Jurnal Pendidikan Indonesia
Volume 12, Number 1, 2023 pp. 107-115
P-ISSN: 2303-288X E-ISSN : 2541-7207
Open Access: https://doi.org/10.23887/jpiundiksha.v12i1.53192

Science, Technology, Society, Environment Training Model to Improve Positive Attitudes of Early Childhood Teachers in the Environment

M.A Muazar Habibi[1*]

[1]Early Childhood Education Teacher Education Study Program, Department of Education, Faculty of Teacher Training and Education, Mataram University, Indonesia

ARTICLE INFO

Article history:
Received October 17, 2022
Revised October 20, 2022
Accepted March 07, 2023
Available online March 25, 2023

Kata Kunci:
Literasi lingkungan, pendidikan karakter, sikap

Keywords:
Environmental literacy, character education, attitude

ABSTRAK

Kurangnya sikap positif mungkin disebabkan oleh lemahnya implementasi pendidikan lingkungan. Salah satu cara untuk mengatasi masalah tersebut adalah dengan mempersiapkan calon guru PAUD agar memiliki kemampuan menanamkan kepedulian lingkungan kepada anak didiknya sedini mungkin agar anak didik tumbuh menjadi manusia yang peduli terhadap lingkungan. Tujuan dari penelitian ini adalah mengembangkan skenario pelatihan pendidikan lingkungan dengan model Sains, Teknologi, Masyarakat, Lingkungan (STSE) yang diintegrasikan ke dalam pembelajaran tematik saintifik, khususnya bagi calon guru PAUD. Penelitian ini merupakan jenis penelitian pengembangan. Ada tiga aspek yang dinilai oleh para ahli tersebut yaitu kegunaan, akurasi, dan kelayakan dengan menggunakan analisis data kuantitatif dan kualitatif. Penilaian pengguna berasal dari calon guru yang dilakukan melalui wawancara, dan data dari wawancara tersebut dianalisis secara kuantitatif dan kualitatif. Hasilnya melibatkan tiga penilaian ahli di bidang anak usia dini, pendidikan lingkungan, dan teknologi pendidikan, meskipun diperlukan analisis lebih lanjut. Investigasi selanjutnya dilakukan pada subyek kelompok pengguna, menunjukkan nilai positif sebesar 83,3%, dalam mendukung produk tersebut. Dengan demikian, hasil uji efisiensi menunjukkan bahwa pelatihan pendidikan lingkungan dengan menggunakan Pelatihan Pendidikan Lingkungan dengan model STSE dan diintegrasikan dengan pelajaran tematik ilmiah, diketahui meningkatkan 32,44% dari seluruh aspek sikap positif calon guru terhadap lingkungan.

ABSTRACT

The lack of positive attitude may be caused by the weak implementation of environment education. One of the ways to solve the problem is by preparing prospective early childhood teachers to have the ability to instill environment concern to their students as early as possible so that the students grow up becoming people who care about the environment. The purpose of this research is to develop training scenarios on environmental education using Science, Technology, Society, Environment (STSE) model integrated into scientific thematic lessons, particularly for prospective early childhood teachers. This research is kind of development research. There were three aspects assessed by these experts namely usability, accuracy, and feasibility employing quantitative and qualitative data analyses. User judgment came from the prospective teachers done through interviews, and the data from these interviews were analyzed quantitatively and qualitatively. The results involved three expert assessments in the field of early childhood, environmental education, and educational technology, although further analysis is required. Subsequent investigation conducted on the subject user group, indicating a positive value of 83.3%, in support of the product. Therefore, the efficiency test results showed the training on environmental education using the Environmental Education Training with STSE model and integrated with scientific thematic lessons, were known to enhance 32.44% of all aspects of the prospective teacher's positive attitudes on the environment.

*Corresponding author
E-mail addresses: miazar.habibi@unram.ac.id (M.A Muazar Habibi)

1. INTRODUCTION

Low attitudes towards environmental conservation have had an impact on environmental quality in Indonesia. Some data shows about the decline of biodiversity in Indonesia. About 600 plant species are known to have become extinct in the 17th century. This is due to individual activities that have increased the extinction of plant species by a thousand times (Annisa & Rohaeti, 2017; Heni et al., 2019). The area of forests in Indonesia is reduced by more than one million hectares per year. The temporary environmental/ecological damage since 2010 – 2020 has been very concerning, this was stated by the Ministry of Environment (Nurani, N. F., Ridlo, S., & Susilowati, S. M. E. (2020). Environmental damage due to human activities is generally caused by: 1) ignorance of the community to the consequences of their actions, for example throwing garbage in rivers or any place that is not realized will cause pollution, 2) insistence on the needs of life so that unwittingly environmental damaging activities continue to take place as well as destroying forests and the surrounding nature which should be maintained for ecosystem balance, 3) lack of knowledge about the balance and function of the ecosystem, 4) low concern and awareness of the environment, 5) lack of popularization of environmental laws by the government and the application of legal sanctions for violators (Nurani et al., 2020; Uar et al., 2016).

There are several things that underlie the weak human attitude towards the environment as stated by previous study who states that in general individuals lack attitudes towards ecology or the environment because individuals lack understanding of ecological meaning (Yager et al., 2019). Furthermore, other researcher also stated that in order for individuals to have a positive attitude towards the environment, an ability called *Ecological Intelligence* is needed (Eroglu & Erdelhun, 2020). With the *Ecological Intelligence* that the individual has, a process of internalizing values in himself is formed then gives rise to aspects of a positive attitude towards the environment and boils down to awareness of the environment (Goleman, D., L. Bennett, 2012; Setiawan & Mulyati, 2020). Individuals who have ecological intelligence will be able to combine social and emotional abilities, two things that are needed by individuals to understand themselves and the environment beyond their environmentincluding ecological elements. This can be achieved through continuous development of ecological intelligence carried out through formal and non-formal education because it will foster attitudes and awareness towards the environment (*Ecological Awareness*) (Masharova et al., 2020; Shapiro et al., 2016).

Another character who talks about attitudes and awareness of the environment. He said one of the statements that is the key to ecological attitudes in the perspective of ecological psychology is that human experience and behavior (the psychological system), are strongly influenced by events that occur outside the individual (ecological environment) and events within the individual (psychological environment) (H. Akcay & Yager, 2017; Istiana et al., 2018). That one way for individuals to have awareness, sensitivity, empathy, attitudes and environmental intelligence is through a structured set of activities, either through educational activities organized directly in educational institutions or carried out periodically through habituation at home and community environment. (Istiana et al., 2018; Santos & Royer, 2020). Currently, severe damage to the environment appears to be a disturbing situation, due to inadequate display of positive mentality. This is probably attributed to the pathetic appreciation of environmental education. One possible approach to overcome this challenge is to train prospective early childhood teachers to inculcate constructive behavior towards the environment from a very young age. As a result, a community of positive-minded individuals campaigning for sustainable development is assumed to emerge. Moreover, the orientation for elementary teachers is enhanced by modifying early childhood curriculum, through incorporating Childhood Education Teachers Programs in academic courses, and also providing stand-alone trainings as alternatives due to effective and direct implementation (Beasley et al., 2021; Raja & Priya, 2021).

The Science-Technology-Society-Environment (STSE) model essentially provides an understanding of the relationship between science technology and society, training the sensitivity of individual assessments of environmental impacts as a result of the development of science and technology. According to previous study decisions made by society usually require the use of technology to carry them out. In fact, society and science use technology as a means to store information (Lestari et al., 2017). The important role that technology has can serve as a means of action and investigation in the STSE model. Data also implies the nature of science as a field in all societies. The STSE model or often also called the Science-Environment-Technology-Society (SETS) is aimed at helping individuals know science, its development and how the development of science can affect the environment, technology and society reciprocally (Hairida, 2017; Rosario, 2018). This model can at least open up individual insights about the nature of science, environment, technology, and society education or STSE as a whole (B. Akcay & Akcay, 2015; Bettencourt et al., 2013; Heni et al., 2019). The STSE model can connect the real-world life of an individual as a member of society with the classroom as a science learning space. The learning process

that uses this model can provide a learning experience for individuals in identifying potential problems, collecting data related to problems, considering alternative solutions, and considering consequences based on certain decisions (Allchin, 2014; Chowdhury, 2016).

Base on those explanation this development model is outlined in the STSE model book on environmental education training through science lessons to improve the attitudes of ECCE teacher candidates towards the environment, which consists of the STSE Model Book for Environmental Education Training whose content is about Training Guidelines with the Science-Technology-Society-Environment (STSE) model with An Appendix to the Training Materials. The model developed is the only STSE model used as a technique in environmental education training that is integrated with thematic learning with scientific concepts. With this developed model, prospective teachers have the ability to view things in an integrated manner by paying attention to the four elements of the STSE model, so that they can gain a deeper understanding of the knowledge they already have and can be applied in developing environmental attitudes towards.

2. METHOD

This research is more oriented to research and development or Research and Development (RnD), namely research that aims to develop an appropriate product. Products developed with the media and learning methods that synergize with today's technology but without eliminating the conventional approach to learning as a whole commonly used in kindergarten by using themes in every learning process (Gall et al., 2019). In addition, the stages of the development process are products that are considered effective and efficient. In general, it contains three main processes, namely planning, design, and development, along with 3 complementary attributes, namely standard, on going evaluation and project management, some of the topics in this model also include the strategy of developing STSE-based learning that can be used by kindergarten teachers and prospective kindergarten teachers (Sugiyono., 2014). This study was conducted at the PAUD Lenterahati Institution West Lombok Islamic Boarding School West Nusa Tenggara Barat. It is a development research which is a type of descriptive qualitative study. The data were collected by the triangulation or combined technique. And upon analysis of the data, the results emphasize the meaning of generalization. The test subjects of the product are; The initial trial is an expert evaluation or expert test related to Teacher Training experts, Educational Psychology experts and Educational Technology experts while the product effectiveness trial subjects consist of students of the early childhood teacher education program. The steps taken in this development research are shown in Figure 1.

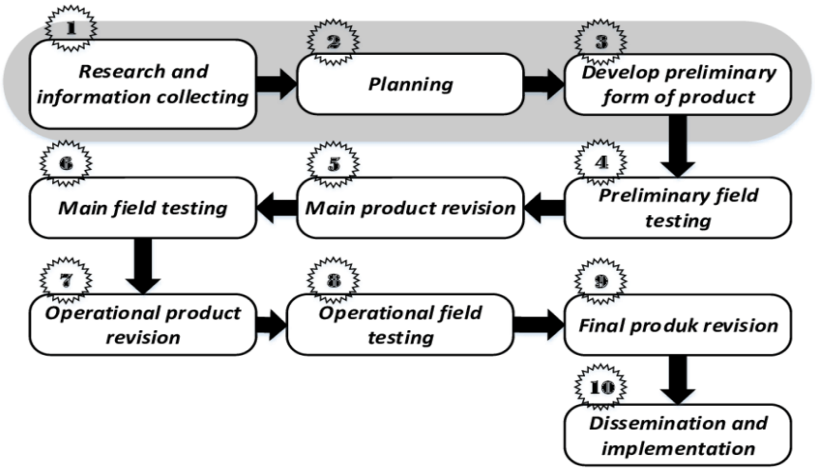

Figure 1. Development Research Flow Theory Research and Development Borg and Gall

Base on Figure 1, the development stages consisting of Stage 1 to 7, starting with data collection, model formation and then its implementation through pre-testing and post-testing, model was applied to develop the product, and the effectiveness was analyzed using t-test, termed pre-test and post-test. The development processes include: 1) preliminary research and data collection, 2) planning, 3) sample design, 4) primary field testing, 5) initial product revision, 6) further field testing and 7) operational product review. However, 8) operational testing, 9) final product revision, and 10) dissemination, were not employed due to certain adjustment to the needs, time, and objectives, this is because of time constraints and this research is only limited to product testing and not up to dissemination. Furthermore, effectiveness experiment was used to determine the product utility in order to increase the positive

attitude. The analysis of the development results based on expert and user group assessments were provided. The specialist's category includes: utility, feasibility, and accuracy. These were performed in the fields of early childhood, environmental education, and educational technology, with the processing of qualitative and quantitative data. Subsequently, the user group was involved with undergraduate students of early childhood education major, through closed interviews and specifying written suggestions on: 1) product contents, 2) writing systematics, 3) layout, and 4) follow-up obtained from the processed data.

3. RESULT AND DISCUSSION

Result

Analysis of Expert Assessment

Quantitative Data; According to the expert for the development of the Science-Technology-Society-Environment (STSE) model , the accuracy and usability aspects are classified as very accurate and very useful. Likewise, the feasibility aspect is classified as very feasible and feasible. Also, the user test results are classified as very accurate and accurate for accuracy, very useful and useful in the aspect of usability and then feasible for the feasibility aspects. Then the next step is to improve based on the advice provided by experts and users. The stages of improvement are: (a) Improvement on the advice based on quantitative values on the assessment instrument, there are no stages of improvement based on these because the results of evaluations from experts and users on usability, accuracy and feasibility are very useful, very accurate and very feasible. (b) Improvement on the advice based on qualitative values are suggestions and notes provided by experts and users.

Based on the expert's advice ; Experts I and II did not provide suggestions for improvement but Expert III did: (a) material in PowerPoint should be more interesting and have a better format, (b) material for implementing activities should always come with introduction, main activities and closing, (c) assignments might be attached as Material 3, (d) at the end of work there should be materials for conclusions, reflections and questions as tasks, (e) there should be material for final evaluation which could be tests, interviews or questions and work products, (f) literature needs to be added to its revisions, and (g) media should be more varied. And all the improvements have been completed according to the expert advice. Based on user's advice; All the three users did not provide suggestions and input for improvement. The only advice given was in aspect of appreciation, hope and utilization of the developed PMB model, which bothers on the fact that the STSE model model was very useful for teachers in increasing their achievement motivation, could be used as a guide or reference in training achievement motivation and that the model is very feasible when it comes to developing the teachers. Development of STSE models for teachers in improving achievement motivation. The analysis of the activity process was reviewed from each aspect of achievement motivation and effectiveness of the STSE model. This sub-focus description includes: (a) analysis of the activity process in each aspect of achievement motivation, and (b) the effectiveness test analysis of the STSE model. Results from Assessment of each Aspect in Table 1.

Table 1. The Percentage of Improvement on each Aspect

Aspect		Pretest	Posttest	Impro-vement
1st aspect	Have a high level of personal responsibility	40%	96%	56%
2nd aspect	Dare to take and carry on the risk	44%	96%	53%
3rd aspect	Have realistic goals	43%	95%	51%
4th aspect	Have a comprehensive work plan and strive to realize goals.	44%	96%	53%
5th aspect	Utilize of concrete feedback in all activities carried out.	40%	96%	56%
6th aspect	Look for opportunities to realize a programmed plan.	44%	96%	52%

Base on Table 1, this data was obtained from expert assessment using questionnaires. Also, the analysis includes: utility, feasibility, and accuracy, as conducted by three professionals of early childhood, environmental education, and educational technology. The results originated from the examination of utility, feasibility and accuracy on training scenarios on environmental education using Environmental Education Training with Science-Technology-Society-Enviroment model integrated into scientific thematic lessons. However, further use and development are possible. These provisions are therefore, employed to train prospective teachers (undergraduate students of early childhood education) to exhibit positive behaviors towards sustaining the environment using Natural Sciences (IPA) learning approach. In terms of feasibility, early childhood education expert stated the training scenario on environmental

education with STSE model, is already sufficient for application. This is captured in a comprehensive discussion between various materials in the publication. Furthermore, in terms of accuracy, the document was considered significant and appropriate for prospective teachers, although there is need to cater for elementary school. Expert II (Environmental Education); The expert was handed the training scenario draft and within of 2 weeks to study, was able to provide significant contributions as follows: 1) there was no clarity of concept in order to ascertain the level of accepted for low or high class, 2) models and materials are based on studies or learning experiences of elementary school, and 3) theme or topics of environmental education are expected to be more specific.

Based on the suggestions and main concepts, efforts at improving the draft are in accordance with provisions from the professionals. Expert III (Educational Technology Expert). The consultant was provided with corrective input on the draft guidebook and training materials, with specified appreciation. Also, certain opinions are deemed urgent based on expert's submission, including: 1). In the manual, the specific objectives to achieve through the training are clearly outlined, 2) pictures are required to facilitate action in each stage, 3) from a technical perspective, the cover design, both in the guidebook and the material, is expected to contain 3 - 4 images, and presented in enlarged format depending on the page, 4) book titles at home appear as a guidebook and material put together, and not barely as attachment, 5) the need to pay careful attention to consistency in terms of using upper and lower case letters, particularly in the book , and 6) layouts are considered, therefore lesser pictures are extended, especially for the cover. Apart from the above suggestions, experts appreciate the benefits of the book, including: 1) the value for prospective teachers as a breakthrough in training systems using Environmental Education Training with STSE approach, 2) appropriate for use due to simpler language and easily comprehended contents, and 3) sufficiency in terms of presentation.

User Group Test Analysis

Quantitative Data; The analysis result conducted by the user group subjects was specified at 83.3%, and was declared suitable to the product. In addition, the assessments were described as show in Table 2.

Table. 2. Tabulation of the field test interviews results

Description	Sb 1	Sb 2	Sb 3	Sb 4	Sb 5	Sb 6
The number of yes answers	5	4	5	5	5	6
The number of no answers	1	2	1	1	1	0
The total yes answer	30 = 83.30 %					
The total no answer	6 = 16.70 %					
Total Answers	36					

Based on Table 2, the subjects generally offered yes answers up to 30 or 83.30%. This denotes several respondents agreed, understood and stated the product as useful. Meanwhile, the no outcomes were barely 6 or 16.70% of the total 36 responses. Specifically, the results are show a total of 6 respondents answered yes. The product useful to prospective teachers, said out of 6 respondents. This shows the other 5 stated the draft was considered quite significant. This training product important to apply in order to increase the prospective teacher's knowledge on environmental education. Eenvironmental education be integrated into scientific thematic lessons in elementary schools. The respondents did not actually comprehend the concept, as observed from the reactions. However, out of 6 submissions, only one selected yes (understand), while the remaining 5 said no. And in order to train students on integrated science lesson model of environmental education with Environmental Education Training with STSE model. Overall, the respondents specified.

The Results of Product Effectiveness Test

The effectiveness test result is believed to be the success of training on environmental education, using the Environmental Education Training STSE model integrated into scientific thematic lessons, as observed in the increase of average score from 2.80 to 3.71, or by 32.44%. This implies the training on environmental education using Environmental Education Training with STSE model, and integrated with scientific thematic lessons, is significant in enhancing positive attitudes of prospective early Childhood teachers towards the environment. Specifically, the results are described as follows (according to the instrument developed by Harlen (1993), termed: 1) the training tends to advance by 21.95% in terms of concern for prospective teachers towards the environment, 2) an increase by 36.40% based on appreciation 3) the inclination by 34.94% in terms of prospective teacher's responsibility towards the environment, and 4) the training enhanced 37.69% of the prospective teacher's attitudes to protect the

environment, 5) the capacity to expand 32.44% of all positive attitudes aspects on prospective early childhood teachers.

Discussion

Referring to previous research that has been published in international journals on the STSE learning model that conducted research on the STSE approach. States that the development of creative thinking skills must be started and honed from the moment the child is in kindergarten and at the earliest possible age (Rosario, 2018). So that everything that the child gets can be absorbed and can be developed optimally by the child, so for that a facilitator is needed who can facilitate the development of creative thinking in children that can be done by a teacher or parent at home. Other study state that increasing the importance of encouragement to be able to improve creative thinking skills where he revealed that at this time children begin to need an impulse to imagine, create, recognize various knowledge and practices (Nurani et al., 2020). So triggering creativity in STEAM learning is needed to improve children's thinking to be more independent and flexible, as well as creative self-efficacy and creative problem-solving skills they also state that Learning in ECCE with (STEAM) Science, Technology, Engineering, Art, And Mathematics to develop children's creativity and apply active and creative learning models, where children play an active role in exploring information about new things in the child's self through the surrounding environment. The implementation pattern of this model uses training techniques given to prospective teachers, namely students of Strata One Early Childhood Education Program, the implementation pattern with this training is because it is based on the fact that training is one way that can change attitudes and increase awareness in trainees in accordance with the training objectives says that the direct goal of the training program is to 1) increase the individual's self-awareness, 2) improve skills in one or more areas, and 3) increase the individual's motivation to carry out his or her duties or work satisfactorily (Yager et al., 2019; Yuliani & Saragih, 2018).

This training pattern uses the *Science-Technology-Society-Environment* (STSE) model through scientific thematic learning aimed at improving the attitude of prospective teachers towards the environment. The lesson used to integrate the *Science-Technology-Society-Environment* (STSE) model is scientific thematic learning because it is based on the environment or the lesson about science is not only a collection of knowledge, because science contains four components, namely: content, process, attitude and technology (Amirshokoohi, 2016; Imaduddin & Khafidin, 2018; Maulidati.S., 2018). In learning science, individuals should not only learn content, but must learn the process of science by using technology in order to create an individual attitude that reflects comprehensive knowledge about science. Therefore, in the purpose of science education, it must be able to develop the ability to participate, creativity and attitudes of individual concern both towards technology, society and the environment.

With scientific thematic learning that aims to develop the ability of cognition, creativity and attitudes of individual concern for technology, society and the environment, it is quite relevant if it provides understanding and fosters an attitude of individual concern for the environment can be used scientific thematic learning (science). One of the thematic concepts of science that can foster the development of elements of attitudes towards the environment is the *Science-Technology-Society-Environment* (STSE) model, because this model is one of the models that can be an alternative to solve problems that exist in society related to technology, social and environment (Arici et al., 2019; Syahmani et al., 2021; Taştan et al., 2018). The *Science-Technology-Society-Environment* (STSE) model is a learning model concept that can be integrated in scientific thematic learning, it aims to open individual insights to understand the nature of science, environment, technology and community education as a whole (Hairida, 2017; Shafi et al., 2019). A number of characteristics of the *Science-Technology-Society-Environment* (STSE) model are aimed at providing contextual science learning, individuals under the situation to utilize the concept of science to the form of technology for the benefit of society, individuals are asked to think about the various possible consequences that can occur from human behavior patterns on the environment. With this model, it will strengthen the ability of individual cognition with relevant knowledge and then it is hoped that individuals will have an attitude that cares about the environment.

In the relationship between the Science-Technology-Society-Environment (STSE) model and scientific thematic learning (Science) is because the *Science-Technology-Society-Environment* (STSE) model applied to the scientific thematic learning process is believed to be able to bring the education system to produce graduates who can apply the knowledge they have gained to improve the quality of human life without having to harm their environment (Martín-Gutiérrez et al., 2017; Rosario, 2018). The characteristics of the *Science-Technology-Society-Environment* (STSE) model in the scientific thematic learning process can be mentioned some of them as follows: 1) aims to provide scientific thematic learning contextually, 2) individuals are brought into situations to utilize the concept of scientific thematic learning to a form of technology for the benefit of society, 3) individuals are asked to think about various

possible consequences that occur in the transfer process the concept of scientific thematic learning to the form of technology, 4) individuals are asked to explain the connection between the elements of the scientific thematic learning concept discussed with other elements in the *Science-Technology-Society-Environment* (STSE) model that affect the various relationships between these elements, 5) individuals are brought to consider the benefits or disadvantages of using scientific thematic learning concepts when changed in the form of relevant technologies, 6) individuals are invited to discuss the *Science-Technology-Society-Environment* (STSE) model from various directions and from various starting points depending on the basic knowledge that the individual has (Nurani et al., 2020; Praseptiangga et al., 2016).

To transform knowledge about science and its relationship with environmental education integrated in scientific thematic learning with the *Science-Technology-Society-Environment* (STSE) model, it is necessary to strengthen the curriculum of the Strata One Early Childhood Education Program, which is the institution where education is held for prospective teachers. So far, to teach environmental education, a teacher only emphasizes concepts with the method of lectures and group discussions in the classroom, therefore prospective teachers need to be introduced to the concept of the Science-Technology-Society-Environment (STSE) model, because this model concept can be used as an alternative in carrying out active learning because of the *Science-Technology-Society-Environment* (STSE) model . combining the concepts of environmental education, science, technology and society as a whole by actively involving students both in the classroom and outside the classroom with fun stages (Assaraf & Orion, 2015; Nieveen, 2019). The nature of the Science-Technology-Society-Environment (STSE) model in education reflects how to do and what the *Science-Technology-Society-Environment* (STSE) model can reach. The Science-Technology-Society-Environment (STSE) model must be able to make individuals who study it, both students, teachers and citizens truly understand the relationship of each element in *Science-Technology-Society-Environment* (STSE) (Nuray & Morgil, 2010; Yörük et al., 2010). The inseparable relationship between science, the environment, technology and society is a two-way reciprocal relationship that can be studied for the benefits and disadvantages it produces. In the end, individuals are able to answer and overcome every problem related to the earth's wealth as well as social issues and global issues, until in the end it boils down to how to behave to the environment (Annisa & Rohaeti, 2017; Praseptiangga et al., 2016). The success of the *Science-Technology-Society-Environment* (STSE) model with sufficient depth is very relevant to solving the problems that plague everyday life. For example, problems of pollution, unemployment, natural disasters, social unrest and others. These issues can be brought indoors or *outdoors* and studied through the *Science-Technology-Society-Environment* (STSE) model to find solutions, at least prevention (Ozer et al., 2021; Yalaki, 2016).

4. CONCLUSION

The efficacy of the results of this research can be emphasized on: The strengths of the Science-Technology-Society-Environment (STSE) model in environmental education training with the *Science-Technology-Society-Environment* (STSE) model through science lessons to improve the attitude of prospective Kindergarten Teachers and Kindergarten Teacher Candidates towards the environmentare: a) This model becomes, the only *Science-Technology-Society-Environment* (STSE) model on environmental education training integrated with science lessons. b) With this developed model, prospective teachers have the ability to look at things integrally by paying attention to the four elements of the *Science-Technology-Society-Environment* (STSE) model, so that they can gain a deeper understanding of the knowledge they already have and can be applied in developing attitudes towards the environment., c) This model is a technique for training prospective teachers to be sensitive to emerging problems in their environment., d) With this model, prospective teachers have concern for the living environment or living system by knowing science, its development and how the development of science can affect the environment, technology and society reciprocally. Aikenhead

5. REFERENCES

Akcay, B., & Akcay, H. (2015). Effectiveness of ScienceTechnology-Society (STS) Instruction on Student Understanding of the Nature of Science and Attitudes toward Science. *International Journal of Education in Mathematics, Science and Technology*, *3*(1), 37. https://doi.org/10.18404/ijemst.50889.

Akcay, H., & Yager, R. E. (2017). The impact of a science/technology/society teaching approach on student learning in five domains. *Journal of Science Education and Technology*, *19*(6), 602–611. https://doi.org/10.1007/s10956-010-9226-7.

Allchin, D. (2014). From science studies to scientific literacy: A view from the classroom. *Science & Education*, *23*, 1911–1932. https://doi.org/10.1007/s11191-013-9672-8.

Amirshokoohi, A. (2016). Impact of STS issue-oriented instruction on pre-service elementary teacher views and perceptions of science, technology, and society. *International Journal of Environmental & Science Education*, *11*(4), 359–387. https://eric.ed.gov/?id=EJ1094628.

Annisa, & Rohaeti, E. (2017). Pengaruh model pembelajaran STM terhadap kemampuan berpikir kritis dan sikap peduli lingkungan. *Jurnal Pendidikan Matematika Dan Sains*, *4*(2), 98–105. http://journal.uny.ac.id/index.php/jpms.

Arici, F., Yildirim, P., Caliklar, Ş., & Yilmaz, R. M. (2019). Research trends in the use of augmented reality in science education: Content and bibliometric mapping analysis. *Computers and Education*, *142*(August), 103647. https://doi.org/10.1016/j.compedu.2019.103647.

Assaraf, O. B., & Orion, N. (2015). Development of system thinking skills in the context of earth system education. *Journal of Research Science Teaching*, *42*(5), 518–560. https://doi.org/10.1002/tea.20061.

Beasley, K., Lee-Hammond, L., & Hesterman, S. (2021). A Framework for Supporting the Development of Botanical Literacies in Early Childhood Education. *International Journal of Early Childhood*, *53*(2), 119–137. https://doi.org/10.1007/s13158-021-00291-x.

Bettencourt, C., Velho, J. L., & Almeida, P. . (2013). Biology teachers' perceptions about ScienceTechnology-Society (STS) education. *Procedia-Social and Behavioral Sciences*, *15*, 3148– 3152. https://doi.org/10.1016/j.sbspro.2011.04.262.

Chowdhury, M. A. (2016). Integration of STS/STSE and SSI for effective science education and science teaching. *Electronic Journal for Research in Science & Mathematics Education (EJRSME)*, *20*(5). https://ejrsme.icrsme.com/article/view/16006.

Eroglu, G., & Erdelhun, B. (2020). Identification of Endangered Species in Karpasia National Park (Cyprus) and Their National HAbitats, and Attitude of Local Students Towards Such Species and Habitats. *Revista Argentina de Clínica Psicológica*, *XXIX*(5), 1860–1863. https://doi.org/10.24205/03276716.2020.1181.

Gall, M. D., Gall, J. P., & Borg, W. R. (2019). *Educational research: An introduction* (7th ed.). Allyn and Bacon.

Goleman, D., L. Bennett, and Z. B. (2012). Ecoliterate: How Educators Are Cultivating Emotional. *Social and Ecological Intelligence*.

Hairida, H. (2017). Using Learning Science, Environment, Technology and Society (SETS) Local Wisdom and based Colloids Teaching Material. *JETL (Journal Of Education, Teaching and Learning)*, *2*(1), 84–89. https://doi.org/10.26737/jetl.v2i1.146.

Heni, D. N., Binadja, A., & Sulistyorini, S. (2019). Pengembangan perangkat pembelajaran tematik bervisi SETS berkarakter peduli lingkungan. *Journal of Primary Education*, *4*(1), 30–35. https://journal.unnes.ac.id/sju/index.php/jpe/article/view/6919.

Imaduddin, M., & Khafidin, Z. (2018). Ayo Belajar IPA dari Ulama: Pembelajaran Berbasis Socio-Scientific Issues di Abad ke-21. *Thabiea : Journal of Natural Science Teaching*, *1*(2), 102. https://doi.org/10.21043/thabiea.v1i2.4439.

Istiana, R., Islamiah, N. I., & Sutjihati, S. (2018). Analisis Sequential Explanatory Partisipasi Siswa Dalam Pelestarian Lingkungan Ditinjau Dari Aspek Persepsi Siswa Tentang Sekolah Berbudaya Lingkungan. *Jurnal Ilmiah Pendidikan Lingkungan Dan Pembangunan*, *19*(02), 15–26. https://doi.org/10.21009/plpb.192.02.

Lestari, H., Ayub, S., & Hikmawati, H. (2017). Penerapan Model Pembelajaran Sains Teknologi Masyarakat (STM) untuk Meningkatkan Hasil Belajar Fisika Siswa Kelas VIII SMPN 3 Mataram. *Jurnal Pendidikan Fisika Dan Teknologi*, *2*(3), 111–115. https://doi.org/10.29303/jpft.v2i3.297.

Martín-Gutiérrez, J., Mora, C. E., Añorbe-Díaz, B., & González-Marrero, A. (2017). Virtual Technologies Trends in Education. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(2), 469–486. https://doi.org/10.12973/eurasia.2017.00626a.

Masharova, T. V., Mikhlyakova, E. A., Krukovskiy, V. Y., & Yang, G. (2020). The use of cloud services to enhance information interaction in e-learning to improve the quality of educational results. *Perspektivy Nauki i Obrazovania*, *47*(5), 384–397. https://doi.org/10.32744/pse.2020.5.27.

Maulidati.S. (2018). Pengaruh Pembelajaran Berbendekatan Saintifik Berorientasi Science Environment Technology Society Terhadap Kemampuan Berpikir Kritis dan Hasil Belajar IPA Siswa Kelas V. *Jurnal Pendidikan Dasar Indonesia*, *2*(2). https://ejournal-pasca.undiksha.ac.id/index.php/jurnal_pendas/article/view/2693/0.

Nieveen, N. (2019). Prototyping to reach product quality. *In Design Approaches and Tools in Education and Training*, 125–135. https://doi.org/10.1007/978-94-011-4255-7_10.

Nurani, N. F., Ridlo, S., & Susilowati, S. M. E. (2020). Pengembangan modul pendidikan lingkungan hidup (PLH) berbasis karakter untuk menumbuhkan wawasan dan karakter peduli lingkungan. *Unnes Journal of Biology Education*, *3*(1), 53–60. https://journal.unnes.ac.id/sju/index.php/ujbe/article/view/4155.

Nuray, Y., & Morgil, I. (2010). The effects of science, technology, society, environment (STSE) interactions on teaching chemistry. *Natural Science*, *1*(12), 1417. https://doi.org/10.4236/ns.2010.212173.

Ozer, S., Kiray, S. A., & Cardak, O. (2021). Science Teacher Candidates' Views about Science-Technology-Society-Environment Relations. *Eurasian Journal of Educational Research*, *91*, 83–103. https://eric.ed.gov/?id=EJ1284056.

Praseptiangga, D., Aviany, T., & Parnanto, N. (2016). Pengaruh Penambahan Gum Arab terhadap Karakteristik Fisikokimia dan Sensoris Fruit Leather Nangka (Artocarpus heterophyllus). *Jurnal Teknologi Hasil Pertanian*, *9*(1). https://doi.org/10.20961/jthp.v9i2.12858.

Raja, M., & Priya, G. G. L. (2021). An Analysis of Virtual Reality Usage through a Descriptive Research Analysis on School Students' Experiences: A Study from India. *International Journal of Early Childhood Special Education*, *13*(2), 990–1005. https://doi.org/10.9756/INT-JECSE/V13I2.211142.

Rosario, B. I. D. (2018). Science, Technology, Society and Environment (STSE) approach in environmental science for nonscience students in a local culture. *DDC Professional Journal*, *1*(1). https://ejournals.ph/article.php?id=700 S.

Santos, B. F. G. S., & Royer, M. R. (2020). The development of critical thinking on environmental education and the environment: project of high school students from Uniflor – PR. *Revista Prática Docente*, *5*(1), 234–248. https://periodicos.cfs.ifmt.edu.br/periodicos/index.php/rpd/article/download/578/268.

Setiawan, I., & Mulyati, S. (2020). Pembelajaran Ips Berbasis Kearifan Lokal. *Jurnal Ilmiah Pendidikan Dasar*, *7*(2), 121–133. https://doi.org/10.30659/pendas.7.2.121-133.

Shafi, A., Saeed, S., Bamarouf, Y. A., Iqbal, S. Z., Min-Allah, N., & Alqahtani, M. A. (2019). Student Outcomes Assessment Methodology for ABET Accreditation: A Case Study of Computer Science and Computer Information Systems Programs. *IEEE Access*, *7*, 13653–13667. https://doi.org/10.1109/ACCESS.2019.2894066.

Shapiro, H. G., Erickson, K. A., Peterson, M. N., Frew, K. N., Stevenson, K. T., & Langerhans, R. B. (2016). Which species to conserve: evaluating children's species-based conservation priorities. *Biodiversity and Conservation*, *25*(3), 539–553. https://doi.org/10.1007/s10531-016-1067-0.

Sugiyono. (2014). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Syahmani, S., Hafizah, E., Sauqina, S., Adnan, M. Bin, & Ibrahim, M. H. (2021). STEAM Approach to Improve Environmental Education Innovation and Literacy in Waste Management: Bibliometric Research. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, *3*(2), 130–141. https://doi.org/10.23917/ijolae.v3i2.12782.

Taştan, S. B., Mehdi, S., Davoudi, M., Masalimova, A. R., Bersanov, A. S., Kurbanov, R. A., Boiarchuk, A. V, & Pavlushin, A. A. (2018). The Impacts of Teacher's Efficacy and Motivation on Student's Academic Achievement in Science Education among Secondary and High School Students. *EURASIA Journal of Mathematics Science and Technology Education*, *14*(6), 2353–2366. https://doi.org/10.29333/ejmste/89579.

Uar, N. D., Murti, S. H., & Hadisusanto, S. (2016). Kerusakan lingkungan akibat aktivitas manusia pada ekosistem terumbu karang. *Majalah Geografi Indonesia*, *30*(1), 88–95. https://doi.org/10.22146/mgi.15626.

Yager, R. E., Choi, A., Yager, S. O., & Akcay, H. (2019). A comparison of student learning in STS vs those in directed inquiry classes. *Electronic Journal of Science Education*, *13*(2), 186–208. https://ejse.southwestern.edu/article/view/7805.

Yalaki, Y. (2016). Improving university students' science-technology-society-environment competencies. *International Journal of Progressive Education*, *12*(1), 90–98. https://dergipark.org.tr/en/pub/ijpe/issue/26318/277360.

Yörük, N., Morgil, I., & Seçken, N. (2010). The effects of science, technology, society, environment (STSE) interactions on teaching chemistry. *Natural Science*, *1*(12), 1417–1424. https://doi.org/10.4236/ns.2010.212173.

Yuliani, K., & Saragih, S. (2018). The development of learning devices based guided discovery model to improve understanding concept and critical thinking mathematically ability of students at islamic junior high school of Medan. *Journal of Education and Practice*, *6*(24), 116–128. https://files.eric.ed.gov/fulltext/EJ1078880.pdf .