in lessons much better than the others. It can be said that the practiced information provides more permanent learning. In their study with pre-service primary school teachers, Şimşekli and Çalış (2008) asked questions to them regarding their knowledge on SPS and found that most of them did not respond correctly. Besides, it was observed that many of the questions regarding observation skills were answered incorrectly at the end of the year. As a result, they said that SPS should try to be improved by practices. When asked to define the SPS, it is seen that they make definitions suitable for SPS by considering their knowledge and practices. They also stated that they realized this when they used a skill that was transferred to daily life.

It was observed that pre-service teachers could not fully apply or use SPS in their first lessons. Observation results showed that they used these skills inadequate and could not fully integrate them into the lessons. Addressing the identified shortcomings, it was tried to help them improve by giving feedback. It was seen that they had more control over the subject and tried to overcome their shortcomings in the second lessons. Looking at the overall lessons, pre-service teachers improved themselves and reached a sufficient level to integrate these skills into lessons. It was observed that pre-service teachers integrated SPS easily by increasing their knowledge and reinforcing practices and skills. Gürses, Cuya, Güneş, and Doğar (2014) support the idea that university students' practice potential should be increased to raise awareness related to SPS. As a result of the practices, it was ensured that pre-service teachers learn by doing. The results of this were positive. The increase of SPS used in lessons is an indicator of this. In addition, as the pre-service teachers' knowledge level increased, their self-confidence improved, and their control over the course also increased. It was noticed at the end of the second lesson that they easily integrated the skills they did not use before or even were aware of. The research conducted by Lanka (2007) showed that school laboratory experiences helped students to reveal important aspects of science and at the same time to develop knowledge about certain science concepts. Thus, science teachers had the necessary knowledge and skills to plan and carry out learning experiences that expose students to research experience. The research emphasized the relevance of SPS development to academic ability. In this respect, the skills learned through practice provide a better transfer to students.

Many pre-service teachers did not use many of the SPS in their first lesson. The SPS used were limited and they only transferred 4 of them to their courses, knowingly or unknowingly. In the second lesson, it is seen that they can integrate 8 SPS into their lessons. pre-service teachers could not use all SPS. Besides, the subject and content of the lessons described are not comprehensive enough to convey all SPS.

In the second lessons, it was seen that pre-service teachers have more confidence and try to address almost every science process skill. The reason for this is that they become aware of the mistakes they make through the increase in knowledge levels and feedbacks. It seems that science teaching practices are linked to motivation (motivational beliefs, constructivist activities and development of SPS). Therefore, if pre-service teachers have positive attitudes towards practical activities, this may significantly affect their performance (Ornstein, 2006). Therefore, the fact that teachers mastered SPS enabled them to transfer these skills to their students in a better way.

Prospective primary school teachers play an important role in laying the foundations of SPS. To fully fulfil these roles, they need to have a comprehensive knowledge of SPS and use these skills effectively (Yıldırım & Sezek, 2014). Also, it was found that teacher competence in SPS encourages a positive attitude towards science among students (Luft, 2001). Molefe, Stears and Hobden (2016) stated in their study that the statements explaining which SPS are included in which activity, how these SPS can be acquired, what each skill means and how they can gain competence in this skill will contribute to a better understanding by students. As a result, it can be said that SPS serve as a very important way for pre-service teachers to start learning science teaching. Therefore, pre-service teachers should have a strong conceptual understanding and be able to effectively fulfil their SPS in their classrooms.

Sukiniarti (2016) stated that teachers should have some competencies in order to transfer the SPS. These are the teacher paying attention to the student's characteristics and finding the right time in applying the science process skill approach; to guide students during the research and to make them active in learning, they must always motivate the student and be able to strengthen their pedagogical knowledge, including science pedagogy, especially for primary school students. In this regard, it should be ensured that the pre-service teachers have these competencies. For this, lessons can be designed so that pre-service teachers can gain comprehensive knowledge of SPS and get to practice during the lesson. Additionally, pre-service teachers can be encouraged to use SPS in teaching practice lessons.

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ASSESSING ENVIRONMENTAL KNOWLEDGE AND ATTITUDE OF CADETS IN THE PHILIPPINE MILITARY ACADEMY, BAGUIO CITY, PHILIPPINES

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ABSTRACT

Environmental problems continue to be a pressing concern worldwide. Climate change, land degradation, biodiversity loss, and pollution in soil, air, and water are often related to the lack of environmental education or awareness. Environmental education is instrumental in changing or forming a person's knowledge and behavior towards nurturing the environment. An evaluation of environmental knowledge and attitude is a key ingredient in crafting desirable environmental approach and education. Hence, an assessment of these variables involving the cadets of the Philippine Military Academy (PMA) in Baguio City, Philippines was undertaken. The study employs a descriptive-quantitative design in the form of a survey to 575 randomly selected cadets during the first semester of the Academic Year 2019-2020. The study was carried out from January to April 2020. The study revealed that the level of environmental knowledge and the attitudes of cadets is very good and strong positive, respectively. The knowledge of respondents about the environment is not influenced by gender. Still, it differs in terms of class. This may be attributed to their exposure to the environmental course in the academic curriculum. This is similar to their environmental attitude when grouped according to similar categories. Correlation analysis of the two variables is found not significant r (573) =0.10, p (two-tailed) =0.01. A study that will gauge the attitude of the respondents using different quantitative data is recommended. Also, to progress the sense of environmental stewardship among cadets, the environmental science course in the curriculum of the Academy should be retained.

Keywords: Environmental knowledge, environmental attitude, Philippine Military Academy, cadets

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Altarez, R., Austria, M., Bayron, J., Paltongan, T., Teofilo, R., Santianez, M., Poda-an, R. & Ibrado, A. (2021). Assessing environmental knowledge and attitude of cadets in the Philippine Military Academy, Baguio City, Philippines. *Journal of STEAM Education, 4*(1), 13-30.

INTRODUCTION

Environmental problems are amongst the most critical conditions that confront the world today. Some of these problems such as climate change, land degradation, biodiversity loss, and pollution in soil, air, and water significantly impact the health of our biosphere. The effects of these problems are observed in the Philippines, a country known for its dense forest and rich biodiversity (UNDP, 2019). One environmental problem example is taken from the data of ESSC (1999) that shows rapid change in the country's forest cover from 90% in 1521 to 70% in 1900, and then to 22% in 1998. The forest cover loss initiated the protection, preservation, and improvement of the country's existing forests, which triggered a significant concern from the national government and other organizations (Estoque, et al., 2017). During the last decade, the government became supportive, and several reforestation projects and policies emerged in the Philippines (Lasco, et al., 2012).

Humankind is one of the major driving forces of climate change and other environmental problems and issues (Zobeidi, et al., 2020). Hence, knowledge and attitude to the environment are essential variables in nurturing pro-environmental conduct (Choe, et al., 2019). Environmental knowledge includes the understanding of environmental problems and its consequences, as well as the recognition of actions that must be taken to solve such challenges. Environmental attitude, on the other hand, refers to the capacity of an individual to evaluate an array of objects, issues, and people, including the self (Lieflander & Bogner, 2016). Several factors can and do influence the development of an individual's environmental knowledge and attitudes. For instance, education is instrumental in changing or forming a person's knowledge and behavior (Harum, et al., 2011; Lieflander & Bogner, 2016; Varela-Candamio, et al., 2017; Batri, et al., 2019; Zobeidi, et al., 2020) as well as the expansion of a sense of stewardship (Liobikiene & Poskus, 2019).

There are several studies on assessing environmental knowledge and attitude of individuals. A study of Dewulf, et al. (2020) revealed that environmental knowledge provides meaningful but narrow view in generating decisions. However, a study by Jakucionyte-Skodiene, et al. (2020) showed that environmental knowledge together with attitude and positive behavior have essential roles in energy consumption and related CO_2 emissions. Similarly, Cerri, et al. (2017)

and Mohiuddin, et al., (2018) revealed that environmental attitude influences the purchasing of sustainable or green products. In terms of elevating the level of environmental knowledge and attitudes, Mifsud (2011); and Sadik and Sadik (2014) stated that the television and the internet are essential factors in raising environmental awareness. A study by Lieflander and Bogner's (2016) emphasized that students who engaged in learning about the environment will less likely abuse natural resources. Otto and Pensini (2017) verified that even a short-term nature-based environmental education has positive impacts on learner's knowledge and attitude. Although these variables are assessed together, the research findings of Borhan and Ismail (2011), Paco and Lavrador (2017), and Braun and Dierkes, (2017) showed that environmental knowledge does not necessarily lead to a positive environmental attitude of an individual. However, these findings were different from the claims of Bradley, et al., (1999); Harum, et al. (2011); Lieflander and Bogner (2016); Zheng, et al. (2017); Itasanmi and Jegede (2019); Zobeidi, et al. (2020) that environmental knowledge has a positive influence on the environmental attitude of various individuals.

Investigating an individual's environmental knowledge and attitude is essential for the improvement of environmental education. While the Philippine legislature enacted Republic Act No. 9512 or the National Environmental Awareness and Education Act of 2008 (PCOO, 2020) which enables colleges and universities to offer environmental courses to students, there is no research conducted to assess environmental knowledge and attitude of students. It is therefore relevant to undertake a research that determines the level of knowledge and attitudes of students particularly the cadets of the Philippine Military Academy (PMA) in Baguio City, Philippines. These cadets, while still students at present, are set to be future military leaders and partners of the Philippine government to protect the country's natural resources. Hence, this study aims to assess the environmental knowledge and attitude of cadets of the PMA.

METHOD

Survey Development

This study employs a descriptive-quantitative design in the form of a survey. The survey was used to gauge the level of environmental knowledge and attitude of the respondents. A self-made questionnaire, consists of ten (10) questions that determine environmental knowledge and ten (10) items that describe the environmental attitude of the respondents, were crafted (Annex A). The content of the environmental knowledge and attitude questionnaire was lifted from the study of Choe, et.al, 2019. It was then revised to become contextually appropriate and suited to the conditions of the cadets of the PMA.

The researchers together with the course director of Environmental Science subject from the Department of Natural Sciences, PMA, validated the content of the questions that were used for the environmental knowledge test. Ten (10) questions were selected. The questionnaire was in multiple-choice-type format, with one correct answer. This questionnaire was pre-tested to 30 students to determine if there are questions that need modification or adjustment.

On the other hand, the questions to measure the environmental attitude of the cadets underwent content validity and pre-tested to 30 students for internal consistency or reliability computation (Table 1). The result of the reliability test for the variable "Environmental Attitude" was 0.92. It shows that the questionnaire is internally consistent, and revision of any question is not

required. This is also aligned with Taber's (2018) recommendation that Cronbach's alpha values above 0.7 are sufficient measure of reliability or internal consistency of an instrument.

Table 1. Reliability Coefficients for Environmental Attitude.

Variable	No. of Item	Cronbach's Alpha
Environmental Attitude	10	0.92

The debate on selecting 4-,6-,7- and so on in Likert scale is still ongoing (Chyung, et.al., 2017). According to studies, a scale with no mid-point minimizes social desirability bias or the desires of the respondents to choose what they believe to be a socially acceptable answer (Garland, 1999; Chang, 1999). Though there is no significant difference in the internal structure in terms of means, standard deviation, correlations, Cronbach's alpha, and factor loading in many Likert scales, it was found that more scale points seem to reduce skewness and show normal distribution (Leung, 2011; and Wu and Leung, 2017). A study of Adelson and Mc-Coach (2010), and Leung, 2011 on the other hand, revealed that the presence and absence of a midpoint does not affect the questionnaire's reliability and validity. As recommended by Chyung, et.al. (2017), the decision of using a specific Likert scale is dependent on what the survey designer considers important in relation to clearing the ways for respondents' perceptive effort. This means reinforcing the ease of taking the survey and, at the same time, allowing the respondents to state their perception well especially when they are under stress. Since the students of the PMA are loaded with various pressures including academic requirements, and military training on top of their other duties, this study used a forced-choice scale so that the respondents chose either a disagreement or agreement in the option (Table 2).

Table 2. The Likert Scale Used in the Study.

Description	Scale	Interpretation
Strongly Disagree	3.26-4.00	Strong positive environmental attitude
Disagree	2.51-3.25	Positive environmental attitude
Agree	1.76-2.50	Negative environmental attitude
Strongly Agree	1.00-1.75	Strong negative attitude

Population Determination and Conduct of Survey

The researchers provided ample time for the respondents to avoid unanswered entries. The respondents of this study are the cadets of the First Term, AY 2019-2020. The sample size was calculated using the Cochran's formula for the finite population. A total of 575 cadets were randomly chosen for an interview (105 – first-class cadets, 87 - second class cadets, 171 - third-class cadets, and 212 - forth class cadets). The computed sample size was further subjected to proportional sampling to determine a viable respondent that should be interviewed per class or year level.

The study was carried out from January to April 2020. During this time, the COVID-19 pandemic was starting to be of concern to many. However, in the PMA, the area is secured and all the students are confined in the camp. They are not allowed to go outside the camp without proper permission from an appropriate authority. Hence, the conduct of this research was not affected by COVID-19 pandemic.

Study site

The research was conducted at the Philippine Military Academy (Figure 1). This military school is located at Fort Gregorio del Pilar Baguio City, Philippines. It is roughly 250 km north of Manila and approximately 1,400 m above sea level, with an average temperature of 20 ° C (Altarez, et al., 2019).

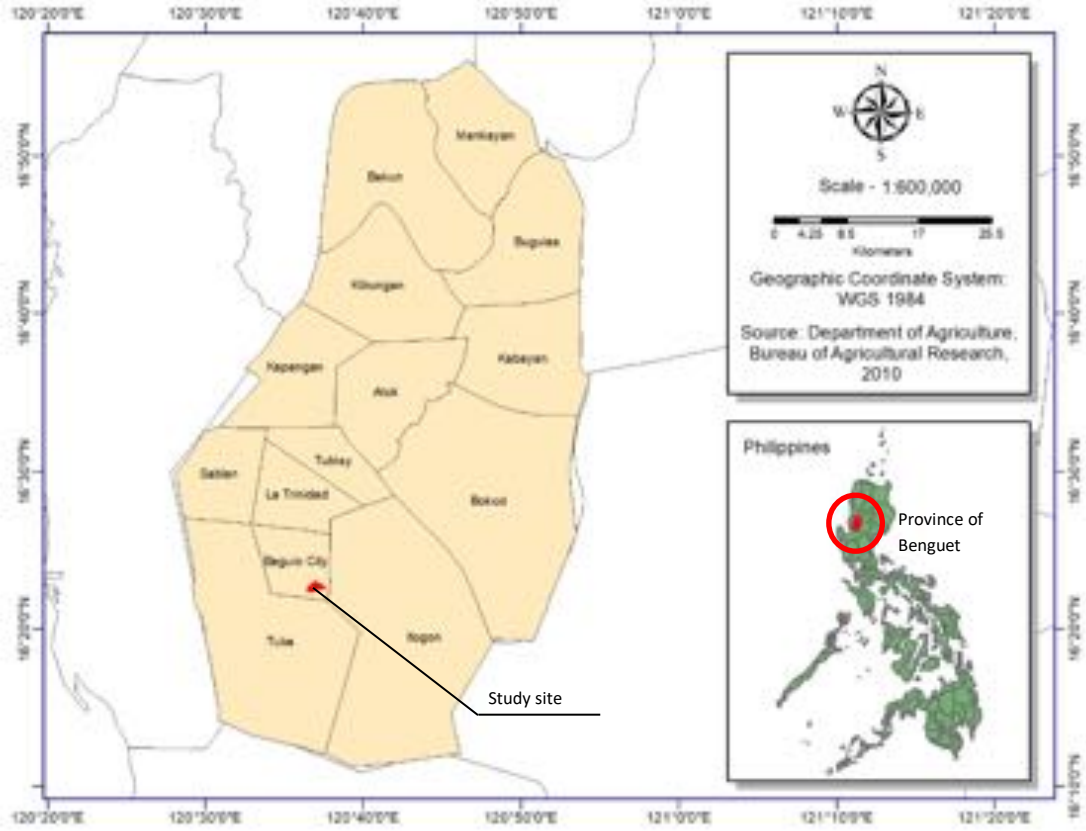

Figure 1. Location of the study area (Altarez, et al., 2019)

Profile of the Respondents

The cadets of the PMA are taking academic courses during their 4-year stay in the institution. However, their academics are also topped with additional courses, such as physical, aptitude, and military courses. The performance of cadets is measured by assessing the different subjects included in their curriculum. Finally, after finishing the curriculum, the cadets or students of the Academy will be conferred with a Bachelor of Science Degree. Also, because of the K-12 program of the Philippine government, the PMA gradually changed its curriculum. Thus, in due time, cadets will graduate with a degree of Bachelor of Science in National Security Management.

Table 3 shows the distribution of respondents by sex, 100 (17.40%) females, and 475 (82.60%) males for a total of 575 respondents. The respondents are mostly male because of the limitations on the number of female cadets due to the imposed quota. The quota of female cadets every

class ranges from 10% to 20% of the class' total strength before entering the Academy as first-year or fourth-class cadets.

Table 3. Distribution of Respondents by Sex

Sex	Frequency	Percentage
Male	475	82.60
Female	100	17.40
Total	**575**	**100**

Among the 575 respondents, 36.87% are the first-year students or otherwise called in the Academy as fourth-class cadets. Respondents are further distributed as follows- 29.74% of the sample size are third class cadets, 15.13% are second class cadets, and 18.26% are graduating cadets (Table 4).

Table 4. Distribution of Respondents by Class

Class	Frequency	Percentage
1 CL	105	18.26
2 CL	87	15.13
3 CL	171	29.74
4 CL	212	36.87
Total	**575**	**100**

RESULT AND DISCUSSION

Environmental knowledge

In general, half of the respondents have very good knowledge of the environment. Only a minimal percentage, roughly around 7%, have poor to fair performance (Table 5). The respondents' relatively decent scores may be attributed to the environmental lessons they acquired from their elementary and secondary education, as well as the environmental science subject they took up in the Academy. Likewise, the enacted RA 9512 law, explicitly highlighting the intensification of environmental education in the Philippines, may have a significant contribution to the respondents' very good environmental knowledge. The internet and television, as highlighted by Mifsud (2011); and Sadik and Sadik (2014), may have also influenced the respondents' level of understanding of the environment. A strong environmental knowledge provides an advantage in satisfactorily implementing the military personnel's environment-related duties and obligations in modern military organizations (NATO-CCMS, 2000). A future soldier with a high level of environment literacy will facilitate a continuous building of an environmentally responsible Armed Forces of the Philippines (Smit and van der Merwe, 2018).

Table 5. Environmental Knowledge of Score Distribution of The Respondents

Score	Interpretation	1CL		2CL		3CL		4CL		Overall	
		Freq	Percentage	Freq	Percentage	Freq	Percentage	Freq	Percentage	Freq	Percentage
1-2	Poor	1	0.95	0	0	8	4.68	2	0.95	11	1.91
3-4	Fair	3	2.86	2	2.30	15	8.77	9	4.24	29	5.04
5-6	Good	21	20.00	10	11.49	48	28.07	49	23.11	128	22.26
7-8	Very Good	59	56.19	42	48.28	80	46.78	122	57.55	303	52.70
9-10	Excellent	21	20.00	33	37.93	20	11.70	30	14.15	104	18.09
Total		**105**	**100**	**87**	**100**	**171**	**100**	**212**	**100**	**575**	**100**

An independent sample t-Test was conducted (Table 6) to determine the garnered environmental knowledge score difference between male and female respondents. The result of the analysis revealed that there was no significant difference in the scores between the male respondents (M=7.08; SD=1.68) and female respondents (M=7.35; SD=1.58); t Stat = -1.49, p = 0.13. The result further shows that environmental knowledge is not influenced by gender.

Table 6. Independent Sample t-Test Analysis for Environmental Knowledge Score of Male and Female Respondents

Variable	Mean	SD	t Stat	P-value (two-tail)
Male	7.08	1.68	-1.49	0.13
Female	7.35	1.58		

A one-way ANOVA was conducted to compare the scores of the respondents when grouped according to their class (Table 7). The analysis revealed that a significant difference existed in the ratings of respondents when grouped by class (F=18.63>Critical=2.62; P-value = $1.53x10^{-11}$<a=0.05). The result may be attributed to the exposure of cadets to Environmental Science subjects in their curriculum. Second class and first-class cadets have taken the course during their third year in the Academy, while the underclass cadets have yet to take the said course. Moreover, upper-class cadets (third, second, and first-class) have more authority in accessing the internet and televisions. These resources may have also influenced the disparity in the scores of the respondents when grouped according to class.

Table 7. ANOVA for Environmental Knowledge Score of the Different Classes of the Respondents

Source	df	MS	F	P-value	F critical
Between Groups	3	47.31473	18.62851	1.53E-11	2.62
Within Groups	571	2.53991			
Total	574				

Environmental Attitude

In all ten questions crafted to gauge the level of attitude of the cadets toward the environment shows that they have a strong positive environmental attitude. Table 8 also shows that the responses of the cadets from EAQ1 to EAQ10 are not widely varied from the mean. Arcury (1990) and Burbank, et al. (2006) highlighted that increased environmental awareness influenced by increased information may lead to increased knowledge about the environment. Increased knowledge is a precondition for changing attitudes. Such result is consistent with the

study of Smit and van der Merwe (2018), that soldiers regardless of profile in life, with good environmental knowledge have a positive attitude towards the environment. The data also shows that the respondents wanted to learn more about the environment; this may indicate their concerns about the management and preservation of a healthy and balanced ecology. Also, the respondents strongly wanted to be part of solving environmental problems. They even believe that humans are part of environmental destruction.

Furthermore, the positive environmental attitude of the respondents may have been due to their direct connection with the environment and their desire to help in the reduction of environmental problems. These cadets came from all regions of the country; some started in humble beginnings, coming from a family of farmers and mountain dwellers whose lifestyle is focused on agriculture and forestry. Taking care of the environment is one of the primary lessons taught to them by their parents and relatives. Their influence as future military officers could impact future environmental management, the more they influence their subordinates for positive approach to the environment, the easier it is to reduce future military negative environmental impacts (NATO-CCMS, 2000).

An independent sample t-Test was conducted (Table 9) to determine the level of environmental attitude between male and female respondents. Result of the analysis revealed that there was a significant difference in the environmental attitude of the male respondent (M=3.46; SD=0.74) and female respondent (M=3.71; SD=0.48); t Stat = -4.30, p = 2.56×10^{-5}. This data revealed that there is a varying environmental attitude between male and female cadets. Consistent with other studies, gender still influence the specificity of military roles in a workplace environment (Smit and van der Merwe, 2018). The male and female cadets in the PMA as a first stage in a military organization, remains to have a traditional gender military unequal consideration. Other factors which affect the variation could be exposure to environmental issues (Smit, 2009). Women tend to be more of a care-taking individual (Prime, et.al, 2009; Ballew, et.al., 2018; May, et.al., 2018).

Table 9. Independent Sample T-Test Analysis for Environmental Attitude Score of Male and Female Respondents

Variable	Mean	SD	t Stat	P-value (two-tail)
Male	3.46	0.74	-4.30	2.56×10^{-5}
Female	3.71	0.48		

A one-way ANOVA was conducted to compare respondents' level of environmental attitude when grouped according to their class (Table 9). The analysis revealed that there is a significant difference in the environmental attitude of the respondents when grouped by class (F value = 3.72 > F critical = 2.62; P-value = 0.01 < a=0.05). Similar to the result in their environmental knowledge, the difference may have been linked with the respondent's exposure to the Environmental Science course offered in the Academy.

Table 10. The Over-All Environmental Attitude of the Respondents

Variable	Mean	Std Dev	Interpretation
1. I like to learn something about the environment (EAQ1)	3.55	0.78	Strong positive environmental attitude
2. I would like to contribute to the solution of problems related to the environment (EAQ2)	3.54	0.78	Strong positive environmental attitude
3. I believe that the most important factor in environmental pollution is human (EAQ3)	3.53	0.81	Strong positive environmental attitude
4. I prefer to buy products that do not harm the environment (EAQ4)	3.48	0.81	Strong positive environmental attitude
5. I believe that environmental problems are the most priorities to solve (EAQ5)	3.46	0.79	Strong positive environmental attitude
6. I believe that garbage thrown by people will damage the world (EAQ6)	3.52	0.79	Strong positive environmental attitude
7. I believe that poaching or illegal hunting is an activity needed to be banned (EAQ7)	3.53	0.78	Strong positive environmental attitude
8. I would like to have more environment-related courses at school to be more environmentally conscious (EAQ8)	3.42	0.81	Strong positive environmental attitude
9. I believe that the reduction of forests and the destruction of plants doesn't mean only cutting trees. It means also destroying animals and the environment (EAQ9)	3.57	0.78	Strong positive environmental attitude
10. I believe that population growth is an environmental problem (EAQ10)	3.42	0.87	Strong positive environmental attitude
Mean	**3.50**		**Strong positive environmental attitude**

Table 11. ANOVA for Environmental Knowledge Score of The Different Classes of the Respondents

Source	df	MS	F	P-value	F critical
Between Groups	3	1.849625	3.721254	0.011376	2.62051
Within Groups	571	0.497044			
Total	574				

Relationship Between the Level of Environmental Knowledge and Attitude

In looking at the relationship between the level of environmental knowledge and the variables used in gauging the respondents' overall environmental attitude, no significant relationship was found (r = 0.06 – 0.12). These findings remained the same when the level of environmental knowledge was correlated to the overall environmental attitude of the respondents, r(573)=0.10, p (two-tailed)=0.01 (Table 10). Similar to the study of Kuhlemeier et al. (2010), the relation between environmental knowledge and environmental attitudes, and behavior was very weak. Despite the weak relationship, it can be noted that the willingness and desires of the respondents

as seen in their positive attitudes are highly contributory to their intention to resolve environmental problems.

Table 12. Pearson's Correlation Analysis Between the Level of Environmental Knowledge and Attitude

	Envt'l Knowledge	EAQ1	EAQ2	EAQ3	EAQ4	EAQ5	EAQ6	EAQ7	EAQ8	EAQ9	EAQ10	Envt'l Attitude
Envt'l Knowledge	1											
EAQ1	0.12	1										
EAQ2	0.11	0.87	1									
EAQ3	0.08	0.75	0.80	1								
EAQ4	0.06	0.79	0.81	0.78	1							
EAQ5	0.07	0.77	0.79	0.76	0.80	1						
EAQ6	0.10	0.80	0.84	0.77	0.79	0.78	1					
EAQ7	0.11	0.77	0.79	0.76	0.77	0.78	0.81	1				
EAQ8	0.07	0.75	0.74	0.69	0.72	0.76	0.76	0.75	1			
EAQ9	0.11	0.78	0.80	0.79	0.78	0.78	0.80	0.82	0.75	1		
EAQ10	0.08	0.67	0.69	0.69	0.70	0.69	0.73	0.71	0.67	0.74	1	
Envt'l Attitude	0.10	0.90	0.92	0.88	0.89	0.89	0.91	0.90	0.86	0.91	0.82	1

CONCLUSION

The study revealed the level of environmental knowledge and attitudes of cadets in the Philippine Military Academy during the First Semester of the Academic Term 2019-2020 to be very good and strong positive. The knowledge of respondents about the environment is not influenced by gender. Still, it differs in terms of class. This may be attributed to their exposure to the environmental course in the academic curriculum. There is a significant difference in environmental attitude when grouped according to sex and class. This may be due to the varied perception of respondents across sex and group classification and may have been influenced by a varied exposure to environmental information. Furthermore, regardless of sex and class, the connection of environmental knowledge and attitude of cadets is found not significant $r(573)=0.10$, p (two-tailed)=0.01. Hence, environmental knowledge of cadets does not necessarily translate to environmental care. Also, based on the data gathered, the respondents display a strong positive attitude and outlook towards environmental protection regardless of their environmental knowledge. It shows that cadets generally care for the environment despite low scores in environmental knowledge assessment. Other factors may have influenced their attitudes such as exposure to environment-related news and programs on televisions, and awareness of environmental issues.

RECOMMENDATION

A study that will gauge the respondents' attitudes using different quantitative data (ratio data) is recommended to see if the correlation between the variables investigated in this research will show a different result. Also, it is recommended for the Academy to continue with the environmental science course in the curriculum not just to comply with Republic Act No. 9512 but also to foster a sense of environmental stewardship among the cadets.

NOTES

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Annex-A

We are the 2CL Cadets of the Philippine Military Academy. We are conducting a study entitled, "Assessing Environmental Knowledge and Attitude of Cadets in the Philippine Military Academy, Baguio City, Philippines" as part of our course Environmental Science 332 (ES332).

In this regard, may we request you to participate in answering this short questionnaire? We will assure you that all answers from this instrument will only be used for this study. Thank you for your participation!

Name: _____ **Class:** ___ 1CL, ___ 2CL, __ 3CL, __4CL

Company: __A, __B, __C, __D, __E, __F, __G, __H, **Sex:** __ M, __ F **Age:** ___

PART 1: ENVIRONMENTAL KNOWLEDGE. This section will gauge the cadets' environmental knowledge.

INSTRUCTIONS: Following is a 10-item question. There is only one correct answer per question. Please answer each item and do not leave a blank answer. Encircle the choices which you feel correct.

1. Environmental Problems can be solved through.

a) Shared efforts of the government and the society
b) Legislation alone
c) Local-level
d) International level

2. Ecological balance refers to

a) Survival of plant life
b) Survival of Animal life
c) Appropriated form of each element of the environment
d) Survival of the Human race

3. Environmental degradation occurs due to

a) Rainfall
b) Solid waste
c) Uncontrolled human activities
d) Technological developments

4. Green House Effect is a natural phenomenon because
a) It keeps the atmosphere warm
b) It causes global warming
c) It depletes the ozone layer
d) It makes the land fertile

5. Sanctuaries and National parks can be established by
a) Private individuals
b) Social organizations
c) Public companies
d) Government

6. Tsunami is caused by
a) hurricane
b) Heavy rainfall in the ocean
c) Marine pollution
d) Earthquakes below the ocean surface

7. Ultraviolet rays of the sun are filtered in the atmosphere by
a) Nitrogen
b) Hydrogen
c) Ozone
d) Carbon

8. The main source of water pollution is the following except:
a) Industrial effluents
b) Domestic wastes
c) Spray
d) Pesticides, insecticides, and fertilizers used in the agricultural fields

9. The coral reefs, a valuable natural resource of the coast is exploited for:
a) Seafood
b) Synthetic fiber
c) Cement
d) Plastic goods

10. The best way to manage our solid waste is through:
a) Reduction of waste at source
b) Recycling
c) Reuse
d) None of the above

PART 2. ENVIRONMENTAL ATTITUDE. This section will gauge the Environmental Attitude of the cadets

SCALE	DESCRIPTION	INTERPRETATION
1	Strongly Disagree (SD)	I strongly disagree about the statement.
2	Disagree (D)	I disagree about the statement
3	Agree (A)	I agree about the statement
4	Strongly Agree (SA)	I strongly agree about the statement

INSTRUCTIONS: Using the Likert scale above, kindly put a checkmark (/) on how you agree on the following statements:

STATEMENTS	SD	D	A	SA
1. I like to learn something about the environment.				
2. I would like to contribute to the solution of environmental problems.				
3. I believe that the most important factor in environmental pollution is human.				
4. I prefer to buy products that do not harm the environment.				
5. I believe that environmental problems are the most priorities to solve.				
6. I believe that garbage thrown by people will damage the world.				
7. I believe that poaching or illegal hunting is an activity needed to be banned.				
8. I would like to have more environment-related courses at school to be more environmentally conscious.				
9. I believe that the reduction of forests and the destruction of plants doesn't mean only cutting trees. It means also destroying animals and the environment.				
10. I believe that population growth is an environmental problem.				

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DEMYSTIFYING THE 'DENSE' PROBLEM OF DENSITY USING 5E LEARNING CYCLE

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ABSTRACT

The purpose of this action research was in two folds. First, it was to find out the efficacy of the 5E Learning Cycle in improving pupils' understanding of density. And second, to find out whether there will be a significant difference in males and female pupils' understanding of density after the application of the 5E Learning Cycle. All 36 Basic Six pupils of a Basic School in the Assin North Municipality in the Central Region of Ghana were purposively selected to participate in the study. Since the design used was action research, the data collection procedure occurred in three stages: Pre-intervention stage, intervention stage and post-intervention stage. The results of the study showed that the mean score for the post-intervention test was almost twice the mean score of the pre-intervention test. While the girls' mean score showed a 111.26% increase, the percentage increase in mean scores for the boys was 98.68%. However, there was no significant difference between the performance of the boys and girls in the post-intervention test. This study confirmed that by taking pupils through the Engagement, Exploration, Explanation, Elaboration and Evaluation phases of the 5E Learning Cycle, learners will gain an improved understanding of density.

Keywords: 5E learning cycle, Density, basic school, science teaching and learning, inquiry

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INTRODUCTION

For several decades, potent techniques that encourage learners to construct knowledge for themselves rather than teachers directly revealing information to learners have been advocated by science educationists. These advocacies have resulted in a plethora of theories and techniques for teaching science, especially to children. The conventional teaching technique in which the teacher passes information to passive learners has been seen as an inappropriate technique that dims the creative instinct of learners (Palmer, 2019). Attempts at replacing this conventional approach to teaching have produced a variety of teaching approaches developed through extensive research. These teaching approaches are developed based on learning theories such as behavioral, cognitivist, constructivist, social constructivist and developmental theories (Altan, Lane, & Dottin, 2019). The advantages of using these innovative approaches effectively have been extensively documented and can be summarized as *effective use of innovative approaches in teaching and learning lead to an improvement in retention of learners and learners' understanding concepts* (Qazi, Ashar & Ahmad, 2019; Jensen, Neeley, Hatch, & Piorczynski, 2017).

The teacher's role in the science classroom is progressively changing. In the recent past, basic school science teachers considered science as a body of facts that are best learned through direct instruction and memorization. The learners were therefore only considered as receptors of the facts. The teachers' duty in the science classroom was to transmit science facts to passive learners. However, the quest for encouraging learners to meaningfully construct and use knowledge in novel situations is changing how science teachers teach science, especially to young learners (Lehesvuori, Ramnarain, &Viiri, 2018). As a result, inquiry-based-rational is becoming pronounced in the science classroom. The application of inquiry-based teaching approaches is a key strategy for effectively delivering science lessons in basic schools.
Learners are in the science classroom to do science, science is not to be done to them (The National Research Council [NRC], 1996). The inquiry approach to teaching is about 'doing' science. The NRC (1996) defined inquiry as a:

> … multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. (p. 23).

Inquiry is largely about engaging learners to let them learn the scientific way of knowing the natural world and develop their capacity to conduct scientific inquiries on their own. Lehesvuori, Ramnarain, and Viiri (2018) have rightly observed that the application of inquiry-based approaches to teaching science causes a shift from teacher-centered approaches that leads to learners memorizing text in textbooks to learner-centered approaches in which learners are engaged in hands-on activities. One inquiry-based strategy that has been found by researchers to be very helpful to young learners is the learning cycle inquiry approach.

The learning cycle approach emerged from the Science Curriculum Improvement Study (SCIS) conducted in the 1950s. The SCIS proposed 'Learning Cycle' (Atkin and Karplus, 1962) was grounded in theories of learning and teaching at the time. The cycle included exploring concepts through experimentation, inventing conceptual understanding from data from experiment and classroom discussions and applying concepts (NRC, 2007). Dass (2015) described learning cycle as a pedagogical approach in which teachers organize lessons in a way that reveals the

purpose and worth of lesson content at the initial stages of the lesson with 'real-life contexts, involves students actively in the learning process, provides opportunities for connecting lesson content to real-life applications, and gets students to "experience" science the way real scientists do and problem-solving the way real engineers do'(p. 5).

The application of the Learning Cycle approach differs from the traditional approach. The traditional method of teaching emphasizes the progression of skills and techniques, the delivery of ready-made information and knowledge of the outcome of an investigation before the investigation is completed. As described by Serbessa (2006) it is a transmission method that relies on 'didactic, expository and teacher-centered approaches' (p. 130). The learning cycles hinges on cognitivist psychology and constructivist theory. It emphasizes the explanation and investigation of the phenomenon, use of evidence to back-conclusion and experimental design. In the learning cycle approach to teaching, the teacher becomes a mentor and a guide who principally helps learners access, organize, interpret and transfer knowledge to solve problems. At the same time, students gain expertise in learning (Serbessa, 2006; Taşlıdere, 2015). Sarı, Hassan, Güven, and Şen (2017) pointed out, that the learning cycles generally result in better retention and understanding of concept, higher achievement, improved reasoning skills, superior process skills and attitudes towards science.

In this study, the 5E Learning Cycle was used as an intervention to help basic school pupils understand density. Density is a confusing topic in Science because it is abstract (Hashweh, 2016). According to Hitt (2010), pupils find 'density "too deep" to understand and "too theoretical" to have any meaning for their lives' (p. 25). Even though pupils to some extent have an understanding of mass and volume, pupils do not develop a conceptual understanding of density (Dole, Hilton, Hilton, & Goos, 2013). This is true for the pupils who participated in this study. The purpose of the study was to find out the efficacy of the 5E Learning Cycle in improving pupils' understanding of density. It was also to find out whether there will be a significant difference in males and female pupils' understanding of density after the application of the 5E Learning Cycle.

5E Learning Cycle

As the name suggests, the 5E Learning Cycle is a five-stage learning cycle. The cycle consists of the engagement, exploration, explanation, elaboration and evaluation phases. These phases do not proceed in a unidirectional manner. There can be mini cycles among two or three phases. For example, there can be several explorations and explanations before proceeding to elaboration. Another feature is that the evaluation phase includes assessment as, for and of learning. This implies that evaluation does not necessarily end the cycle. It occurs throughout the implementation of the 5E Learning Cycle. Figure 1 is an illustration of the 5E Learning Cycle.

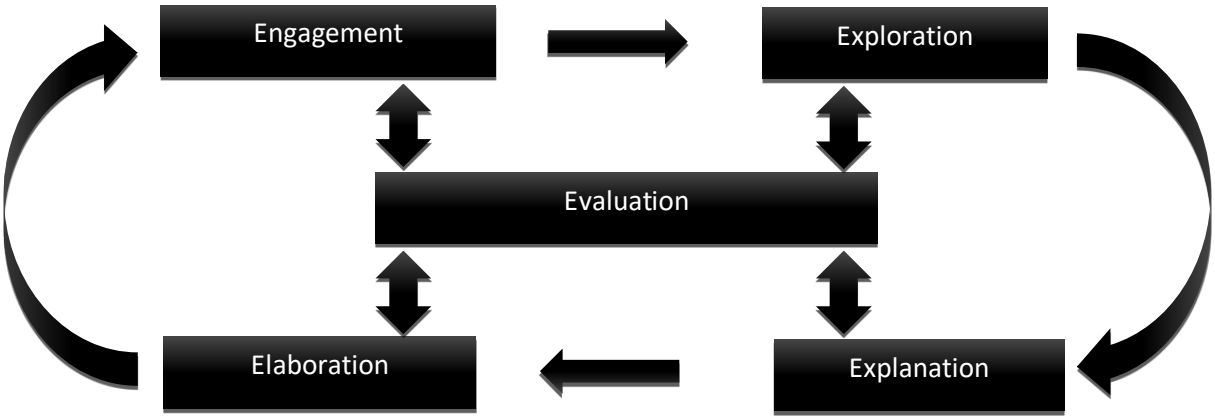

Figure 1. An illustration of 5E Learning Cycle

The engagement Phase is the introductory stage of the lesson. As pointed out by Dass (2015), the engagement phase aims at engaging learners' minds in the learning process so that they begin thinking about the topic and generate curiosity and interest in the lesson. In this phase, the learners' prior knowledge and/or possible misconceptions are identified and dealt with at the exploration stage.

The exploratory stage directly follows engagement and is designed to get learners to actively explore so that questions can be answered and solutions to problems can be designed and tested. This phase may involve designing and conducting experiments, participating in laboratory activities, gathering data from print sources and so on. This phase generally provides learners with concrete learning experiences. Learner-centered activities are used to enable learners to explore. It is the stage where the main inquiry-based activities are implemented. The activities incorporated here encourages learners to work in a cooperative learning environment without direct instruction from the teacher to enable the learners to develop skills and concepts. The activities are designed such that the learners are actively involved in the lesson 'mind-on' and 'hands-on' before the formal explanation of terms, definitions and concepts.

The explanation phase is a teacher-directed 'minds-on' phase. The key feature of this phase is that the teacher uses a teacher-directed interactive environment to help the students describe their understanding of the concepts being learned and how the concepts-connects to real life. The teacher first allows the learners to express their ideas and explanations. Following this, the teacher introduces the technical information and directly clear learners' misconceptions (Bybee, 2009).

The fourth stage of the cycle focuses mainly on the application of knowledge in novel situations. The application may be through answering 'new' questions, solving 'new' problems, or by using the concepts learned to address 'new' issues. At this phase, students are encouraged to apply knowledge gained at the explanation stage to reinforce the 'new' knowledge. This is done to help learners develop a deeper understanding of the concepts (Duran & Duran, 2004).

The evaluation in the learning cycle inquiry approach is different from the traditional approach. Though it completes the cycle, it occurs at every stage of the cycle. Both formal and informal

assessments are appropriate at the evaluation phase. It is an on-going process in which teachers make observations of their students as they apply new concepts and skills. The learners have the opportunity to conduct peer or self-assessment.

METHOD

The research design used in conducting the study was action research. Action research is a systematic inquiry pre-dominantly conducted by educationists interested in the teaching and learning process who seek information on how teaching and learning occur, so that they can offer innovative ways of teaching or improve teaching and learning (Mertler, 2006). The study was designed to improve Basic Six pupils' understanding of density. In the study, the 5E Learning Cyclewas used as an intervention to demystify density. All 36 Basic six pupils of a Basic School in the Assin North Municipality in the Central Region of Ghana were purposively selected to participate in the study. The pupils were selected to participate in the study based on their performance in the pre-intervention test conducted to find out how pervasive the problem was. A sample is the fraction of the population from whom data is collected. This fraction of the population may be considered as representatives of the population or they may be considered as non-representatives of the population depending on how the fraction of the population was selected. (Som, 1995). The sample consisted of 14 girls and 22 boys. Since the design used was action research, data collection occurred at three stages: Pre-intervention stage, intervention stage and post-intervention stage. At the pre-intervention and Post-intervention stages, the pupils were tested. The test consisted of 10 questions which tested pupils' knowledge in calculating densities, explaining why objects float and sink and predicting which objects will sink or float in water. The intervention lasted for two weeks. A summary of the activities conducted during the intervention period has been presented below.

Engage

The pupils were.

1. put into heterogeneous groups of 4-5 pupils.
2. provided the following materials: 500ml measuring cylinder, water trough half-filled with water, cork, piece of stick, bottle top, 50 pesewas coins, marble and worksheet.
3. asked to make predictions whether the following objects will sink or float in water: Cork, piece of stick, bottle top, 50 pesewas coins and marble.
4. asked to record their predictions on their worksheet.

Explore

The pupils were asked to.

1. put each of the five items into the water in the trough and record their observation (sink or float).
2. measure the mass of each of the five objects using a balance.
3. measure the volume of each of the objects with the aid of measuring cylinder, using the displacement method.

The mass and volume of the various objects were recorded in a table as shown in Table 1.

Sample Data Table for Recording Mass and Volume of Objects

#	Item	A	B	C
		Mass	Volume	Density (Mass/Volume)
1	Cork			
2	Stick			
3	50 pesewas Coin			
4	Marble			
5	Bottle top			

4. complete Column C by dividing the Mass by the Volume.

Explain

In a teacher-led discussion, pupils compare the prediction at the engagement phase to the result of their experiment. Then went ahead to explain why some objects float and others sink in water using the densities calculated and the density of water.

Exploration

Pupils were;

1. given a list of items and their densities and they were asked to indicate whether the objects will float or sink in water.
2. asked to pick objects in the environment and determine their densities.

Evaluation

1. Groups were asked to display the results of their activities in the exploration phase for peer assessment.
2. A set of questions were given to pupils to test their understanding of the determination of density, comparison of different densities and explanation on why some named objects sink in water while other named objects float in water.

RESULTS

The results of the pre-intervention test and the post-intervention test were analyzed using bar graphs, descriptive and inferential statistics. To find out the effect of the 5E Learning Cycle on gender, the results of the two tests were disaggregated with respect to gender. A comparison of the pre-intervention test and the post-intervention test results have been presented in Figure 2.

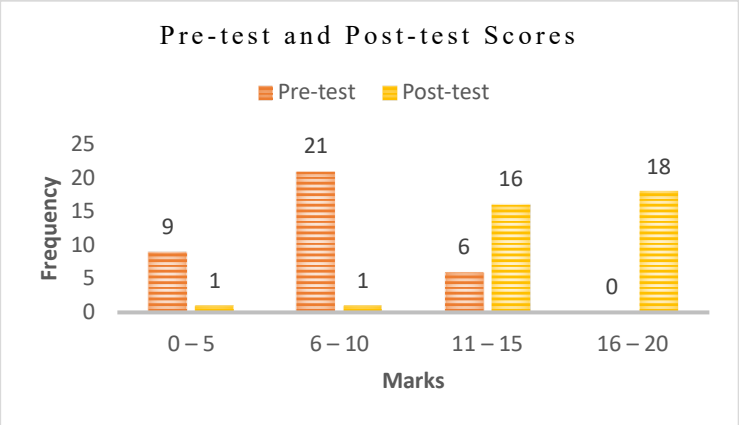

Figure 2. Pre-test and Post-test Scores

It can be seen from Figure 2 that there was a sharp contrast in the result of the two tests. While no pupil had a score above 15 in the pre-intervention test, 18 pupils scored above 15 in the post-intervention test. One pupil each scored from 0 – 5 and 6 – 10 in the post-intervention test. However, in the pre-intervention test, 30 pupils had scores in these two categories combined.

Generally, the performance of the pupils in the pre-intervention test was weak, relative to their performance in the post-intervention test. To investigate whether there were differences in the performance of boys and girls in the pre-intervention and post-intervention test the scores for the two tests were disaggregated. Figure 3 shows the result of the pre-intervention according to gender.

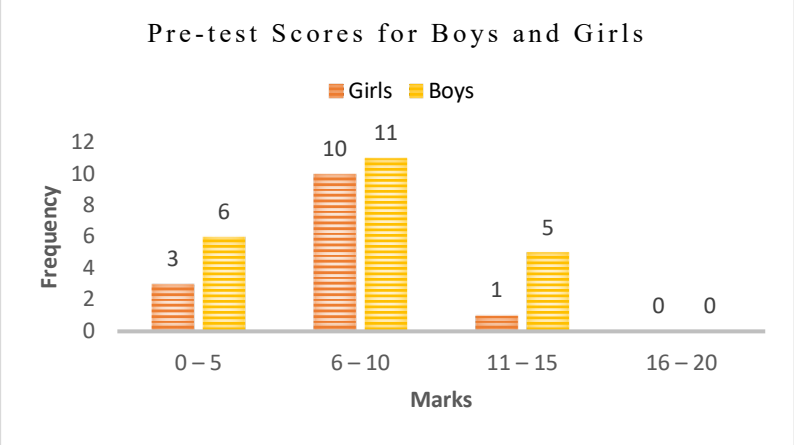

Figure 3. Comparison of Pre-test Scores for Boys and Girls

From Figure 3, the performance of boys and girls in the pre-intervention test was similar. No boy nor girl had a score above 15. The number of boys who scored from 6 – 10 was one more than the girls. The number of girls who scored 0-5 marks was one half of the number of boys who scored 0 – 5. Only one girl scored 11 – 15 while four more boys than the girls scored the same range of scores. Despite the difference observed in the score range 11 – 15, the majority of the boys and girls scored less than 10 out of 20. The post-test results of the boys and girls have been presented in Figure 4.

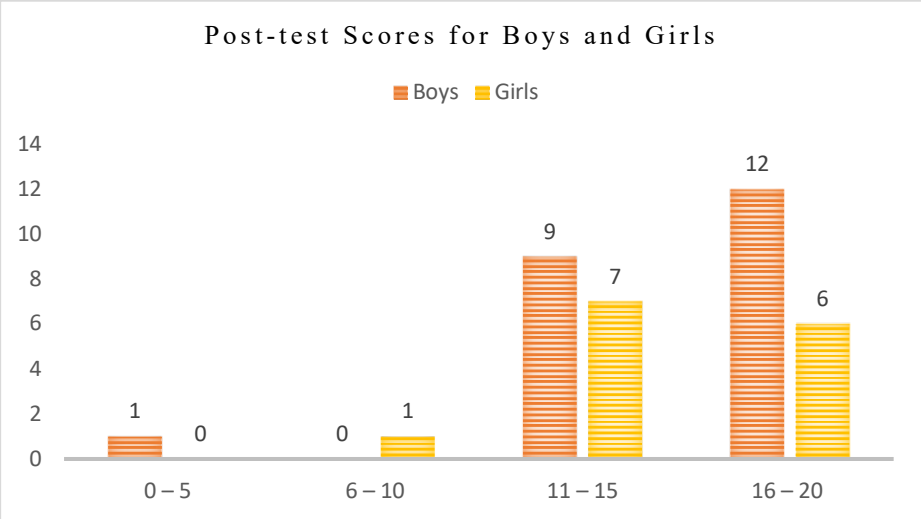

Figure 4. Post-test Scores for Boys and Girls

As shown in Figure 4, the performance of the boys and girls in the post-test was also similar. In the case of the post-test, the scores shifted to the right. A boy and a girl scored 0 – 5 and 6 – 10 respectively. Other than these two, all the scores were above 10. The difference between the boys and girls who scored 11 – 15 was 2. However, for 16 – 20, the number of girls was one

half that of the boys. In the post-test, the majority of both boys and girls scored more than 10 marks.

The maximum, minimum and mean scores for boys and girls were computed to determine the group the 5E Learning Cycle favored. The scores for the Pre-intervention test and Post-intervention test have been presented descriptively in Table 1.

Table 1. A descriptive presentation of Pre-intervention Test and Post-intervention Test

Gender		**Pre-test**	**Post-test**
Girls	Mean	6.93	14.64
	N	14	14
	Std. Deviation	2.90	2.65
	Minimum	1	8
	Maximum	12	18
Boys	Mean	7.55	15.00
	N	22	22
	Std. Deviation	3.89	3.19
	Minimum	1	5
	Maximum	15	20
Total	Mean	7.31	14.86
	N	36	36
	Std. Deviation	3.50	2.96
	Minimum	1	5
	Maximum	15	20

The mean scores for the post-intervention test were almost twice the mean score of the pre-intervention test. While the girls' mean scores showed a 111.26%increase, the percentage increase for the mean scores for the boys was 98.68%. The changes in results can also be seen in the maximum and minimum scores of boys and girls for the post-intervention test and pre-intervention test. The minimum score for the girls increased from 1 to 8 while the boys' increased from one in the pre-intervention test to five in the post-intervention test. The mean scores for the girls in the pre-intervention test and post-intervention test were lower than that of the boys. To determine whether these differences were significant, a Mann-Whitney U test was done to compare the performance of the boys and girls in the pre-intervention test and post-intervention test. There was no significant difference between the performance of the boys (*Mdn=6.50*) and girls (*Mdn=7.50*) in the pre-intervention test U (N_{girls}=14, N_{boys} = 22*) =161, Z=0.245, p=0.81*. This result suggests that although there was a difference of 0.62 between the mean score for the boys and the mean score for the girls in the pre-intervention test, the boys and girls had the same understanding of density. Again, the result suggests that if there is a difference in performance between the boys' and girls' understanding then it is largely contributed by the implementation of the 5E Learning Cycle. There was no significant difference between the performance of the boys (*Mdn=15.00*) and girls (*Mdn=15.00*) in the post-intervention test U (N_{girls}=14, N_{boys} = 22*)=1381, Z=0.524, p=0.62*. This suggests that the

application of the 5E Learning Cycle was appropriate for both boys and girls used in the study. In order words, the 5E Learning Cycle favored both boys' and girls' understanding of density.

DISCUSSION

The application of the 5E Learning Cycle in teaching density greatly improved pupils' understanding of density. This positive impact on pupils' understanding of density cut across gender. The use of the 5E Learning Cycle is one of the potent ways of designing purposeful and meaningful lessons in Science. As an approach that hinges on inquiry, the 5E Learning Cycle allows pupils to link results of experiments to activities to their preconceptions about a topic. As Putra, Nur Kholifah, Subali, & Rusilowati (2018) put it, the 'use of the learning cycle provides opportunities for students to express their previous knowledge and the opportunity to refute, debate their ideas', (p. 173) resulting in developing a higher level of thinking. Applying the 5E Learning Cycle helped pupils to learn and retain information meaningfully. The use of the 5E Learning Cycle also developed pupils' scientific reasoning, problem-solving abilities and communication skills.

Analysis of the pre-intervention test and post-intervention test results showed that the 5E Learning Cycle was effective in helping pupils understand density. This result is consistent with the studies of Hitt (2005); Campbell (2006); Akbulut, Sahin and Cepni (2012); Almuntasheri, Gillies, and Wright (2016); Putra, Nur Kholifah, Subaliand Rusilowati (2018); Wendel, P., Spoltman, and Pochodylo (2019); and Diyana, Haryoto, and Sutopo. (2020). The use of the 5E Learning Cycle did not just improve pupils' understanding of density, it also motivated students to learn. An unusual suspense was created among the pupils. For each activity, they were eager to know what the outcome would be and so they did not mind so much that they were having extended lessons. This motivation to learn generated by the 5E Learning Cycle could be one of the positive effects the approach has on pupils. This motivation to learn may account for the increase in the mean scores of pupils in the pre-intervention test and the post-intervention test. This suggests that the pupils' understanding of density doubled after the application of the 5E Learning Cycle. It also suggests that the retention of the concepts learned was high.

The application of the 5E Learning Cyclewas suitable for both boys and girls. The positive effect of the 5E Learning Cycle on students' understanding of density was observed in both boys and girls. There was no significant difference between the performance of boys and girls in the pre-intervention test. This suggests that before the application of the 5E Learning Cycle the girls had a weak understanding of the density just as the boys. There was also no significant difference in the performance of boys and girls in the post-intervention test, although the girls showed greater gains in performance than the boys. The girls showed greater gains because the mean score for the girls was a little lower than that of the boys in the pre-intervention test. The gains in the mean scores in the girls' performance could be interpreted as that the 5E Learning Cycle has the potential of improving the performance of weaker learners. However, the t-test result did not support this claim. The t-test results indicated that the 5E Learning Cycle can promote boys' and girls' understanding of density.

CONCLUSION

The 5E Learning Cycle is an effective teaching approach for teaching density. Using the usual methods of teaching concepts learners find it difficult to understand may not yield positive results. The 5E Learning Cycle is one of the innovative approach's science teachers can

consider when looking for a teaching approach that can improve learners' understanding of density. This study confirmed that by taking pupils through the Engagement, Exploration, Explanation, Elaboration and Evaluation phases of the 5E Learning Cycle, learners will gain an improved understanding of density. What is good about the application of the5E Learning Cycle in teaching density is that it motivates learners to learn meaningfully as they reflect on their preconceptions and compare them to the results of experiments they have conducted. The 5E Learning Cycle improves learners' conceptual understanding of density and the ability to conduct scientific inquiry related to density.

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PERCEPTIONS OF ACADEMIA OF DIFFERENT HEALTH PROFESSIONS TOWARDS INTER PROFESSIONAL EDUCATION

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ABSTRACT

Interprofessional education is an approach to educating and training students and practitioners from different professions to work in a collaborative manner. The purpose of this research was to examine attitudes towards interprofessional in readiness for interprofessional learning scale was measured with respect to how their influence in clinical situations in Sri Lanka. The questionnaires were sent though post and emails to the consenting participants as per their suggestions of most convenient ways during January 2018 to academics in Sri Lanka representing all faculties in the country including medicine, nursing and physical therapy educational programmes. There were 46% replied and hundred percent of respondents agreed that it was important to patients would ultimately benefit by provide interdisciplinary learning opportunities. The results of this study suggest that a favorable perception of both interprofessional teamwork and interprofessional education exists amongst academic administrators of Sri Lankan health professional education programs.

Keywords: Attitudes, interprofessional education, interprofessional relations

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INTRODUCTION

The delivery of high-quality patient care demands collaborative practice among multiple health professionals (Mu'taman Jarrar & Don, 2016; Mu'taman Jarrar, Sebiany & AbuMadini, 2018). Collaborative practice occurs when health care workers from different professional backgrounds work effectively in a team, communicate productively, and understand each other's roles (Lindqvist & Educaton, 2010; Norwegian Education, 2015). There is an abundance of evidence in international literature supporting collaborative practice. Yet owing to the traditional training of individual health professions, establishment of it has been problematic. Thus, Inter Professional Education (IPE) was introduced with prospects of enhancing the quality of patient care by preparing a "collaborative practice-ready" health workforce. According to World Health Organization (WHO) "inter professional education occurs when students from two or more professions learn about, from and with each other to enable effective collaboration and improve health outcomes" (Lindqvist & Educaton, 2010; Zechariah et al., 2019; Bridges et al., 2011; Buring et al., 2009).

The importance of IPE was first recognized in late 1970s. WHO was the pioneer to acknowledge IPE as an important aspect of healthcare in 1978 and noted that there is an increased trend towards multi-professional teamwork in healthcare supported by an increasing body of evidence (WHO, 1988). Following this, the Center for the Advancement of Interprofessional Professional Education (CAIPE) was established in 1987 in the United Kingdom (CAIPE, 1997; Zeer, Tretyakova & Miroshnichenko, 2019). At present the introduction of IPE into the training curricula of healthcare professions has become an important objective for governments and universities internationally. In the UK, the government supports interprofessional education in both post-qualification and undergraduate settings (Department of Health, 2001; Merriman et al., 2020).

A Bridge to Quality" summit report "All health professionals should be educated to deliver patient-centered care as members of an interprofessional team, emphasizing evidence-based practice, quality improvement approaches, and informatics" (Hinrichs et al., 2019; Gilbert, 2005; Coster et al., 2008). Apart from lack of infrastructure and commitment at the administrative level, the attitudinal difference among faculty members have been identified as a major barrier in incorporating IPE into the health profession curricula. Therefore, it is very much important for the faculty members to appreciate the advantages of IPE so that they can be fully engaged in implementing the change. To date this has been challenging in part due to increased workload and partly because of lack of time. Therefore, the present study is designed to investigate the perceptions towards Interprofessional Learning amongst academia in different health professions in Sri Lanka.

METHOD

Study Design and Study Population

Cross sectional descriptive study will be done representation of all Medical and Allied health faculties in Sri Lanka. The academic staff of Medicine, Physiotherapy and Nursing of above representation from all faculties in Sri Lanka. Sample size a total of 56 academic members were included. The whole cohort of academic staff members in the mentioned study settings will be invited to complete the questionnaire.

Study Instruments

Data will be collected using a self-administered questionnaire. The questionnaires, consent forms and information sheet will be provided in English language only since the academic staff members are proficient at speaking and writing in English.

Readiness for Inter-Professional Learning Scale (RIPLS)

RIPLS is a simple, self-administered questionnaire which has been originally developed in 1999 by Parsel and Bligh (Parsell & Bligh, 1999). This 19 ties scale examines the attitude of health and social care students and professionals towards inter professional learning. Using a five-point Likert type scale, it assesses the attitudinal differences with open ended questions for IPE.

Data Collection

Ethical clearance was obtained from Ethics Review Committee, Faculty of Medicine, General Sir John Kotelwala Defence University. After obtaining ethical clearance, Heads of the relevant institutions will be contacted over the phone/ met in person and informed about the study. Their permissions were obtained prior to the data collection. The questionnaires were sent though post or emails to the consenting participants as per their suggestions of most convenient ways.

Processing and Analysis of Data

Analysis of data will be done using (SPSS version 20). The data will be initially analyzed using descriptive statistics. Analytical statistical methods were used to compare responses of different groups. The free comments will be content analyzed.

Ethical Clearance

They were informed about the study and given time to clarify doubts. The voluntary participation was reassured. Informed consent was obtained from each participant after providing information. The written information sheets were provided to the participants. The completed consent form was ensured that subjects have understood the information provided. The participants were informed about their right to not to participate and that they will not be penalized for doing so.

Confidentiality

The questionnaire is anonymous and identified only by a unique identifier. Such information will not be published. All soft copies are password protected and hard copies will be kept in a locked cabinet. The data will be disposed after 7 years of the research study. These data will never be used in such a way that you could be identified in any way in any public presentation or publication without your express permission.

FINDINGS

Participants were also asked to indicate their level of agreement or disagreement with a series of attitudinal items related to interdisciplinary education

Table 1. Attitudes Towards Interdisciplinary Learning

	Strongly disagree		Disagree		Neutral		Agree		Strongly agree		Total
	N	%	n	%	n	%	n	%	n	%	
Learning with other students more effective member of a health care team					1	1.8	22	39.3	33	58.9	56
Patients would ultimately benefit if health students / professionals worked together							13	23.6	42	76.4	55
Shared learning with other health students increase my ability to understand clinical problems					3	5.5	19	34.5	33	60.0	55
Communications skills should be learned with other health students / professionals			1	1.9	2	3.7	23	42.6	28	51.9	54
Team-working skills are vital for all health students / professionals to learn					1	1.8	12	21.4	43	76.8	56
Shared learning will help me to understand my own professional limitations			1	1.8	3	5.4	21	37.5	31	55.4	56
For small group learning to work, students / professionals need to respect and trust each other					3	5.4	19	33.9	34	60.7	56
I don't want to waste time learning with other health students / professionals	26	46.4	26	46.4	2	3.6	1	1.8	1	1.8	56
Shared learning with other health care professionals will help me to communicate better			2	3.6	3	5.4	27	48.2	24	42.9	56
Opportunity to work on small group projects with other health care students			1	1.8	4	1.5	28	50.9	22	40	55
Opportunity to share some generic lectures, tutorials or workshops with other health care students / professionals			1	1.8	4	7.3	31	56.4	19	34.5	55
Shared learning and practice will help me clarify the nature of patients' or clients' problems					4	7.3	23	41.8	28	50.9	55

(Table 1). In terms of items which received the largest support, 100% of respondents agreed that it was important Patients would ultimately benefit if health students professionals worked together for academic health center campuses to provide interdisciplinary learning opportunities, 98.2% agreed that Learning with other students / professionals will make me a more effective member of a health care team and Team-working skills are vital for all health students / professionals to learn in interdisciplinary courses, 94.5% agreed that interdisciplinary efforts require support from Shared learning with other health students / professionals will increase my ability to understand clinical problems and Communications skills should be learned with other health students / professionals and For small-group learning to work, students / professionals need to respect and trust each other.

Table 2. Potential Barriers to the Implementation of Interdisciplinary Learning in Clinical Situation

	Minimally important		Somewhat important		Very important		Essential		Total
	n	%	n	%	N	%	n	%	
Management of acute situations e.g. Cardiopulmonary Resuscitation, trauma, burns, seizures, unconscious patient, poisoning			6	10.9	15	27.3	34	61.8	55
Clinical decision making e.g. long-term care planning, discharge planning	2	3.6	7	12.7	20	36.4	26	47.3	55
Performing procedures e.g. lumbar puncture, blood culture, taking a biopsy, ascitic tap	4	7.3	14	25.5	18	32.7	19	34.5	55
Work in the theatre e.g. surgery, anesthesia, post-operative care	3	5.5	4	7.3	17	30.9	31	56.4	55
Work in the labor room including neonatal care	1	1.9	8	14.8	14	25.9	31	57.4	54
Work in the hospital clinic e.g. referrals	1	1.8	12	21.8	23	41.8	19	34.5	55

Table 2 presents results related to potential barriers to the implementation of interdisciplinary education in clinical situations. In terms of ranking the highest rate was given to in hospital rehabilitate care which was 90.7%, and all most all the clinic setting all discipline gave the above 76% other than the performing procedures e.g. lumbar puncture, blood culture, taking a

biopsy, ascitic tap which is the lowest such as 67.2%. The all the disciplines and no potential barriers in setting up interdisciplinary education in the clinical setup.

Table 3. Potential Barriers to The Implementation of Interdisciplinary Learning in Their Skills

	Minimally		Somewhat		To a larger extent		Extremely		Total
	n	%	n	%	n	%	n	%	
Decision making skills	4	7.1	5	8.9	28	50.0	19	33.9	56
Respect for each other			3	5.4	18	32.1	35	62.5	56
Understanding how groups work	1	1.8	4	7.1	19	33.9	32	57.1	56
Communication skills	2	3.6	4	7.1	19	33.9	31	55.4	56
Teaching skills	1	1.8	13	23.6	24	43.6	17	30.9	55
Understanding professional roles and responsibilities	1	1.8	3	5.4	20	35.7	32	57.1	56
Recognizing limitations as a professional	3	5.4	5	8.9	19	33.9	29	51.8	56
Leadership skills	4	7.2	5	8.9	21	37.5	26	46.4	56

Table 3 reports results for responses concerning courses that lend themselves to interdisciplinary education in skills to be development (e.g., decision making skills). Respondents were asked to indicate the extent to which they extremely or minimally skilled to carry out the interdisciplinary education. Respect to each other was ranked highest (94.6%) and teaching skills were ranked the lowest such as 74.5%. All the skills such as decision-making skills, understanding how groups work, communication skills, understanding professional roles and responsibilities, recognizing limitations as a professional, and leadership skills ranked above 84% which is significant in this nature setup.

DISCUSSION AND CONCLUSION

Several barriers to the successful implementation of interdisciplinary education have been identified in the literature. Barriers related to the perceived loss of professional and disciplinary status, curricular and scheduling challenges, and lack of familiarity and comfort with interdisciplinary education among universities and departments have been described (Parsell & Bligh, 1999). In some instances, there may also be a certain level of ‘‘unwillingness’’ on the part of both students and teachers alike to experiment with new ways of teaching and learning (WHO. 1988). Parsell and Bligh (1999) classified barriers into categories including structural, curriculum/teaching, professional/disciplinary, and attitudinal. Issues surrounding timetabling and differences between the course characteristics of different health professional curricula present some of the most significant challenges for post-secondary education institutions

seeking to implement interdisciplinary education. As a result, there can be difficulties in coordinating the curricula of different professional groups so that the demands of interdisciplinary education can be met.

In a similar study to that reported in this paper, Gardner et al. (2002) concluded that senior administrators in health professional schools in the United States held overall positive attitudes towards interdisciplinary teams and interdisciplinary education (Gardner et al., 2002). The responses to the survey conducted for this paper suggest a high level of support amongst Canadian academic administrators towards the concept and principles of interdisciplinary health care teams, the efficiency and productivity of teamwork and the value of teamwork in the provision of patient-centered care. Respondents also held favorable attitudes towards interdisciplinary education in general. The results suggest that respondents hold a positive perception of the role of interdisciplinary education in fostering the development of teamwork skills amongst health professional students. The responses to Parsell and Bligh's scale suggest that respondents across all professions also have a positive perception of the influence of interdisciplinary education on the acquisition of individual professional identity.

The respondents identified several possible barriers to the implementation of interdisciplinary education in the didactic setting. The barriers which were rated the highest, in keeping with results from the Gardner et al. (2002) survey of US schools of health professional education, were problems with schedule/calendar, rigid curriculum, turf battles, and lack of perceived value. The results are that while respondents identified a number of barriers to interdisciplinary education, the majority indicated that ''interdisciplinary didactic courses'' were not logistically difficult (Gardner et al., 2002). This may reflect perspectives on the organization and coordination of ''common learning'' activities in which students from different professional education programs are brought together to learn together, commonly through didactic teaching methods such as lecturing. In comparison to interdisciplinary education activities which are based on clinically based experiential learning, common learning activities may present less logistical challenges. The respondents to this survey also represent only the views of academic administrators of Canadian degree-granting institutions or collaborative community college-university programs, serving primarily undergraduate students and graduate level students, and in some instances continuing professional education as well. Nonetheless, the survey results do provide a better understanding of the general attitudes of academic administrators of Canadian programs of health professional education. The results do suggest that these respondents support interdisciplinary teamwork and interdisciplinary education. Further investigation is required on the influence of faculty attitudes towards interdisciplinary teamwork and interdisciplinary education. Faculty members, as role models, have a major influence on the professional socialization process and the development of attitudes and value systems among health professional students. It is important to have a better understanding of the nature of faculty attitudes and the role of faculty development in promoting and fostering positive attitudes towards interdisciplinary education amongst faculty in health professional education.

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CREATING THE SCIENCE LEARNING ENVIRONMENT OF SECONDARY SCHOOL STUDENTS' DREAMS

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ABSTRACT

The development of today's technology and science make it compulsory to adapt the teaching environment to the needs of the period. This research aims to determine what real actors of education students' dream of studying in a science learning environment. 266 5th grade secondary school students selected from metropolitan (N = 134) and rural (N = 132) areas were participants in the research designed in the descriptive survey study. Student drawings were used as a data collection tool. Chi-Square tests were applied in the comparison of the obtained data. In the light of the findings, the science learning environments of rural and metropolitan students' dreams are very different from the existing educational environments; they are related to the environment they live in, intertwined with nature, integrating fun and comfortable environments that meet the requirements of today's technology. Additionally, at the end of the research, an architect turned patterns consisting of student drawings into an ideal science learning environment design.

Keywords: Science learning environment, classroom designs, student drawings, middle school students

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Bektas, O. & Unver-Oguz, A. (2021). Creating the science learning environment of secondary school students' dreams. *Journal of STEAM Education, 4(*1), 52-81.

INTRODUCTION

The dizzying development of scientific knowledge in the century we live in has led to the development of place technologies in many fields. We talk about colonizing the planet Mars, mapping the human genome, and supercomputers as small enough to carry in our pockets. We also talk about education at every opportunity. In the Modern Era, classes and schools that have gotten stuck in the 20th century are not very different from medieval schools. If we visualize, a teacher and students who listen to her/him carefully while take notes and ask questions from time to time reflect the basic classroom order. Of course, learning methods have changed, nowadays we use markers or smart boards instead of chalk, but the format has not improved much yet. When we look at the classrooms of today's modern schools, it is possible to notice some things that are overlooked. For example, nowadays students take their notes on tablets, not on papers, they automatically convert what they write into computer text and this information is stored in the "cloud". The students are often more competent than adults in the use of these technologies. Yet why are the ideas of these students not used in the design of educational environments? The aim of the study is to determine the science learning environments that they want to study in their dreams.

Today's Science Learning Environments

Adapting to the changing conditions in daily life, people have started to use technology as a consumption tool by internalizing the concept of "change". With the development of technology, devices that are subject to science fiction movies started to be used in many sectors such as software and robots at the beginning of the 20th century. This situation gave people more time for other things, saving physical power, and opening opportunities to use creative environments. At this point, the adaptation of science education to this development and change has been a problem worth examining. One of the problems for this research is the position of the science learning environment in the imaginary world and the way students will reveal how the science learning environments are compatible with today and students of this age. Current samples in science learning environment form Turkey and flexible classroom environments in general were presented in below.

Examples of Flexible Classroom Environments

Education is an ongoing process with many shareholders such as student, teacher, administrator, parents and teaching environment. A school-age child spends the most time in an educational environment. If the student profile of today is examined, a speed-focused profile is seen intertwined with technology. In this case, it is a necessity to design the environment in which students spend most of their time gathering relevant shareholders. Despite this development in science and technology, the goal of raising generations beyond the age in teaching environments with classroom environments behind the requirements of the age is a difficult goal to achieve. Cooper, Cowie, and Jones (2010) studied the effectively of The New Zealand Science Learning Hub [SLH]. The program is the collaboration between research organizations,

industries, science educators, and teachers that enabled the development of a resource that is dynamic, up-to-date and relevant, and that can be used to inform the teaching of science in New Zealand schools. The results showed that students are keen to engage with and actively explore the range of media within the SLH contexts.

The education systems of countries in the world are graded according to the results of international student assessments (PISA, TIMMS, etc.) that measure the academic success of students. Finland, which is among the most successful countries in PISA, has made radical changes in education (Sahlberg, 2018). In Figure 1, an image from the Finnish educational environment is included.

Figure 1. A Teaching Environment in Finland. Retrieved from https://indigodergisi.com/2016/12/finlandiya-egitim-sistemi/

Teachers from the shareholders of the above-mentioned education are obliged to do postgraduate education in their own fields. Technology and "flexible classroom environments" have been created in educational environments and supported with appropriate teaching programs.

Science learning environments in Turkey

The development of teaching environments and contents in our country has accelerated after the proclamation of the Republic. However, some basic thoughts have been maintained as a continuation of pre-Republican reform movements. It is known that Satı Bey established the rows that existed in today's learning environments during the Ottoman period (Akyüz, 2012). Considering the development of technological devices presented in Figure 2 from 150 years ago to present. The fact that the education environments of the students studying in the early 1900s and the education environments of the students studying today are in the same order clearly reveals that there is no change in the educational environments despite the fact that the realities of the century and the age have changed.

Figure 2. Technology from Past to Present Retrieved from http://www.yenigolcuk.com/yazar-balIklar-agaca-tIrmanamaz-1332.html

Comparing the predominance of agricultural issues in the 1927 science curriculum and the goals of raising individuals who are questioning science literate today, the objectives of these two curricula are different but the science learning environment seem almost the same. Here, we need to open a separate paragraph for the Village Institutes. The education mobilization that the country needs in education and training has been researched and established based on the philosophy of "the villager is the master of the nation", and the educational mobilization aimed at advancing the villages in fields such as agriculture, commerce, culture, and art has been initiated. Students studying in village institutes came from their villages without school environment and built their own schools. Teaching activities in these schools have been a move that facilitates village life and increases the quality of education. İsmail Hakkı Tonguç and Hasan Âli Yücel, whose efforts were paramount in the establishment of village institutes and in the creation of teaching environments, set off with a social goal ahead of the eras which are presented in Figure 3.

Figure 3. Village Institutes Classroom Environment. Retrieved from https://www.tarihtoplum.org/koy-enstituleri/

After the Village Institutes, training colleges, teacher high schools, and education faculties served as institutions that taught at different levels to train teachers who are the guides of the teaching environment. In today's classrooms, educational environments have been renewed with the Education Information Network (EBA) and the projects that make up its technological background. But including education faculties, no significant change has been observed in teaching environments. In Figure 4 below, we can see a comparison between a classroom environment taken in today 2000s and a picture taken in the 1950s on average 50 years ago.

Figure 4. Class Environments from Past to Present. Retrieved from (Picture on the left): http://kefad2.ahievran.edu.tr/archieve/pdfler/Cilt16Sayi3/JKEF_16_3_2015_87-104.pdf. Retrieved from (Picture on the right): https://www.fahriikiler.com/siyah-beyaz-kareler/

In brief, it is difficult to say that there is a change between the two environments, despite many teaching approaches changes, scientific and technological advances between these two terms. Although technology has been progressing at a dizzying pace, there has been no similar progress in classroom settings. When it comes to class environment, the settlement order comes to mind and this layout is classified into three categories: U layout, circle layout and traditional classroom layout (Figure 5).

Figure 5. From left to right U, Circle, and Traditional Classroom Layouts. Retrieved from http://muteferel.blogspot.com/

Research on Learning Environments

When we talk about the learning environment, we see the climate of the classroom, student-teacher or student-student relationship, physical conditions of the classroom, factors affecting students' success, and attitudes. In relevant literature, some research stands out such as, using drawings for students' thoughts on any subject (Allen & Bowles, 2012; Asiyai, 2014; McHatton, Farmer, Dedrick Shaunessy, Ray, & Bessete, 2015), studies examining the images related to the learning environment (Burnett, 2002; Allen & Fraser, 2007; Elmas, Demirdöğen, & Geban, 2011; Özdemir & Akkaya, 2013; Radovan, & Markovec, 2015; Şahin Akyüz, 2016) and the studies examining the effect of the learning environment on academic variables (Yılmaz & Akkoyunlu, 2006; Brock, Nishida, Chiong, Grimm, & Rimm-Kaufman, 2008; Yener Köknel, Kutlu Güvenkaya, & Şener, 2009;Acat, Karadağ, & Kaplan, 2012; Feyzioğlu, Feyzioğlu, & Küçükçıngı, 2014; Al Şensoy, & Sağsöz, 2015).

In the study of Allen and Bowles (2012), they support four arrangements about students' belonging to school: adult support, positive belonging in peer groups, commitment to education, and school environment. In addition, the attitude of the teacher is very important for the interaction between the student and the teacher. The teacher, who gives negative feedback to students, negatively affects the students' perception of the school. In a study conducted by Burnett (2002), a student accustomed to receiving negative feedback has found that their relationship with their teacher was negatively affected.

In the school environment, besides facilitation serious actions such as teaching and learning activities, it should also give the student happiness (Freire, 2000). When we look at our studentship period, it is a fact that different activities such as extracurricular lesson activities and laboratory activities excite us and increase our motivation. Many variables can be effective and affect us like this kind of activity. Asiyai (2014) revealed the effective roles of learning environments in students' motivation and academic success. The sample of the research consisted of 800 students selected from public schools and private schools. According to the findings, the perceptions of private school students about their physical learning environments showed a significant difference compared to public school students. Investigating the perceptions of students and parents about the learning environment with the mixed pattern model, Allen, and Fraser (2007) stated that there is a relationship between the learning environment and especially the student attitude. Qualitative findings have revealed that students and parents generally find the classroom environment satisfactory, but students prefer more and more research while parents prefer more teacher support. Özdemir and Akkaya (2013) who was working with general high school students and teachers in their studies conducted a study in which they analyzed schools and ideal school perceptions by using metaphors. When the findings of the research were examined, it was seen that teachers and students in secondary education have a negative attitude towards school. The metaphor, which has the highest frequency in the findings, has been identified as a "prison". McHatton and the others (2014) conducted

research in the type of screening, where they examined the perceptions of secondary school students about learning environments through their own drawings. The findings show that secondary school students have different experiences in terms of education-based behavior management, interactions and teaching methods. It was emphasized that drawing as an applicable and innovative tool both enables informative and educational changes and enables the voices of all learners to be heard in the research. Radovan and Markovec (2015) conducted a study in which students examined the relationship between motivation and perceptions of learning environments. In the research, it underlined that lecturers in higher education have difficulty in deciding which teaching strategy may be effective and how to organize their lessons. Türkmen and Pedersen (2003) use The Constructivist Learning Environment Survey (CLS) to understand international students' perception of the learning environments in university science courses. Results stated that student perceptions of the learning environment influence learning behaviors and outcomes that in turn become part of the experienced learning environment of self and others.

Şahin Akyüz (2016) conducted a research to determine the images of eighth grade students towards real and ideal science learning environments. According to the findings of the study, it is seen that the students define the ideal science classroom environment as interactive boards, experiment tables and visuals, learning techniques based on multiple intelligences, and environments where group teaching is carried out. Yılmaz and Akkoyunlu (2006) examined the effects of different learning environments on permanence. In the study, attention was drawn to the changes in the cognitive, affective or neurophysiologic structures of the individual during the learning process. Yener Köknel, Kutlu Güvenkaya, and Şener (2009), in their research examining the illumination studies of primary education classrooms, revealed the mistakes made in the lighting conditions of the classrooms.

The place of drawings in education is also very important. Drawing is the method that illustrates how students imagine many different situations; frequently used to make sense of images acquired from different people such as teacher, principal and scientist. Studies using drawings as a data collection tool (Atasoy, Kadayıfçı, & Akkuş, 2007; Yörek, 2007; Köse, 2008; Aykaç, 2012; Yıldız Duban, 2013; Muthersbaugh, Kenn, & Charvoz, 2014; Özsoy, & Ahi, 2014; Rybska, Tunnicliffe, & Sajkowska, 2014) and studies on the image of the scientist (Chambers, 1983; Barman, 1997; Morseley, & Norris, 1999; Song, & Kim, 1999; Rubin, 2003; Buldu, 2006; Schibeci, 2006; oFralick, Kearn, & Thompson, 2009; Oğuz Ünver, 2010; Leblebicioğlu, Metin, Yardımcı, & Çetin, 2011; Bayrı, Köksal, & Ertekin, 2016) are a few examples in the educational literature in this area.

As a result, studies to examine learning environments generally cover current physical conditions, classroom culture or the main stakeholders of education, teachers, students, parents or administrators. Studies on students' expectations in the design of learning environments are limited (Acat, Karadağ, & Kaplan, 2012; Al Şensoy & Sağsöz, 2015; Asiyai, 2014; Bland Derek, 2009). This research aims to investigate the science-learning environment in which students' dream of studying instead of evaluating the current science learning environments. The issues examined in the research; what is the science-

learning environment that 5th grade students want to study like, and what are the similarities and differences between the science learning environments in the dreams of students studying in metropolitan and rural areas? In addition, what is the ideal science learning environment design in which students' dream of studying in light of the data collected?

METHOD

Research Model and Participants

This research has been designed to use the descriptive survey (Fraenkel & Wallen, 2009) method for revealing the science learning environments imagined by middle school students and evaluating the obtained data in terms of rural and metropolitan students.

Participants of the study were chosen from among rural and metropolitan students. Metropolitan cities are regions with higher trade volume and socioeconomic level compared to rural areas. A total 226 middle school students participated to research from 5th grade middle school students (N=134) of an institutional private school with different campuses in Izmir and 5th grade middle school students (N=132) from village schools in the central district of Muğla province. Convenience sampling methods has been made to determining the participants in order to make comparative research. (Patton, 1987)

Data Collection Tool

Drawings are an effective data collection tool by which children can have their voices heard because the participants of the study are children. (Mc Hatton et. al., 2014) In addition, children were asked to describe their drawings in writing so that the drawings could be analyzed better. When the studies on students' images in the literature (Barman, 1997; Bessette, 2008; Brock et al., 2008; Fralick et al., 2009; McHatton et al., 2014; Morseley & Norris, 1999; Muthersbaugh et al., 2014) were examined, it was concluded that drawings were used as data collection tools.

Before the research took place, a pilot study was conducted in order to predict the problems that could be compiled and to improve the catagories by testing the data collection tool. After determining the collection of pilot study data through drawings, studies were conducted to determine how to form the question to students who will draw their response. The question developed was: "We want to create an environment where we will conduct your science lessons for you. You will totally imagine this learning environment. We will set up this environment in line with your dreams. Draw your designs and tell me in writing" (see Appendix 1). After determining the issue to be directed to the students, the data collection process was planned, and the necessary environment was created for students to draw easily. While asking research questions to students, care was taken to not use the word "class" order to not affect the images they will reflect in their drawings. The researcher told the students that the drawings they made would not be

evaluated as good or bad and that this was not a competition, only the researcher would see their drawings. During the data collection process, dry crayons of different colors, 25x35 sized drawing paper and snacks that they enjoy while drawing were given to all students so they could draw their drawings in more detail. In order for the students to draw easily, it was ensured that there were no school administrators and teachers in the environment where the drawings are made.

Analysis of Data

While analyzing the data obtained from metropolitan and rural areas, markings were made to the checklist to determine the available-not available status of the codes. The numerical equivalents of the themes in the drawings are expressed as frequency. These frequencies have been prepared to be interpreted with a statistics program. The Chi-Square Test ($\chi 2$) was used to reveal the relationships between variables. The Chi-Square Test is based on comparing the observable frequencies of each variable with the frequencies expected to be obtained in the research. (Gay, Mills & Airasian, 2012).

While analyzing the collected data, researchers used a Science Learning Environment Checklist created by considering examples in the literature (see Appendix-2). While developing the checklist used in data analysis, expert opinion was received from 3 researchers who are experts in their field. In the Checklist, three main themes were determined; namely, the location of the science learning environment, the images of science and the order of the science learning environment, and the codes and sub-codes related to these themes. Codes based on the Location of the Science Learning Environment theme are determined as; indoor, outdoor and unusual place. Codes linked to Science Images are determined as; images related to equipment/experiment materials, images related to information, images related to technology tools and others. The codes related to the theme of Order of Science Learning Environment are determined as the position of the teacher and the position of the student. In the results section, these codes and sub-codes will be presented in detail with examples.

For the consistency of the study, two different researchers analyzed the data separately and Cohen's Kappa was found to be 0.82. According to Landis and Koch (1977), a kappa value of between 0.81-1.00 indicates an almost perfect consistency.

RESULTS

The findings obtained by the analysis of the collected data are presented with sample drawings and tables depending on the themes of the location of the science learning environment, science images and the layout of the science learning environment. Chi-square ($\chi 2$) and p significance values were used while interpreting the findings.

The Image of the Science Environment in the Minds of Rural and Metropolitan Middle School Students

The distribution of images related to the scientific learning environments in the minds of middle school rural and metropolitan students according to each theme, code and sub-codes are explained in Table 1. Accordingly, it is seen that 56.8% (N = 75) of rural students draw outdoor place as a science learning environment. But, this rate constitutes 20.9% (N = 28) of metropolitan students. When it comes to the inside, it is seen that 40.2% (N = 53) of the rural students and 42.5% (N = 57) of the students from the metropolitan area made interior drawings. The other sub-code was created for the environments that are outside the school environment such as conference hall, gym, and cinema and cannot be described as classroom or laboratory environments. Drawings that do not depict the outdoors or indoors are coded as unusual drawings. If a learning environment is designed against the laws of nature and physics, it is coded as a fantastic environment while the learning environments drawn in place are coded as universe centered. Conspicuously, this rate reaches 50 for metropolitan students while only 4 of the rural students dream of unusual places.

Table 1. Distribution of the Theme of the Science Education Environment by Rural and Metropolitan Students

	Indoor							Outdoor			Unusual Place					
	Classroom Environment		Laboratory		Other		∑(%)	Nature-centered		∑(%)	Universe-centered		Fantastic Environment		∑(%)	Final Total
	N	%	N	%	N	%		N	%		N	%	N	%		
Rural	22	8.27	22	8.27	9	3.38	19.92	75	28.20	28.20	0	0	4	1.50	1.50	49.62
Metropolitan	7	2.63	23	8.65	27	10.15	21,43	28	10.53	10.53	24	9.02	25	9.40	18.42	50.38
Final Total	29	10.90	45	16.92	36	13.53	41.35	103	38.73	38.73	24	9.02	29	10.90	19.92	100

Another finding that is commonly observed indoor, outdoor and in unusual places which are students imagine more spacious and wider environments than congested ones. If the sample drawings related to the "Classroom Environment" sub-code linked to the indoor code are analyzed, it is seen that a closed classical classroom environment looking at the drawing of MIMKB-34 made by a student from rural areas in Figure 6. The drawing has been associated with the code "Classroom Environment" because it creates a classical perception of class surrounded by walls. It is remarkable that in the drawn science-learning environment, the teacher's desk is positioned close to the middle and there is no window in the environment. On the other hand, while the corners of the walls are indicated with bold lines in the drawing, it is another remarkable element that the table and the desk where the students are located are dull.

Figure 6. An example of "Classroom Environment" drawing by the student coded MIMKB-34 (rural).

Considering the science learning environment, it is inevitable to come across a design that can be directly associated with laboratories. In Figure 7, in the drawing by MIMKB-7, there is a laboratory and a specially designed experiment table with a cupboard. In this environment, some of the basic materials of the laboratories, the Erlenmeyer and the test tube stand, can be seen on the test table. The student drew him/herself while actively engaged in experimenting. In the drawing, it is seen that stools were preferred to sit around the table where the experiments were conducted.

Figure 7. An example of an interior drawing of the "Laboratory Environment" by the student coded MIMKB-7(rural).

An example of the "Other" sub-code in science learning environments indoors is the IBT-26 drawing presented in Figure 8. At first sight, it attracts attention with its different architecture. In this picture, the student drew the science learning environment as an Erlenmeyer. In this drawing, it is seen that there is a closed science learning environment with green stairs in which experiments were made. Again, cupboards for holding experimental materials and tables for experimenting are drawn in this picture. But, in addition it is also remarked “It is a fun environment”. If we look at the drawing, it is seen that fumes are coming out from the top of the building like a "factory chimney". The student who made the drawing wrote that she/he designed a fun factory where experiments were made.

Figure 8. An example of “Other Environments” drawing by the student coded IBT-26 (metropolitan).

In Figure 9, the student coded IBT-53 designed the science learning environment as a house where comfort and coziness are in the foreground in the “other” sub-code. A multi-shelf bookcase, a bed and balloons are the highlights of the picture.

Figure 9. An example of the indoor place drawing of "Other Environments" by the student coded IBT-53 (metropolitan).

It has been observed that the students frequently draw the laboratory environment in the indoor drawings. "Other environments" is the second sub-code with the highest frequency out of the laboratory environment drawings. The "Classroom environment" drawings are the fewest science learning environment design by students.

Drawings made by students in the outdoor code have been examined under the "nature centered" sub-code. This sub-code includes all outdoor drawings such as forests, parks, gardens and seaside. It was seen that the drawings centered on nature were the second preference (38,73%) with the highest percentage according to the findings of the research. It was observed that students from rural areas (28,20%) drew more nature-centered drawings compared to metropolitan students (10,53%). In Figure 10, the student with the code of MIMKB-70 from the rural area drew an open area where the sun is positioned on the upper right of the paper. Into this open area, a tent, which is called the "student tent", is placed for class and accommodation needs. There is a green tree right next to the student tent. In the department where the lessons are taught in the science environment, it is seen that three desks are lined in opposite directions to the teacher's desk and towards the front of the teacher's desk. In addition, it is seen that the indoor environment is designed only for sheltering, whereas the education is drawn open air, wide and spacious.

Figure 10. An example of "Nature Centered" drawing of the student with the code of MIMKB-70 (rural).

If we look at the IBR-12 drawing (Figure 11) from the metropolitan area, an open and spacious area with plenty of trees is seen by a stream. It is observed that in an environment decorated with small bushes and different flowers, teachers and students are happy.

Figure 11. An example of "Nature centered" drawing in outdoor place of IBR-12 coded student (metropolitan).

The unusual place drawings are grouped as "Universe Centered" and "Fantastic". It is seen that the Metropolitan IBT-3 coded student related to the "Universe Centered" sub-code, imagines a science learning environment with a planet view in place (Figure 12). Because of hosting of known universe images, the drawing is not considered a fantastic environment drawing. In addition, the student thought about the comfort of the environment by placing a pool and a bed in the science environment. The table she/he drew in the science learning environment only belongs to her/him and has all the materials she/he may need while teaching. Another noticeable finding in the drawing is that the student imagines the planets in the same plane.

Figure 12. An example of the "Universe Centered" drawing of the student coded IBT-3 in an unusual place (metropolitan).

One of the unusual pictures, if we examine the IBR-24 coded drawing presented in Figure 13, the student drew herself/himself flying over the clouds with wings. The environment is completely made up with

clouds and she/he has built a bridge out of a rainbow between two clouds. Again, the desk for the student to put her/his notebooks and pens are made of clouds. In this drawing, again, comfort, spaciousness, spaciousness, freedom, softness and fun elements are in the front plan.

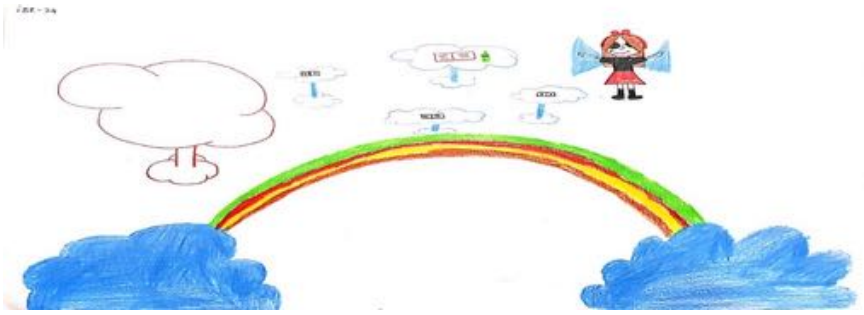


Figure 13. An example of the "Fantastic Environment" drawing of the student coded IBR-24 in an unusual place (metropolitan).

In another metropolitan data coded "Fantastic Environment", the cloud image and flying action emphasize that the environment the student dream if surprising and unusual. In Figure 14, the student coded IBR-1 used the expression "…the place where I study is above the clouds. There is a crazy scientist out there. Lots of test tubes…" in his/her written expression. The student drew the instructor as a crazy scientist. He/she has unified the science education environment and science fiction environments in his/her dreams.

Figure 14. An example of the "Fantastic Environment" drawing of the student coded IBR-1 in an unusual place (metropolitan).

Rural and metropolitan city participants with three sub-codes of the science learning environment and χ2(Chi-Square) and p (asymptotic significance) values which reveal the significant relationship and the region they joined are presented in Table 2. Significant difference of multiple comparison of rural and metropolitan students between Chi-Square test relationships was found (χ2= 59.78 >χ2critical=5.99, p<.05).

Table 2. Test Multiple Comparison of the Theme of the Location of the Science Learning Environment by Rural and Metropolitan Students and the Chi-Square Test

Location of the Science Learning Environment									
			Outdoor	Indoor	Unusual Place	Total	χ^2	df	p
School Region	Rural	f	75	53	4	132	59.788	2	.000
		%	%28.2	%19.9	%1.5	%49.7			
		PH	6.0	-.4	-6.8				
	Metropolitan	f	28	57	49	134			
		%	%10.5	%21.4	%18.4	%50.3			
		PH	-6.0	.4	6.8				
	Total	f	103	110	53	266			
		%	%38.7	%41.4	%19.9	%100.0			

The Image of the Equipment, Information and Technology in the Minds of Rural and Metropolitan Middle School Students

Other details in student drawings are observed under the following codes: images of equipment (experiment materials, stationery materials, school or classroom equipment's and not described); images of information (equations, scientific models, texts are not described) and images of technology (today's technology, advanced technology are not described). Tools and experiment materials in the drawings of rural and metropolitan students, the results of the observations of images related to information and technology are presented in Table 3, Table 4 and Table 5 respectively.

65.4% of the students reflected in their drawings both stationery and laboratory materials they frequently use in their daily life. When we look at the images related to the information, it was seen that 30.8% of the students drew equations, scientific models and captions.

Table 3. Distribution of the Theme of the Equipment by Rural and Metropolitan Students

	Described			Not described			Total		
	f	%	∑(%)	f	%	∑(%)	f	%	∑(%)
Rural	80	46.0	30.1	52	56.5	19.5	132	49.6	49.6
Metropolitan	94	54.0	35.3	40	43.5	15.0	134	50.4	50.4
Total	174	100	65.4	92	100	34.5	266	100	100

Table 4. Distribution of the Theme of the Information by Rural and Metropolitan Students

	Described			Not described			Total	
	f	%	∑(%)	f	%	∑(%)	f	∑(%)
Rural	23	28.0	8.6	109	59.2	41.0	132	49.6
Metropolitan	59	72.0	22.2	75	40.8	28.2	134	50.4
Total	82	100	30.8	184	100	69.2	266	100

Table 5. Distribution of the Theme of the Technological by Rural and Metropolitan Students

	Today's Technology			Advanced Technology			Not Described			Total	
	f	%	∑(%)	f	%	∑(%)	f	%	∑(%)	f	∑(%)
Rural	13	20	4.89	0	0	0	119	66.48	44.73	132	49.6
Metropolitan	52	80	19.54	22	100	8.27	60	33.52	22.56	134	50.4
Total	65	100	24.43	22	100	8.27	179	100	67.29	266	100

Accessible devices such as smart-phones, tablets, boards, projectors which are today's technology; devices such as holograms and teleportation units are considered advanced technology products. It was found that metropolitan students included images of technology tools, advanced (8.27%) and today's technology (19.54%) drawings were, while 44.73% of the rural students did not make any description in this field. In Figure 15, examples of students' drawings of science images are presented under the title of rural and metropolitan cities.

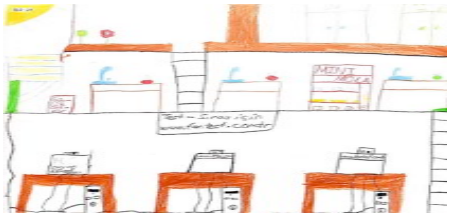
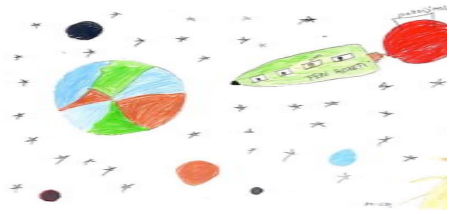
Codes	Drawings	
	Rural	Metropolitan
Images Regarding Tools-Equipment Testing Materials		
Images Regarding of Information		
Images to Technology Tools		

Figure 15. Examples of the "Equipment, Information and Technology" drawings of the rural and metropolitan students.

According to $\chi 2$ and p values which reveal a significant relationship between the regions they participated in, with the descriptions of the rural and metropolitan participants about the equipment and experimental materials, no significant relationship was found $\chi 2 = 2.677 < \chi 2$ critical $= 3.841$, $p > .05$. However, there is a significant relationship between the description of the images $\chi 2 = 22{,}074 > \chi 2$ critical $= 3.841$, $p < .05$ in the drawings. Lastly, it is seen that there is a significant relationship $\chi 2 = 64.83 > \chi 2$critical $= 5.991$, $p < .05$. between the images of technology tools for metropolitan students.

The Image of the Layout of the Science Learning Environment in the Minds of Rural and Metropolitan Middle School Students

The layout of the science learning environment in students' images were examined in two categories; the position of the teacher and the student. These categories are defined with sub-codes as "teacher centered", "student centered" and "not described". Among all the students, only 27.44% (N = 73) of the students

drew the layout of the science learning environment. Rural and the metropolitan students who drew instructors as teacher-centered are 54.16% (N=26) and 44.84% (N=22) respectively (see Table 6).

Table 6. Distribution of the Theme of the Layout of Science Learning Environment by Rural and Metropolitan Students

	Teacher Centered			Student Centered			Not Described			Total	
	f	%	∑(%)	f	%	∑(%)	f	%	∑(%)	f	∑(%)
Rural	26	54.16	9.77	9	36	3.38	97	50.26	36.47	132	49.6
Metropolitan	22	45.84	8.27	16	64	6.02	96	49.74	36.09	134	50.4
Total	48	100	18.04	25	100	9.40	193	100	72.56	266	100

In Figure 16, examples of teacher-centered and student-centered drawings of rural and metropolitan students in science learning environments are presented.

Codes	Drawings	
	Rural	Metropolitan
Teacher-centered		
Student-centered		

Figure 16. Examples of the "Layout of the Science Learning Environment" drawings of the rural and metropolitan students.

When we look at the difference between the regions regarding the position of the teacher and the student of rural and big city students, it is observed that there is no significant differences $\chi 2 = 2.284 < 2\text{critical} = 5.991$, $p > .05$.

DISCUSSION AND CONCLUSION

Learning environments should be able to be designed with the characteristics and needs of students in mind. According to the results of the research, the science learning environments in students' dreams are very different from today's science learning environments. According to the results of the research, the science learning environment in which only 10.90% of the students want to study in their dreams coincides with the existing classroom environments. Feire (2000) emphasized in her study that the school should give happiness to children. However, Al Şensoy and Sağsöz (2015) and Asiyai (2014) stated that almost all of the participants were not satisfied with the classical classroom order in their study, which investigated the effect of students' satisfaction with the spatial order and academic success. Another study Brock and the others (2008) determined that there is a significant relationship between students' perceptions of the learning environment and their social and academic achievements. Similarly, Türkmen and Pedersen (2003) emphasize that classroom environments are directly related to constructivist learning. Finally, in Radovan and Makovec's study (2015), it was concluded that students can easily demonstrate their personal goals in learning environments with strong communication based on collaboration and that their perception of the learning environment is positive.

Another finding of the study is that students imagine more and more spacious learning environments compared to congested learning environments, which is a common observation in indoor, outdoor and unusual place drawings. Similarly, Veltri, Banning, and Davies (2006) showed in their study that the factors that distract students (loud noise, wrong lighting, ineffective use of technological devices) disrupt the active learning environment and negatively affect the teaching environment. In addition, another remarkable result of the current research is that students want to attend science lessons in comfortable environments filled with fun and the comforts of home. The floor mats, large seats, and playground drawings of students are the proof of how much they care about this. Being in contact with friends and teachers in their drawings shows their movement and communication needs. It is an emphasis on the necessity for "school architecture for children" mentality that drives the designs of playgrounds and entertainment areas where students can easily run. There are many studies on how Finland succeeds which has made a name for itself with its success in PISA exams. Sahlberg (2018) examines the Finnish teaching model and emphasizes the importance of relaxation, comfort, regular breathing and physical activity for a sound learning experience in his book. In the current research, the expectations of comfort by the students in their drawings are significant considering the environments in which students take off their shoes and walk around comfortably in schools in Finland as well as at home. In the research, it was

observed that the number of students' drawing related to the nature-centered sub-code in the outdoor coded drawings was significantly different in the direction of the rural participants. On the other hand, the universe-centered and fantastic environment drawings connected to the unusual place code are significantly higher in the direction of metropolitan students in the research findings. This result shows us how much the students' science environment preferences are related to the environment in which they live, their experiences and even their culture. As a result, the student does not imagine an environment independent of her/his own culture and environment as an educational environment. The famous educator Prof. Dr. Selçuk Şirin, stated at every opportunity that the best school for the child should be the school in the neighborhood where she/he lives. Therefore, it is essential to standardize the quality of teaching for each region.

Similarly, in the current research students imagine interesting science learning environments parallel to their experiences such as rainbows, holograms etc. McHatton and the others (2014) defined students' thoughts about learning environments as the physical conditions of the classroom, students' perceptions in the learning environment and the placement of the teacher in the classroom. In their studies, it has been concluded that they define both highly gifted and formal education students considering the drawings of the students regarding the learning environment.

Another result of the current research is that the students used course and experiment materials in their drawings which integral parts of the scientific learning environment are not directly questioned. In their research Veltri and the others (2006) emphasize classroom materials and technological equipment have a very important place both between the students in the classroom and the distance education students and the teacher.

In the current research, 72.56% of the students did not specify the position of the instructor and the student in their drawings, the remaining rural (N = 26) and metropolitan (N = 22) students made teacher-centered drawings. Feyzioğlu and the others (2014) observed in their study in which they examined the mental models of pre-service teachers for science teaching that this situation evolved to a student-centered approach as the grade level increased. In his study, Aykaç (2012) who asked students, "What comes to your mind when we say teacher?", found that some students perceived teachers as a "flower" or "heart", some perceived them as a "human", and some perceived it as a leader like "Atatürk". McHatton and the others (2015) stated in their research that gifted students drew the teaching environment as student centered, active and competitive. However, it is said that the world is changing shape, on the way to becoming a science and technology society, but recent studies on the drawings of scientists (Fralick, Kearn, & Thompson, 2009; Oğuz Ünver, 2010; Akçay, 2011; Ağgül Yalçın, 2012, Kara, & Akarsu, 2013) show that students still depict them stereotypically. Although the current research is limited, the science teacher is also described or drawn in line with a certain stereotype.

As a result, rural and metropolitan students dream of a science learning environment that includes their own lives and culture, comfortable, in touch with nature but using the possibilities of technology. This situation is the proof that the science learning environment in the students' minds are far from today's classroom environment.

Using the results acquired from the data, a layout plan of the appropriate teaching environment was asked to be created by an architect in the form of plans. Accordingly, Figure 17, depicts a science learning environment design has emerged consisting of 5 different stages placed in a large area. Opportunities for activities such as research, teaching, sports and entertainment are provided to students in these stages. In addition, a pond surrounding the teaching environment and the stream connected to this pond refer to the nature theme in students' drawings. Also the thicket areas around the science environment campus are designed in response to the students' desire to interact with nature.

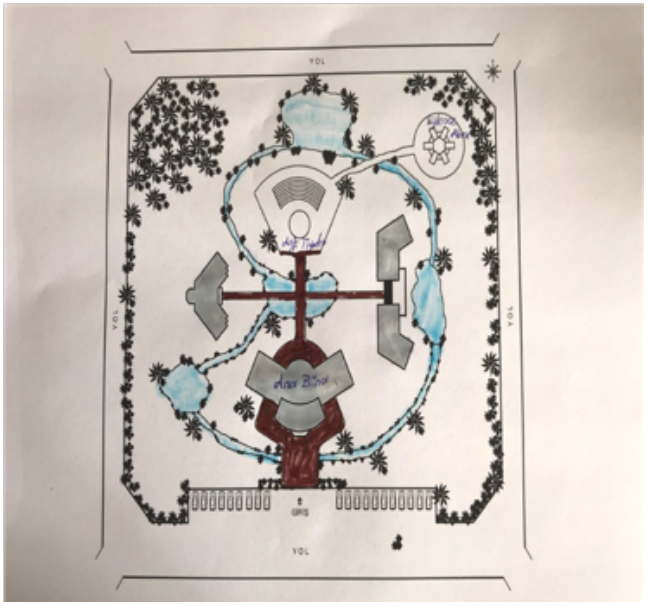


Figure 17. Architectural interpretation of the scientific environment according to student drawings.

Implication for Further Studies

In the light of the findings obtained from the drawings of the students participating in the study, the site plan of the science environment of the students' dreams was presented as a suggestion with the support of the architect. In addition, other recommendations determined according to the results of this research are listed below:

1. While creating science learning environments, the opinions of students who have always been neglected indispensable shareholders of education until today, should be taken.

2. Science learning environments should be integrated with nature. Therefore, science educators who have a voice in school management and instructors should definitely include out of school learning environments in their planning.

3. They should have place where the rainbow that touches and takes attention of students' dreams, advanced technologies, fantastic places and ideas exist in science learning environments.

4. Science learning environments should not be cold and dark in the classical laboratory understanding, but should be colorful, well-lit and comfortable.

5. They should design science environments that integrate the environment in which each student lives, not in a single prototype.

6. When designing science learning environments, the needs of students both now and in the future should be considered.

7. They should create student centered and supporting communication environments.

8. Science learning environments should definitely be supported with experiment sets, tools and technology equipment.

9. Regardless of whether it is a state-owned or private institution, an independent commission that will determine the designs of teaching environments and their suitability for the needs of students should investigate how appropriate the existing schools are to train future students.

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Appendix 1. Data Collection Tool

Draw your dream science environment

We want to create an environment for you to conduct your science lessons. You will completely imagine this learning environment. We will establish this environment in direction with your dreams. Draw your designs and write to me.

Appendix 2. Science Environment Drawings Checklist

Theme	Sub-code	f		%	
		Yes	No	Yes	No
Indoor	Classsroom Environment				
	Laboratory				
	Other				
Outdoor	Nature Centered				
Unusual Place	Universe Centered				
	Fantastic Centered				
Images Related to Tools-Equipment / Experiment Materials	Experiment Materials				
	Stationery Equipment				
	School/Class/ Equipments				
	Not described				
Informational Images	Equations				
	Course Tool Scientific Models				
	Captions				
	Not described				
Images Related to Technology Tools	Today's Technology				
	Advanced Technology				
	Not described				
Other	Other				
Location of Teacher	Teacher Centered				
	Student Centered				
	Not described				
Location of Student	Teacher Centered				
	Student Centered				
	Individual				
	Not described				

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STUDENTS' INSIGHTS ON TEACHING AIR POLLUTION IN INDONESIAN CLASSROOMS: A REPORT BASED ON SEMI-STRUCTURED INTERVIEWS

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ABSTRACT

This qualitative study based on grounded theory was conducted among 49 active student leaders of Indonesia to determine how students perceived the situation of environmental education in their senior high schools and how the issue of air pollution is tackled in their conservative classrooms. The responses from semi structured interviews were specifically coded using the principle of open, axial, and selective coding and the content were systematically categorized, compared, and summarize to explicitly elicit the context of students' general perceptions. Indonesian students acknowledge: (i) worsening situation of air quality brought by the combination of anthropogenic and natural causes, (ii) social media platforms to be the major available source of information and (iii) issues about air pollution are urgently needed to be address through innovations in the current environmental education system of the country by incorporating a curriculum emphasizing the concepts of sustainability.

Keywords: air quality management, ASEAN, forest fires, green school policies, quality education, sustainable development goals (SDGs)

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INTRODUCTION

Environmental crisis in the modern society is caused by environmental management that ignored the principle of sustainability. Many methods have been done to alleviate these environmental crises globally however until now, there is no instant and quick formula to fix all the damages brought upon by the continued degradation of natural resources. Therefore, it needs another long-term formula in solving this natural problem. One way that can be used is by educational approach (Arioder et al., 2020). According to Herdiansyah et al. (2016) the involvement of environmental development could be done through two kinds of approaches – *project approach* and *motivation approach*. The first approach (project) is based on redesigning existing curriculum that would focus in contributing to the success of the student learning experience. The implementation of this new design involves an evolutionary improvement of the existing traditional curriculum with gradual modifications (Drinka et al., 2019). On the other hand, the second approach (motivation) is characterized of an educational environment that has a set of spatial-objective, social, psychological and pedagogical influences as objects of analysis (Kislyakov, 2017). Although the motivational approach may spend a longer time, Pahl et al. (2017) have noted that it will yield more positive effects because the target students will gradually change their attitude and behavior in persuasive manner. The student's behavior of ignoring environmental problem will turn into attitudes that will always grow and culminate in stability of environmental involvement. Nevertheless, both approaches can be integrated through education systems that would enforce not just environmental awareness but as well as environmental values. These may serve as the backbone of the younger generation to engage themselves on many international policy discourses. The younger generation are expected to actively participate and become game changers for the environmental crises that our world is facing nowadays. In spite of many social digital platforms that allowed the younger generation to learn and communicate many of their environmental concerns, advocacies, and inquiries, conservative education systems, especially on many developing countries in Southeast Asia, are still reliant on traditional education inside the classroom.

In particular is the Muslim dominated country of Indonesia whose rapid urbanization has occured in less than two generations (Dethier, 2017). This urbanization has also boosted the consumption needs of the Indonesian populace. In particular is energy consumption coming from industries and normal households, wherein most of the sustainable energy supplies are needed to be maintained and improved (Alam, 2016). According to Santosa et al. (2008), the rapid development of Indonesia was in fact heavily fueled by fossil fuels, especially oil, followed by natural gas and coal. The exploitation of fossil fuel in "*fueling*" the development of the country resulted in significant environmental quality degradation. Air pollution is perhaps Indonesia's most severe environmental problem. The construction of infrastructure, as well as the development of transportation and also the number of industries can contribute to the increase of pollution in the air (Ummi et al., 2019; Setiawan et al., 2018; Wijayanti et al., 2018; Saudi et al., 2019). Clean air is a basic requirement for human health; however, rapid economic development have resulted to the increase on the number of industries that pollutes the atmosphere. This worsening air quality now poses as a major risk to public health (Liao et al., 2015). Furthermore, fires associated with agricultural and

plantation development in Indonesia has released emissions into the atmosphere that does not only degrade regional air quality but also contributed to greenhouse gas concentrations (Marlier et al., 2015a). Forty-five percent of Indonesia's deforestation from 2000 to 2010 was observed on oil palm, timber, logging, and coal mining concessions (Abood et al., 2015). Fires are considered to be a cheap and effective method to clear and maintain land for agricultural and plantation development (Simorangkir, 2007), but at the same time damages biodiversity, reduces carbon storage potential, and can severely degrade regional air quality.

The Indonesian government tried to address urban environmental issues starting in the 1980s, but this has been a relative failure because policy implementation has been poor due to corruption, weak commitment of public agencies to combat on environmental issues, and local government authorities' low awareness of the environmental problems (Dethier, 2017). Changing people's behaviors and views about the environment, with the hope that this can change their actions and will make them as a more concerned citizen that would protect their environment, is the goal of a sustainable environmental education (EE). In the case of Indonesia, this is addressed by the government through the implementation of the *Adiwiyata* program. *Adiwiyata* is a program that aims to make school residents responsible for efforts to protect and manage the environment by the realization of increasing environmental awareness by implementing cultured environments in schools (Latief et al., 2019; Caddafie et al., 2017; Desfandi et al., 2019). However, the curriculum for most Indonesian high schools nowadays also should be strategically formulated that does not only produce teaching materials but rather pays attention to current developments of fast changing educational landscape. The curriculum must always be updated in line with changes to remain relevant to a changing society (Prihantoro, 2015). Environmental Education (EE) has always tried to balance between two things: a realistic account of the threats that the world is facing and an attitude which would motivate and empower people (Pihkala, 2017). However, there are problems related to the low participation of the community to participate in environmental education (EE) movement due to limited understanding of the existing environmental education issues such as lack of information, and socialization from environmental education itself (Darmawan & Dagamac, 2020).

According to the research of Parker et al. (2018), Indonesian students identified waste or rubbish, and not consumption, as the main problem locally but were not well informed about environmental issues both in national and international scales. They are vague about how to ameliorate environmental problems, reflecting the weakness of EE in problem-solving for the country. According to the findings of their research, students perceived, 'society' – rather than governments, industry or consumers – as the most accountable in causing environmental problems. There is a need to develop an environmentally friendly education as a solution to the aforementioned air pollution problems. The negative actions of human obviously damage the earth which ultimately causes the pressing issue of global warming. Educating students at a very early age on topics related to pertinent environmental problems to raise ecological awareness is an important alternative to address the apathy of people towards environmental protection (Sagala et al., 2019; Hu, 2019). However, a missing gap on many studies concerning environmental issues

related to air pollution in Indonesia is to communicate the insights of many other important stakeholders, particularly are the rapidly evolving high school learners in the country.

Hence, this qualitative study based on grounded theory was conducted among the active youth sectors of Palembang Indonesia to (1) report how students perceived environmental education on their programs and (2) obtain their insight on the issue of air pollution that have been afflicting the province over the last years.

MATERIALS & METHODS

Selection of student participants

A total of 49 public senior high school (20 males and 29 females) student leaders participated in this qualitative study. All these students were between the ages of 14 to 19 years old. The results of the interviews right after analysing there content is shown in this section with some *in verbatim* quotations that were directly translated from Bahasa to English for reference. Since student leaders in most senior high schools in Indonesia are the active volunteers in most green projects of their respective schools, they were purposively selected for this study. In addition, the following criteria was also considered: (i) personal commitment and availability to participate in the series of interview and focus group discussions (FGD) that were conducted for this study; and (ii) on their familiarity in incorporating environmental issues in their daily routine activities. Before the interview commenced, students were oriented about the purpose of the series of interviews and they actively agreed to participate in the rounds of interview session needed for the study. Discussions about the air quality and air pollution problems and how such issues are discussed at the senior high school classrooms have been the consistent themes that were scrutinize throughout the interview process.

Interview process and ethical considerations

Validated semi-structured questions were used for the interviews. The entire interview process was divided into three parts of the discussion component namely; (i) *sketching component* - where participants were asked about important profiles such as their level of education, and their organizational experiences; (ii) *assimilating component* - where participants answer questions based on their knowledge of air quality and the state of environmental education in their respective schools; (iii) *candidate searching component* - where participants present their initiatives and opinions on air pollution control and the need to incorporate such topics in most high school classrooms in Indonesia.

Content Analysis

All the participants were initially informed about the data recording process and they were assured of the privacy of information that they would divulge during the interview. Students that are not yet of legal age,

were asked from the school's permission and authorization of their guardians or families. After the students willingly gave their consent for the recording, the interview commences with the interviewer jotting down important notes that the participants have been actively tackling in an *Aide-memoir*. The notes taken from *Aide-memoir* validated by the voice recordings of all the interviewers were transcribed in verbatim. The responses that were recorded both at the recording process and transcripts from the *Aide memoir* were then divided into segments that were relevant to this study. These responses were specifically coded using the principle of open, axial, and selective coding. Moreover, the content was systematically categorized, compared, and summarize to explicitly elicit the context of student's insights reported in this study.

RESULTS

Student's view about the air quality in Palembang

Three student interviewees have agreed that Palembang have experienced a very poor air quality. 9 students have described the air quality to be *kotor* (dirty), *berkabut asap* (foggy smoke), *berdebu* (dusty), and *tercemar* (polluted). 16 students have noted that the visibility in the city have gotten worse and might indirectly contribute to a number of road accidents. However, 23 students acknowledge that air quality in Indonesia is relatively changing when the rainy season begins. The students described it to be *membaik* (improving) but even though air quality is seasonal, they still find that the air quality to be worsening every year. Students identified several causes of the poor air quality in Palembang. They acknowledged the anthropogenic contribution through vehicular emissions and waste burnings that most Indonesian household practice. Moreover, the natural causes such as forest fires in many parts of the province have been identified to be contributing mostly on the poor air quality. 7 students have described that the color of the sky during early mornings in Palembang over the last years became dark red and they speculated that this is due to the smog brought by forest fires. All students expressed their dissatisfaction over the public policy about air pollution. They have noticed that the local government seems to focus more on building transportations rather than addressing the forest fires problems. Another surprising statement conveyed is that all of them are unaware of the regulations the government have been implementing. 19 students have further added that information on air quality in Indonesia have been acquired on news posted on their social media platforms.

The students' initiative to face the air pollution problems in Palembang

Several initiatives in preventing and acting on air pollution problems in Palembang are conveyed by the students. In terms of preventing, students indicated that they reduced the usage of private vehicles (27 out of 49), stop the indoor burning of waste products at home (5 out of 49), in terms of acting on air pollution, 47 students responded that they wear mask when they do outdoor activities especially on occasions that they notice the haze caused by forest fires. One male student who identified himself to be a frequent

smoker, have even started to worry about the forest fires and smog occurring in Palembang. This made him realized that he needs to slowly quit his smoking habits.

Are high-school classroom helping students to be environmentally informed?

We know that it is possible for classrooms to be a place for students to get a variety of information, and one of them is information about environmental issues. But unfortunately, the current availability of materials and presenters are not very useful to disseminate environmental information based on all the responses of the 49 students who apparently seems to be clueless about theoretical knowledge related to air pollution. Students have acknowledged that air pollution issues are discussed very briefly on certain science subjects such as biology and chemistry. In terms of the learning process, 5 students stated that information about discussion on relevant environmental issues in the classroom was minimal. 3 students have also stated that the school only educated or taught them basic concepts such as Reduce, Reuse, and Recycle (3R). But in overcoming these conditions, 19 students vehemently expressed their self -initiative to independently educate themselves by *dengan mencari informasi diinternet dan social media* (searching information on the internet and social media) or *juga mencari narasumber yang andal* (asking reliable resource persons) to at least validate their environmental insights. However, 1 other student interestingly expressed the subjectivity of student motivation when she stated that *even if their school has provided information, if the awareness of her classmates is still lacking because of many other personal or technical distractions, then high school program's environmental efforts will be useless.*

DISCUSSION

Majority of the students interviewed agreed and stated that the air quality around them was in poor condition. Forest fires that always occur every year in Palembang Indonesia are the main cause of the decline in air quality, coupled with the dense traffic activities, industrial emissions, and waste incineration. In this frequent situation, Palembang students and their schools take the initiative to work to reduce air pollution around them by replanting trees, watering plants, reducing the use of private vehicles, and quitting smoking activities in order to reduce air pollution. Other studies have also showed similar initiatives from other Indonesian high schools. Like for an instance is the SMPN 6 Tuban, that had been recognized as one of *Adiwiyata* school (green school) for the country (Fadlillah et al., 2018), kept on developing strategies to continuously create environmentally friendly characters in SMP 6 Tuban based from the four implementation features of the *Adiwiyata* program namely, environmentally sound policies, environment-based curriculum, participatory environment-based activities, and management of environmental-based supporting facilities (Warju et al. 2017). But each aspect has not been implemented optimally. These aspects can be optimized with the consistency and commitment of the school community. This consistency is enhanced by positioning students as the center in the implementation of the *Adiwiyata* program and adding examples, rewards, and punishments as alternative strategies to increase motivation in developing students' caring character. According to the overall assessment of Yasin. (2019), the

Adiwiyata program and its aspects can contribute positively to creating situations and conditions that support the development of environmental awareness at least among Indonesian high school students. Perhaps, such imperative models coming from *Adiwiyata* schools of Indonesia are needed to be adapted among Palembang high schools to address the low environmental appreciation and motivations raised by the 49 student respondents of this study.

However, despite the activities implemented on those Indonesian schools, student's awareness and active participation that addresses air pollution problems are still generally low. As indicated in our findings in the interview, practices that prevents air pollution such as using private vehicles and indoor burning of waste products are practiced only by less than 50% of the student leader respondents. Maulidya et al. (2014) have indicated that for all environmental literacy components, students were high in components of environmental knowledge and cognitive skills but have not been satisfactory for the affective and responsible behavior components. This is further proved by the case study presented by Meilinda et al. (2017) about the low-level students' environmental literacy in *Adiwiyata* schools of Surakarta, Indonesia. Their findings have shown the following breakdown: *Adiwiyata* 77% for environmental knowledge, 60% for attitude, 70% for environmental concern. Therefore, a high level of knowledge will not always encourage someone, especially students, to show care about the environment (Meyer, 2015). Hence, developing a classroom that would enable students to recalibrate their environmental care towards the environments should be critically considered as well in most *Adiwiyata* program policies.

Nevertheless, the responses of the students interviewed in this study seem to understand the negative backlashes of air pollution in Palembang and students have identified efforts to overcome the weaknesses in the current system of education. Students basically voice out that schools must provide effective learning practices to develop responsible behavior for the environment. The results of this qualitative study find out that Indonesian students wanted to discuss topics related to environmental education. Some of them even suggested raising environmental education as a subject at their very own high school, because they thought that when there will be environmental education at their high-school, more information about existing environmental problems can be given to them. However, it is very important to point out that students in this era of digital age obviously get more engaged with technology (Ainley et al., 2008). This is obvious especially since most of the students' responses in this study have advocated on independent self-initiative means to address their environmental curiosities. Social media could be utilized as a tool to promote awareness regarding various current environmental issues in a much faster way and to a large target groups within a very short span of time, because people are using these platforms nowadays to support environmental campaigns and to connect people locally and globally on minor to major environmental issues (Mallick et al., 2019). Moreover, due to the swift flow of information, propagations of environmental sustainability awareness in higher education would be more effective with the use of social media (Hamid et al., 2017).

CONCLUSION

The role of these future generation has been always imminent especially that student's knowledge, awareness, and behaviour in relation to a particular environmental problem does not always match. Nevertheless, the collective responses of the Palembang students provided in this study clearly conveyed three important messages with regards to the situation of educating students about air quality in the locality: (1) the younger generation acknowledge the yearly worsening of air quality in Palembang brought upon by anthropogenic and natural causes (2) immediate practical actions are urgently needed to address these air pollution issues and for some students, proactive and independent participation in acquiring knowledge, where their local government unit in some point fails to provide, is needed and (3) high school classrooms should be innovative in creating a learning space where their social responsibilities in solving air pollution problems is highlighted and their environmental behaviors towards sustainable development is shaped out.

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