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Transformation of Science Literacy in Elementary Schools: Guided Inquiry Learning Model-Based Teacher Training with PhET Simulation in Pringsewu Regency Elementary School

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2. Guided Inquiry Learning
3. PhET Simulations

The purpose of carrying out this community service activity is to provide understanding and train stakeholders in implementing technology-integrated learning in elementary schools in Pringsewu Regency. The specific target to be achieved is that participants can implement the PhET Simulations-based guided inquiry learning model in their respective classes so that they can improve students' science literacy. The methods used to achieve the goals and targets are (1) expository: presenting and conveying information about 21st century learning, learning models and media; (2) tutorials and mentoring: providing procedures for implementing the integrated guided inquiry model learning of PhET Simulations; (3) assignments and discussions: designing group learning; (4) role playing: implementation of guided inquiry learning integrated with PhET Simulations through teaching

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practice; (5) carry out pretest and posttest; and (6) reflection and evaluation: discussion of challenges and solutions faced during teaching practice. The target of the activity was teachers and principals of elementary schools in Gadingrejo District, Pringsewu Regency. The expected result is that teachers are able to carry out guided inquiry learning integrated with PhET Simulations to improve students' science literacy. The results obtained from this service activity are an increase in teachers' understanding of 21st century learning, the importance of science literacy is reminded from an early age in elementary schools in Gadingrejo District, Pringsewu Regency. In addition, participants were able to implement the PhET Simulations integrated guided inquiry learning model well through classroom learning and reflect and evaluate the course of learning related to the challenges faced and the solution efforts.

Kata Kunci:
1. Literasi sains
2. Pembelajaran Berbasis Penemuan Terarah
3. Simulasi PhET

Tujuan pelaksanaan kegiatan pelayanan masyarakat ini adalah untuk memberikan pemahaman dan melatih para pemangku kepentingan dalam menerapkan pembelajaran terintegrasi teknologi di sekolah dasar di Kabupaten Pringsewu. Tujuan spesifik yang ingin dicapai adalah agar peserta dapat menerapkan model pembelajaran inquiry terarah berbasis simulasi PhET di kelas masing-masing sehingga dapat meningkatkan literasi sains siswa. Metode yang digunakan untuk mencapai tujuan dan sasaran tersebut adalah (1) ekspositori: menyajikan dan menyampaikan informasi tentang pembelajaran abad ke-21, model pembelajaran, dan media; (2) tutorial dan bimbingan: memberikan prosedur untuk menerapkan model pembelajaran inkuiri terarah terintegrasi PhET Simulations; (3) tugas dan diskusi: merancang pembelajaran berkelompok; (4) peran bermain: implementasi pembelajaran inkuiri terarah terintegrasi dengan PhET Simulations melalui praktik mengajar; (5) melaksanakan pretest dan posttest; dan (6) refleksi dan evaluasi: diskusi tentang tantangan dan solusi yang dihadapi selama praktik mengajar. Sasaran kegiatan ini adalah guru dan kepala sekolah di Sekolah Dasar di Kecamatan Gadingrejo, Kabupaten Pringsewu. Hasil yang diharapkan adalah guru mampu melaksanakan pembelajaran inkuiri terarah yang terintegrasi dengan PhET Simulations untuk meningkatkan literasi sains siswa. Hasil yang diperoleh dari kegiatan layanan ini adalah peningkatan pemahaman guru tentang pembelajaran abad ke-21, serta pengingat akan pentingnya literasi sains sejak dini di sekolah dasar di Kecamatan Gadingrejo, Kabupaten Pringsewu. Selain itu, peserta mampu menerapkan model pembelajaran terpadu berbasis simulasi PhET dengan baik melalui pembelajaran di kelas, serta merefleksikan dan mengevaluasi proses pembelajaran terkait tantangan yang dihadapi dan upaya penyelesaiannya.

1. INTRODUCTION

Education is the key to improving the quality of life. Education is currently in the era of digitalization which refers to the use of technology as part of daily life. Digitalization has a significant impact on the integration of technology in learning in schools, especially at the elementary

school level. The modernization also affects literacy and numeracy skills.

Literacy and numeracy skills in 21st century education are fundamental things that students must have. Through a survey conducted by the Programme of International Students Assessment (PISA), literacy and numeracy are the two main aspects that are assessed to determine the education ranking of a country at the international level. One of the aspects of literacy that is assessed is science literacy. Science literacy is the fundamental basis of science education so that students are able to utilize knowledge in science to formulate hypotheses, draw conclusions and make decisions based on the data obtained (Effendi et al., 2021; MM et al., 2020; Widiyanti et al., 2015). Science literacy is expected to develop human resources who have logical and structured thinking so that there is no doubt.

Based on the results of PISA organized by the Organization for Economic Cooperation and Development (OECD), the science literacy ability of students in Indonesia is still relatively low. In 2022, the survey results stated that Indonesia obtained a score of 383 from the OECD average of 384. This score is down from 2018 which received a score of 396, but Indonesia's science literacy has increased by 6 ranks. Although this score shows the resilience of the Indonesian education system in overcoming learning loss, it still needs to be improved because it is still below the OECD average score, which means it is still below international standards (Ministry of Education and Culture, 2023).

The low science literacy ability of elementary school students was also found in one of the schools in Pringsewu Regency. The survey was conducted through the results of IPAS learning which is an indication of the high and low science literacy skills of students. It was found that there were only 9 out of 41 students in class V who achieved the Learning Goal Achievement Criteria (KKTP) ≥ 70 in the science subjects at STS Odd for the 2024/2025 Academic Year. In addition, based on the results of interviews with several educators, data was obtained that students did not have a high interest in reading, the test questions given to students were not in accordance with the domain of science literacy, and educators had not carried out science learning optimally by prioritizing students' scientific competence.

The problem of low science literacy skills in Pringsewu Regency is the impact of the lack of awareness of educators to participate in intensive training on scientific learning. Most educators find it difficult to design learning activities that encourage critical thinking and knowledge discovery by learners. This also causes students' engagement and motivation to learn in science to be low.

The low ability of science literacy among students must receive serious attention so that the educational environment formed can have a positive impact on improving science literacy. One of the first steps to improve science literacy skills in elementary schools, especially in Pringsewu Regency, is to hold a Workshop on Improving Science Literacy Using the PhET Simulations-Based Guided Inquiry Learning Model. The guided inquiry learning model was chosen because through this model, the activeness of students is prioritized while educators function as companions in facilitating scientific exploration based on scientific approaches (Istqomah and Hariyono, 2019). In addition, the guided inquiry learning model is better than other models because the learning carried out relates the material to the life around the students and supports its application in daily life (Dewi and Sunarti, 2018).

The application of the guided inquiry learning model can be integrated with learning media. One of the learning media that can be integrated so that it can improve students' science literacy skills is PhET Simulations. The use of PhET Simulations media makes it easier for students to understand the concepts learned (Price et al., 2017; Salame and Makki, 2021). The combination of the guided inquiry learning model with PhET Simulations can improve students' science literacy skills (Suarmika et al., 2024). Therefore, the existence of this workshop is expected to optimize the performance of educators in the implementation of science learning that prioritizes the active role of students, so that it can be realized to improve the science literacy skills of elementary school students in Pringsewu Regency.

2. METHOD

This community service research uses a role playing approach. The approach was chosen with the intention that the participants understand classroom management and implement technology-based learning. The role playing approach is carried out through

the implementation of the guided inquiry learning model based on the media of PhET Simulations.

In more detail, the methods are as follows.

a. Preparation: providing reinforcement for participants so that they can prepare science learning scenarios with a *guided inquiry learning* model integrated with PhET Simulations media and direct experiment-based learning and hypothesis proofing well.
b. Tutorials and Mentoring: at this stage, participants were given material to introduce science literacy and provide information and materials about the *guided inquiry learning model* and PhET Simulations media. This stage is carried out with material presentations and provides tutorials on the application *of the PhET Simulations-based guided inquiry learning* model, as well as examples of learning plans (teaching modules).
c. Assignments and Discussions: are carried out by providing instructions to *workshop* participants to plan learning and determine topics that are in accordance with the science learning features in PhET Simulations. The assignment was carried out in groups in order to discuss creating a learning environment that prioritizes cooperation.
d. Practice Practice: Practice practice activities (*role playing*) are carried out by applying the *guided inquiry learning* model integrated with PhET Simulations through classroom learning or *microteaching*.
e. Implementation of *Pretest* and *Posttest*: this stage is carried out to measure the improvement of the ability of workshop participants to guide *inquiry learning materials* based on PhET Simulations.

Reflection and Evaluation: this stage is carried out through discussion of the challenges faced during the implementation of integrated *guided inquiry* learning of PhET Simulations and efforts to deal with these challenges.

3. RESULTS AND DISCUSSION

Results

Efforts to improve science literacy skills from an early age need to be pursued as much as possible, considering that science literacy is part of the literacy skills needed by 21st century students. Improving science literacy skills with the

implementation of the guided inquiry learning model integrated with PhET Simulations media is one of the steps that can be taken by educators. However, the reality is that there are still many educators who have not implemented discovery-based learning models such as inquiry. In addition, it is still rare for educators to use digital media, such as PhET Simulations that can help learning. In fact, there are still many schools in each district/city that have not implemented the guided inquiry learning model integrated with PhET Simulations media.

In internalizing the PhET Simulations integrated guided inquiry learning model so that it can be applied in elementary schools, it is important to carry out service. Community service activities were carried out at SD Negeri 2 Bulurejo, Gadingrejo District, Pringsewu Regency. The participants involved were 21 teachers and principals, consisting of 20 teachers and 1 principal. The implementation of service began by carrying out a pretest. The results of the existing pretest are a benchmark for achieving changes in terms of knowledge and skills to the integrated guided inquiry learning model of PhET Simulations. Next, it is to carry out the presentation of presentation materials on 21st century learning, science learning (IPAS), models and learning media. The last stage is the implementation of posttest as well as evaluation of the practice carried out by educators in implementing the PhET Simulations integrated guided inquiry learning model.Pretest and posttest are conducted using the Wayground platform.

Figure 1. Participants Do The *pretest*

Figure 2. GIL and PhET Socialization

Figure 3. Participants do the posttest

Based on the results of the workshop on improving science literacy by using the PhET Simulations-based guided inquiry learning model for educators and elementary school principals in Pringsewu Regency, it was marked by the workshop participants' understanding of teaching practices with the guided inquiry learning modelbased on PhET Simulations on the importance of improving students' science literacy skills. It can be seen through the following bar diagram which explains the difference in understanding of the PhET Simulations-based guided inquiry learning model before and after the implementation of the workshop through pretest and posttest data.

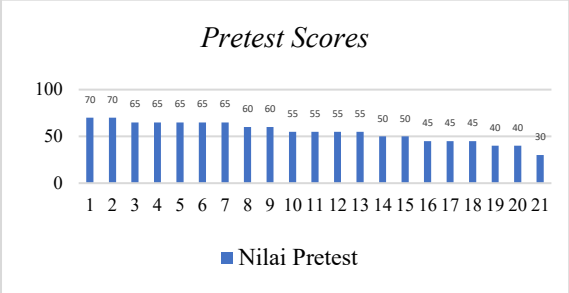

Figure 4. Bar chart *pretest* devotion or initial understanding

Based on figure 4, it is known that before being given training to 21 participants, the participant's score was not below 30. Scores of 0 – 25 were 0 participants, scores of 26 – 50 were 8 participants, scores of 51 – 75 were 13 participants, and scores of 76 – 100 were 0 participants. It can be concluded that almost most of the participants in the initial ability of *the PhET Simulations-based guided inquiry learning* model are classified as not very well understood. There were only 2 participants with a score of 70. The average pretest score of participants was 54.76 with the category of "understanding". However, the score indicates a lack of comprehensiveness. This situation is characterized by participants only being able to explain in general *the guided inquiry learning* model and PhET Simulations, but have not specifically been able to understand their implementation well in the classroom as an effort to improve the science literacy of

elementary school students in Pringsewu Regency.

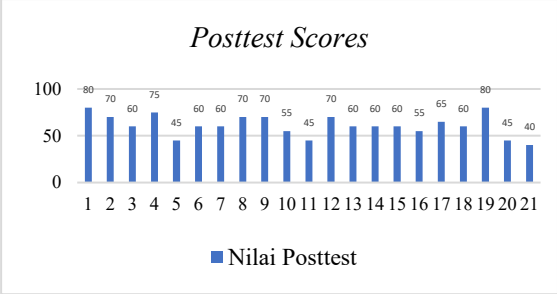

Figure 5. Bar chart *Posttest* of final understanding

Based on figure 5, it is known that after being given training, 21 participants experienced an increase in posttest scores. The lowest score is 40 and the highest score is 80. Scores 0 – 25 were 0 participants, scores were 26 – 50 were 4 participants, scores were 51 – 75 were 15 participants, and scores were 76 – 100 were 2 participants. It can be concluded that most of the participants experienced an increase in grades which indicates that they began to comprehensively understand the guided inquiry learning model and PhET Simulations. Participants were able to explain the specifics of the learning steps of the guided inquiry learning model and the application of PhET Simulations in learning in improving students' science literacy skills. The average score in the posttest was 61.19 where the participants' understanding was categorized as "understanding". Although there was no change in the category, the increase in the average score of participants indicated that the workshop was able to improve participants' understanding well.

Based on figures 4 and 5, the results of the participants' pretest and posttest were used to measure the extent of participants' understanding in understanding the guided inquiry learning model and PhET Simulations in improving science literacy skills so that it was known that:

1. There were no participants with *pretest* and *posttest* scores ≤ 25.
2. Participants with a score of 26 ≤ *pretest* ≤ 50 as many as 8 participants, after the workshop was reduced to 4 participants with the category of understanding enough.
3. Participants with a score of 51 ≤ *pretest* ≤ 75 as many as 13 participants, after the workshop increased to 15 participants in the category of understanding.
4. Participants with a score of 76 ≤ *pretest* ≤ 100 as many as 0 participants, after the workshop increased to 2 participants with the category of very understanding.

Discussion

This service activity started from critical agnostic to the condition of science learning in elementary schools in Pringsewu Regency. Preliminary data showing that students' science literacy skills are still relatively low and worrying is evidenced by the existence of only 21.9% in one of the schools, where 9 out of 41 students who achieved KKTP ≥ 70. The existence of this gap is a reflection of the larger challenges in the national education system.

The problem at the educator level in Pringsewu Regency is that the majority of educators still have difficulty in designing student-centered learning and encouraging independent knowledge discovery. Learning that tends to be conventional by relying on books and lectures results in low student engagement and motivation to learn. Therefore, there is a need for solutions in providing knowledge and training on how to design and implement integrated learning models with digital media in the current era to boost students' science literacy skills.

Rooted in the above problems, we invite educators in Pringsewu Regency to practice designing and implementing learning properly. One of them is by participating in PhET Simulations-based guided inquiry learning model training activities in order to improve the science literacy skills of elementary school students. Given the importance of science literacy as a fundamental aspect of science education.

The guided inquiry learning model integrated with PhET Simulations media is an important need in an effort to improve the science literacy skills of students in elementary schools, especially in Pringsewu Regency. This community service activity was carried out to overcome the challenges faced by educators. As we know, planning learning well is the role of educators in achieving learning goals (Firman and Anhusadar, 2022).

The guided inquiry learning model was chosen in this service theme because this model prioritizes the active role of students with educators as facilitators in scientific exploration with a scientific approach. This model is considered more effective because it links learning to the lives around students and supports its application in daily life (Prasetiyo and Rosy, 2021). The integration of PhET Simulations media in this model makes it easier for students to understand the concepts learned (Serevina et al., 2021). The existence of this integration produces an effective

combination in increasing students' science literacy. Therefore, this workshop activity is a strategic first step to optimize the performance of educators in the implementation of active and technology-integrated science learning to support the improvement of science literacy.

The service activity carried out at SD Negeri 2 Bulurejo, Gadingrejo District, Pringsewu Regency, showed the results of an increase in participants' understanding of the PhET Simulations-based guided inquiry learning model and the importance of improving students' science literacy which was marked by an average increase from 54.76 to 61.19. This increase indicates that participants have been able to explain in detail the learning steps of the guided inquiry learning model and PhET Simulations media to improve students' science literacy skills. In addition, the increase in understanding was marked by an increase in posttest scores obtained by workshop participants. This increase indicates that participants have a better understanding of the PhET Simulations-based guided inquiry learning model and its implementation in learning.

Participants show high enthusiasm, actively participate in discussions and start implementing learning by prioritizing the active role and involvement of learners through the models and media used. The discussion activity at this service showed extraordinary participation from the participants. Workshop participants in each group discussed material that was suitable and suitable for application with the guided inquiry learning model and PhET Simulations media who then took turns expressing their opinions.

Figure 6. Discussion

This discussion activity was carried out to transform the theoretical understanding of educators into practical skills that are ready to be implemented in classroom learning.

Although it showed positive results after the implementation of service activities, there were challenges experienced by workshop participants, namely that educators needed more time

in designing and implementing the learning plans that had been made so that they could be implemented properly and optimally. Therefore, as a follow-up, it is recommended that there be contributions from other learning models and media to be applied in learning to improve students' science literacy skills. In addition, further and continuous assistance is needed to ensure that the implementation of the PhET Simulations-based guided inquiry learning model is more optimal in the classroom.

4. REFERENCES

This training activity through community service was held for 3 days and received an extraordinary response from the participants. This situation can be seen in the enthusiasm of the participants in participating in this training where they actively participate in discussion activities and teaching practices using the PhET Simulations integrated guided inquiry learning model. This activity was also supported by the committee and the Principal of SD Negeri 2 Bulurejo. The results that have been obtained from this training are an increase in participants' understanding of organizing learning with the guided inquiry learning model integrated with PhET Simulations media, marked by an increase in posttest results. Participants have already started to apply well through hands-on practice in the classroom.

Educators' efforts in implementing learning after the implementation of this training prioritize the active role of students through the learning models and media used. The implementation of the PhET Simulations-based guided inquiry learning model has yielded significant results for the implementation of learning that prioritizes the enthusiasm and activeness of students in exploring their knowledge independently. However, there are challenges experienced by workshop participants, namely educators who need more time in designing and implementing the learning plans that have been made so that they can be implemented properly so that they can improve students' science literacy skills more optimally.

Thus, this service report is prepared to be a reference material in improving students' science literacy skills by using the PhET Simulations-based guided inquiry learning model in the basic curriculum. It is realized that in the implementation of activities there are still many shortcomings so that it is still far from perfection. Therefore, there is a need for contributions from other

learning models and media so that they can enrich the treasures of knowledge in an effort to improve students' science literacy skills to realize increasingly qualified 21st century skills in Indonesia. Educators are also expected to always take part in trainings to be able to improve the quality of learning for students.

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