Learning Physics Using Search, Solve, Create, Share and Preview, Question, Read, Reflect, Recite, Review Models Analyzed from Critical Thinking and Problem-solving Skills on Student Learning Outcomes

Santi Eka Ambaryani*, Sarwanto, Sri Budiawanti

Master in Physics Education, Sebelas Maret University, Jl. Ir Sutami 36 Keningan, Jebres, Surakarta, Central Java, Indonesia.

Email: ambaryani_santi14@student.uns.ac.id

DOI: 10.24815/jpsi.v6i3.25143

Abstract. Problem in this research is students’ critical thinking and problem solving skills on learning physics still in low category. The aim of this research is to determine the effect of applying SSCS and PQ4R models, the effect of critical thinking and problem solving skills and their interactions on student learning outcomes. The research used an experimental method and a scientific approach with the research population of all students of class XI IPA SMAN 1 Karanganyar in the 2021/2022. The research sample was determined by cluster random sampling. The experimental class 1 is class XI IPA3 with SSCS model, while experimental class 2 is class XI IPA4 with PQ4R model. The data collection technique used the test method for student learning outcomes data while the questionnaire method for data on students’ critical thinking skills and problem solving skills. The data analysis technique used the Anova test. The results concluded that (1) there is a difference in learning outcomes between students who apply SSCS and PQ4R models, learning outcomes where high critical thinking and problem solving student have better outcome than the low one, (2) there is an interaction between learning models, critical thinking and problem solving skills on student learning outcomes.

Keywords: SSCS Model, PQ4R Model, Critical Thinking, Problem Solving Skills, Learning Outcomes

Introduction

The physics learning process essentially requires high reasoning to understand concepts when solving problems and critical thinking skills in determining the right strategy when solving further problems. The learning process must change the knowledge and skills of students permanently. Therefore, teachers must prepare appropriate approaches, models, methods, and learning strategies to support the achievement of learning objectives. Problems that arise in the scope of physics learning often occur when students are unable to recognize the problems they are facing and students are less able to find the right solution for solving existing problems. Students can be said to be able to solve physics problems if they are able to understand the problem, plan problem-solving strategies, carry out calculations step by step in a coherent and precise manner, and review the results of the work that has been done (Winarti et al., 2017). Taking responsibility in problem based learning is one of the main important things that students have to do, for example they...
should do research, discuss, and eliminate the hypothesis and write the findings by themselves (Alper, 2008).

The reality that occurs in the field, students are still experiencing difficulties and obstacles in developing their critical thinking skills in solving physics problems. Efforts to develop critical thinking skills are still rarely carried out by teachers and less attention is paid to physics learning. Other facts that support the statement of weak problem-solving skills and critical thinking are known from students who have lost their sense of learning (Indrianingtyas et al., 2020). Students are used to being passive and just accepting what the teacher says so that students are not accustomed to thinking critically. Meanwhile, higher order thinking skills such as critical thinking skills and problem solving skills are a challenge for teachers to face competence in the 21st century. The results of research by Baidu & Anggo, (2016) is the learning outcomes of students in the critical thinking test Trial, around 77.27% are still below expected average value. This is because the ability of students to solve problems is still weak, decision-making skills, critical thinking skills and creative thinking skills. Students inabilities to self-regulated and be aware of their thinking process cause problems during mathematical problem solving, especially with word problems (Abdullah et al., 2014).

The evident is strengthen from the students interview which resulted that they have difficulty in understanding and connecting the data presented in the question sheet with the equations that will be used to solve the problem. Students feel that physics lessons have a lot of similarities and material that must be understood. Meanwhile, during this online learning, teachers rarely provide material and explanations, where the teacher only gives assignments. Students also said that when the teaching and learning process took place they understood what the teacher explained and were able to complete the practice questions given. However, when learning is over and the teacher gives assignments with the same discussion material, students are still overwhelmed in interpreting questions of various types and relating them to the appropriate equation for solving the problem. Students are also not precise in applying and processing equations on static fluid material. In line with research Purnamasari, (2017) students tend to memorize every formula given by the teacher without understanding the physical meaning of each formula. Students are often aware of these difficulties, but are still unable to overcome them. On the other hand, successful students spend most of their time analyzing the problem and making sure that they understand it (Sahin & Kendir, 2013).

Problem solving ability of students in physics material is the lack of understanding of students in solving problems in the form of stories and connecting them with mathematical models of the problems given. While physics lessons cannot be separated from solving problems that have various types of solutions. If classroom learning is carried out by intensifying the provision of practice questions, students will be trained and get used to finding, deciding, and using the right solution. However, the teacher must also direct students to organize their skills when understanding the concepts of the material being studied by providing explanations or directions for searching and reading from various sources of information. So that there is an active interaction between teachers and students while learning. Through problem solving activities can provide wide opportunity for students to exchange ideas or opinions as well as higher order thinking (including critical thinking) so as to attain new understanding of the concept being studied (Rezkillah & Haryanto, 2021). On the other hand, physics learning activities in solving problems in the questions should involve the learners’ cognitive and metacognitive activities (Winarti et al., 2022).

The cognitive learning outcomes of SMAN 1 Karanganyar students on static fluid material, there are still some students who have not completed the minimum completeness criteria. Students have difficulty in explaining floating, floating and sinking events.
Students are also not precise in applying and processing equations on static fluid material. In line with the research of Purnami et al., (2017) students tend to memorize every formula given by the teacher without understanding the physical meaning of each formula. Students who fail to understand a concept will have a negative impact on the problem solving process. Physics learning at SMAN 1 Karanganyar should apply innovative learning models such as SSCS and PQ4R models to improve student learning outcomes. Pizzini states that SSCS learning model refers to four phases of problem solving, namely investigating problems (search), planning problem solving (solve), constructing problems (create), and communicating the problem solving obtained (share) (Irwan, 2010). In addition to the application of the SSCS learning model, a learning approach was also carried out using PQ4R model. PQ4R model can help students remember what they have read and teach students how to learn, how to remember, and how to think. According to Widiyanti, (2014) PQ4R model consists of six steps, namely: Preview, Question, Read, Reflect, Recite, and Review.

The application of SSCS learning model is very appropriate to use to improve the ability to create mathematical models and students' cooperation in solving problems in coherent and detailed steps (Mulyana et al., 2018). SSCS model is effectively applied to improve critical thinking skills as evidenced by the test results of students' critical thinking skills in the experimental class which are 0.25 higher than the control class. The application of this SSCS model also received very good responses from students (Hatari, 2016). Yulianawati et al., (2016) stated that success in solving problems depends on students' awareness of what they know and how they do it. Therefore, in the process of learning physics there must be a balance in doing and thinking. SSCS learning involves students' learning experiences in developing critical thinking skills, asking questions, thinking and sharing (Irwan, 2010; Johan, 2012). The SSCS model is effective for improving students' problem solving and critical thinking skills (Milama et al., 2017; Zahroh, 2018).

The PQ4R model directs students to ask questions and encourages students to process the material more deeply and broadly. The results of Wijayanto's research (2018) conclude, the use of PQ4R learning model combined with a scientific approach shows the effect of activity on students' mathematical problem solving abilities is quite high, so teachers must be innovative in determining approaches and learning models that can support the activeness of their students. The results of research Budi Wibowo, (2016) confirm the influence of the learning model with SSCS and PQ4R models on learning achievement. And there is an interaction between SSCS and PQ4R models, motivation, and the level of abstract thinking on learning achievement. Through the SSCS learning model, students will be trained to master mathematical reflective thinking skill and mathematical problem solving abilities (Yasin, 2019).

Based on the description above, SSCS and PQ4R models are learning models designed using a problem solving approach with an independent and more focused thought process. In line with this statement, this study aims to determine the effect of applying the learning model between the SSCS and PQ4R models and to determine the effect of critical thinking and problem solving skills as well as the interaction of the two models with critical thinking and problem solving skills on student learning outcomes.

Methods

This research is a quasi-experimental research conducted at SMAN 1 Karanganyar in the odd semester of 2021/2022. The population in this study were all students of class XI IPA SMAN 1 Karanganyar, totaling 8 classes. The sampling technique used was cluster random sampling. This technique is used by taking samples based on individual groups or in their clusters and not individually. As for how to take samples by drawing lots from class XI IPA 1 to XI IPA 8. Then, class XI IPA 3 as the experimental class I with SSCS model and
class XI IPA 4 as the experimental class II with PQ4R model. Both of these classes have the same learning outcomes. The research design can be seen in Table 1.

Table 1. Research Design

| Group           | Pre-test | Treatment | Post-test |
|-----------------|----------|-----------|-----------|
| Experimental 1  | Y₁       | O₁        | Y₂        |
| Experimental 2  | Y₁       | O₂        | Y₂        |

Non-test data collection techniques were carried out by interviews with physics teachers and students, classroom learning observations, and documentation, while the test data collection techniques used posttest questions and questionnaires. Tests in the form of post-test with essay question sheets used to measure student learning outcomes and questionnaires used to measure students’ critical thinking and problem solving skills. Before being used for research, these instruments were tested first to determine the feasibility of the instrument for data collection. All instruments must be tested for validity and reliability.

The data analysis technique used ANOVA test to test all hypotheses. However, the analysis prerequisite test was carried out in the form of a normality test and a homogeneity test. Hypothesis testing uses the three-way analysis of variance formula, namely 2x2x2 as shown in the factorial design. The test is carried out using the SPSS program with the following criteria:

Ho is rejected if p-value < α
Ho is accepted if p-value ≥ α

If the null hypothesis is rejected, a further post-anova test is carried out to strengthen the results of the hypothesis test. Learning outcomes data were analyzed by quantitative methods using descriptive statistics with SPSS.

Result and Discussion

The requirements analysis test was conducted to see conclusions about the data obtained from the test of the learning outcomes of students in both classes using SSCS and PQ4R models. Prerequisite analysis test was conducted to determine the normality and homogeneity of the research data. The posttest data normality test was carried out using the Shapiro-Wilk test, while the posttest data homogeneity test was carried out using the Levene test with normal and homogeneous conditions if the significance value was greater than 0.05. The results of the analysis prerequisite test are shown in Table 2 and Table 3.

Table 2. Normality Test Results of Posttest Data

| Group           | P-value | Sig. | N  | Conclusion |
|-----------------|---------|------|----|------------|
| Experimental 1  | 0.966   | 0.091| 35 | Normally   |
| Experimental 2  | 0.978   | 0.092| 35 | Normally   |
Based on table 1, the results of the normality test in the experimental class 1 are known to have a significance value of 0.091, while the experimental class 2 has a significance value of 0.092. This shows that the significance value obtained is greater than the 0.05 significance level, which means that the data for the two experimental classes comes from a normally distributed population.

Table 3. Results of Homogeneity

| Group            | F   | Df 1 | Df 2 | Sig. | Conclusion         |
|------------------|-----|------|------|------|--------------------|
| Experimental 1   | 0.001 | 1 | 68   | 0.973 | Homogeneous        |
| Experimental 2   | 0.827 | 1 | 68   | 0.366 | Homogeneous        |

Based on Table 2, it is known that the experimental class 1 obtained a significance value of 0.973 and the experimental class 2 obtained a significance value of 0.366, indicating that the two experimental classes have a significance level greater than 0.05. This gives the conclusion that experimental class 1 and experiment 2 come from a population that has a homogeneous variance value.

The results of the analysis prerequisite test are known that the data comes from a population that is normally distributed and homogeneous, so that a hypothesis test can be carried out, namely the ANOVA test. The test was carried out using the SPSS software program with hypothesis acceptance criteria, namely if the value of sig < 0.05 then \( H_0 \) was rejected and \( H_1 \) was accepted. Then \( \text{sig} > 0.05 \) \( H_0 \) is accepted and \( H_1 \) is rejected. The results of hypothesis are presented in Table 4.

Table 4. Test results of between subject effect

| Source                  | Corrected Model   | Intercept | MODEL | KBK | KPM | MODEL*KBK | MODEL*KPM | KBK*KPM | MODEL*KBK*KPM |
|-------------------------|-------------------|-----------|-------|-----|-----|-----------|-----------|---------|---------------|
| Dependent Variable: HB | 2172.857          | 478915.714 | 522.357 | 191.429 | 32.255 | 21.356 | 6557.143 | 18.934 | 500500.000 |
| III Sum of Squares     | 7.612             | 882.004   | 488.033 | 77.612 | .324 | .266 | .104 | .122 | 96.429 |
| Mean Square             | 2172.857          | 478915.714 | 522.357 | 191.429 | 32.255 | 21.356 | 6557.143 | 18.934 | 500500.000 |
| F                      | .007              | .012      | .000  | .037 | .028 | .011 | .012 | .032 | .007 |
| Sig.                    |                   |           |       |     |     |       |       |       |     |

1) The effect of learning model on learning outcomes

Based on the calculation of research data, the first results of the ANOVA test indicate that there are differences in student learning outcomes given SSCS and PQ4R models as indicated by the difference in the average value of student learning outcomes. Students
who take physics lessons using SSCS model with experimental methods and scientific approaches get better learning outcomes than students who use PQ4R model with experimental methods and scientific approaches on static fluid material. However, the application of SSCS and PQ4R models has a significant relationship in improving student learning outcomes.

The SSCS (Search, Solve, Create and Share) learning model is a learning model that involves students to feel curious and increase their interest in asking questions in investigating a problem and looking for appropriate and real problem solving. The SSCS model is a learning model that teaches students to carry out problem-solving activities or processes and develop problem-solving skills (Ningsih, 2019). While the PQ4R model (Preview, Question, Read, Reflect, Recite and Review) is a learning model that can help students develop their thinking processes in improving comprehension and memory after reading the subject matter. The results of the study (Djumadi & Santoso, 2014; Prawindaswari, 2015) also conclude that the SSCS model is very effective in being used in the learning process because it can improve student learning outcomes. Likewise, the PQ4R model is very effectively used to increase knowledge references by carrying out a learning process that emphasizes activities to find sources of information, read, and understand the subject matter. In the experimental class that uses modules according to stages of learning is giving opportunities for students to correct mistakes. Students understand what activities must be carried out because in the module explained in detail what will be achieved by students, what to do, how to do it, how to know its success, and so forth (Rahmawati et al., 2019). During the learning process in the experimental class 1 using the SSCS model, all the students looked enthusiastic and active in learning. Then, learning process in the experimental class 2 using PQ4R model showed that students had an strongly responded to what the teacher said and active in answering questions in the module. The students were active and worked together in solving complex problems that result in more permanent and logical knowledge acquisition of subject matter and obviously impact directly on improving student learning outcomes (Amini et al., 2019).

2) The effect of critical thinking skills on learning outcomes

Second results conclude that there are differences in student learning outcomes with high and low critical thinking skills. Hakim et al., (2016) stating that critical thinking is included in a very complex category in higher-order thinking processes. Critical thinking involves activities such as analyzing, synthesizing, making judgments, creating and applying new knowledge to real-world situations (Hatari, 2016). Everyone's critical thinking skills are different, especially for students who have high critical thinking skills, it will have a positive effect on learning outcomes.

Based on the results of this study indicate that the average value of cognitive learning outcomes of students who have high critical thinking skills is better than students who have critical thinking skills in the low category. The experimental class 1 with SSCS model obtained an average critical thinking score of 88.29, while the experimental class 2 with PQ4R model obtained an average critical thinking score of 77.14. This gives the conclusion that learning physics by applying SSCS model is better for facilitating students' critical thinking skills in improving learning outcomes. In line with the results of research (Tumewu, 2018) showing that PQ4R model applied to science learning can improve students' critical thinking skills. Affandy et al., (2019) also concludes that there is a significant relationship between critical thinking skills and student learning outcomes. Khotimah, (2017) stated that the higher the critical thinking ability of students, the higher the learning outcomes. The achievement of a good learning activity process requires several critical thinking indicators such as identifying, analyzing, concluding, and evaluating (Hidayanti et al., 2016).
According to students’ worksheets, students involved design solutions, results and conclusions in various case studies in the module from understanding concepts to conducting experiments according to the instructions given by the teacher. Students can see practicum videos related to the subject matter to be practiced then write down the experimental results and conclusions. It means, students have use critical thinking skill. However, various kinds of student answers show students’ critical thinking patterns in responding to problems. The teacher can categorized which students fall into the category of low and high critical thinking. Furthermore, average thinkers had enough skills to begin with regularly monitor their own thoughts. Thus they could effectively articulated the strengths and weaknesses of their thinking (Mutakinati & Anwari, 2018). Good learning implementation can be realized when all the elements in learning are available (Isatunada & Haryani, 2021).

3) The effect of problem solving skills on learning outcomes

Third results of the ANOVA test, it was concluded that there were differences in the learning outcomes of students who had high and low problem solving skills. The experimental class 1 with SSCS model obtained an average problem solving value of 79.43, while the experimental class 2 with PQ4R model obtained an average problem solving score of 79.57. This shows that the difference in the average scores obtained is only slightly so that SSCS and PQ4R models are quite good if used in physics learning to facilitate the improvement of students' problem solving skills.

In addition, learning physics can not be separated from the development of problem solving skills that students have. Each student has different problem solving skills. Students who can manage problem solving activities in solving a problem will be better at obtaining learning outcomes. So it can be concluded from the results of this study that the problem solving skills of students in the high category have a better effect than the problem solving skills of students in the low category. Teachers must know the problem-solving approach that suits the needs of students. Himawan, (2018) also states that the benchmark for mastery of the material depends on the problem-solving abilities of students. Ambaryani, (2021) also emphasized that when students are aware of learning, they will be able to plan the best ways to achieve good results. Students with high solving skills will understand much better when faced with a problem topic, so they can immediately plan the right solution to solve the problem. And these students can help each other to explain their understanding to students with low problem solving skills. Learning becomes directed, utilizes time, and there is interdependence for cooperation.

Presentation of the material, discussions between students and students, discussions between teachers and students as well as various learning slides and videos will be obtained by students in the various features that have been prepared by each teacher who teaches (Marnita et al., 2021). One of the concepts of physics is static fluid which are related to daily life that make it easier for students to solve. However found a lot, when the teacher gives a question that is different from the presentation with the questions exemplified before, the student seem confused to finish (Permatasari et al., 2019). The students must be able to identify and write variety of information from the questions, because in solving problem, an important point that must be done first is understanding the problem (Yuberti et al., 2019).

4) Interaction of learning models with critical thinking skills on student learning outcomes.

Based on the fourth results of calculations using the ANOVA test, it can be concluded that there is an interaction between SSCS learning model and PQ4R model with critical
thinking skills on student learning outcomes. The interaction between SSCS and PQ4R model with high critical thinking skills category and low category is known that students who have high critical thinking skills will have better cognitive learning outcomes than the low one if taught with using SSCS and PQ4R model. Both of these learning models can emphasize cognitive activity and student involvement in the learning process.

In addition, learning physics with SSCS model can make students more active in group discussions, train students' ability to solve problems, train critical thinking, motivate students to study hard, and make it easier for students to continue to interact with new experiences (Hatari, 2016). Besides, there is an authentic problem can increase student curiosity and encourage them to study physics (Muslim et al., 2015). This is in line with the research results of Suciati, (2013) and Lukitasari, (2016) which show that SSCS model is effective in improving students' critical thinking skills. Initial knowledge is needed in the SSCS learning model because at the time of group division based on prior knowledge, each group has heterogeneous members (Agustin et al., 2018). This is intended so that the learning process occurs interdependence of both students with high, medium, and low initial knowledge.

The role of teaching materials will not be seen if its use is not in line with the contents of the learning objectives that have been formulated, if their use is not in accordance with the learning objectives, the teaching materials cannot support a learning process (Rahmawati et al., 2019). Therefore, the teacher’s role in contributing material orally is also very supportive of the students’ thinking processes. Mutakinati & Anwari, (2018) revealed that higher thinker regularly critiqued their own plan for systematic practices and improve it there by and had established good habits of thought. While, lower thinkers had very limited skills in thinking, they only focused on one solution, and they did not try to give better solutions. Students must be proactive themselves if they don’t want to miss the material. Activeness and involvement of students in a comprehensive manner in learning can be one of the main components of increasing student learning outcomes in the form of critical thinking skill (Marnita et al., 2021).

5) Interaction of learning models with problem solving skills on student learning outcomes

Fifth results indicate that there is an interaction between SSCS model and PQ4R model with problem solving skills on student learning outcomes. The interaction between SSCS learning model and PQ4R model with high problem solving skills category and the low category is known that students who have high problem solving skills will have better cognitive learning outcomes than the low one if taught with using SSCS learning model and PQ4R model. The problem solving skills of students can be honed by applying the SSCS and PQ4R model by giving various questions with a higher level of problem complexity. This is done so that students are accustomed to practicing their abilities in determining solutions and solving new problems.

On the other hand, problem solving in physics learning is essentially a solution to non-routine problems using various concepts, principles, and skills. According to Fasha et al., (2018) non-routine questions are forms of questions whose solutions require further stages of thinking because they do not have clear procedures. So that the use of questions of this kind is expected to be able to train students to use the concepts that have been learned in solving everyday problems when faced with new situations that were rarely encountered before. Application of the learning model by giving problems causes students to find concepts through their own activities so that they can understand the concepts (Fajria et al., 2017). This learning activity can help students to improve their critical thinking skill for problem solving materials. In general, creative thinking is correlated with critical thinking and problem solving skills (Wenno & Batlolona, 2021).
Good learning activities should not be fixated on the learning process of students who only take notes, listen to explanations from the teacher and work on questions. Because this will only result in students being passive and less able to use problem solving skills (Agustina et al., 2020). Providing practice questions for each meeting is important so that students become more skilled. The more experienced students are in solving various problems, the better their problem-solving abilities, students should also be able to use these strategies on various problems involving different contexts and different parts of physics (Maulana, 2017). Thus, students have been skilled in critical thinking in problem solving. When students solve the problem there are several indicators that to do not look like students have difficulty writing down known the elements in the question (known and asked) students find the steps to solve the problem (Permatasari et al., 2019). The learning model can also train the students to collaborate in group learning, and the teachers must knows that the students understands the physics concept not just understanding the mathematical concepts (Yuberti et al., 2019).

6) Interaction between critical thinking and problem solving skills on learning outcomes

Based on ANOVA test the sixth result, it can be concluded that there is an interaction between critical thinking and problem solving skills on student learning outcomes. The results of the research that has been carried out based on the initial test of critical thinking and problem solving skills of students in the two experimental classes are still low. The low average value of the initial test is estimated because the knowledge that students have is only limited to the basic knowledge they get from junior high school, other references, or experiences experienced in the surrounding environment. This is also because the experimental class students have been studying online for too long so that teachers cannot control their students' learning activities. Based on the posttest that have been carried out for both experimental classes, it shows that students' critical thinking and problem solving skills have begun to develop. The average score achieved by students has begun to increase for both experimental classes, although the increase is not too drastic.

On the other hand, Agustina et al., (2020) stated that a series of learning models that are relevant to students' learning activities show the process of training problem solving and critical thinking skills that are sought to achieve these skill indicators. Students who can achieve the indicators of critical thinking and problem solving skills mean that they are aware and able to manage their cognitive activities, so that the learning outcomes achieved will continue to increase. This is in line with the statement of Suana & Raviany, (2019) that physics learning activities that are able to visualize, describe, apply concepts, work on problem solving, draw conclusions have trained students to develop critical problem solving skills according to problem solving and critical thinking indicators. In problem solving learning, students are able to summarize knowledge so that it can improve the understanding of students concepts, so that their learning outcomes will also increase (Munira & Safitri, 2018).

The learning outcomes are the main things in learning, either in the form of results that can be measured directly with test or non-test. So, good learning outcomes can be influenced by the learning model used by the teacher (Amini et al., 2019). With SSCS or PQ4R models, the students competencies can improve in several ways, such as transferring concepts to new problems, integrating concepts, and increasing learning skills. This models defines that problem-based is a learning approach that has characteristics of using real problems as a context for students to learn critical thinking, problem solving skill and obtain knowledge about the importance of learning (Permatasari et al., 2019). In addition, the learning carried out based on the the student worksheet followed the SSCS dan PQ4R syntax. Students are more focused on determining the problems sought thought
experiments and understanding physics concepts through actual experiments (Wenno & Batlolona, 2021).

7) Interaction between learning models, critical thinking, and problem solving skills on learning outcomes

The results of the last hypothesis test conclude that there is an interaction between SSCS learning model and the PQ4R model with critical thinking and problem solving skills on student learning outcomes. There is a significant interaction between SSCS and PQ4R models with students who have high category critical thinking skills and the low category as well as high category problem solving skills and low category on student learning outcomes. This states that the two models contribute to the physics learning process in improving student learning outcomes, especially in static fluid material. Based on the responses of students regarding the application of the learning model that has been carried out, they assume that the learning activities that have been carried out are very enjoyable and motivate them to actively seek sources of information and solve problems so that they can easily identify new problems and apply appropriate solutions according to the knowledge they already have.

In addition, learning physics with SSCS and PQ4R models using experimental methods and a scientific approach is one of the innovations in learning. The application of this learning model is expected to make the learning process more optimal so that it can arouse the enthusiasm of students in developing critical thinking and problem solving skills. Thus, these students can improve learning outcomes optimally and significantly. The analysis of the hypothesis above is also reinforced by the results of the analysis of critical thinking questionnaires and problem solving questionnaires that have been filled out by students at the end of static fluid learning. The results of the critical thinking questionnaire analysis showed that 96% of students in experimental class 1 and experimental class 2 were very good at managing their critical thinking skills in physics learning. While the results of the problem-solving questionnaire analysis showed that 85% of the experimental class 1 and experimental class 2 students were very good at managing physics problem solving activities, especially in static fluid materials. The results of this questionnaire analysis prove that the two learning models, namely the SSCS and PQ4R models, are very effective for learning physics, although there are still some students who have not improved their learning outcomes.

The SSCS and PQ4R models are one of the learning models that raise natural phenomena, emphasize information with findings and problem-based learning processes. The facts in the field show that not all students understand the learning process that requires them to experiment. While learning physics is a real science that must be proven true. Because this learning is partly carried out online, not all students are active in the discussion. Teachers also cannot control and direct students to find the right solution if faced with similar problems. Therefore, there are still several factors that influence the success of students in learning, especially for students who have critical thinking and problem solving skills which are still in the low category.

Conclusion

Implementing the SSCS and PQ4R models is proven to influence in improving students’ learning outcomes on critical thinking and problem solving skills. There is a difference in learning outcomes for students who are given physics learning through SSCS and PQ4R models, students learning outcomes where high critical thinking and problem solving have better outcome than the low one. In addition, there is an interaction between
learning models, critical thinking and problem solving skills on students learning outcomes. Both models make a positive contribution to the physics learning process in improving students learning outcomes, especially in static fluid material.

References

Abdullah, N., Halim, L., & Zakaria, E. 2014. A thinking strategy and visual representation approach in mathematical word problem solving toward enhancing STEM literacy. *Eurasia Journal of Mathematics, Science and Technology Education*, 10(3):165–174. https://doi.org/10.12973/eurasia.2014.1073a.

Affandy, H., Aminah, N.S., & Supriyanto, A. 2019. Analysis of students' critical thinking skills on dynamic fluid material in SMA Batik 2 Surakarta. *Jurnal Materi dan Pembelajaran Fisika (JMPF)*, 9(1):25–33. https://doi.org/10.20961/jmpf.v9i1.31608.

Agustin, S., Fitraini, D., Rahmi, D., & Fitri, I. 2018. The influence of the SSCS learning model on understanding mathematical concepts in term of students' prior knowledge. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 2(2):42–53. https://doi.org/10.31004/cendekia.v2i2.1.

Agustina, K., Sahidu, H., & Gunada, I. W. 2020. The effect of guided inquiry learning model assisted by phet media on students' problem-solving and critical thinking skills in physics. *Jurnal Pendidikan Fisika dan Teknologi (JPFT)*, 6(1):17-24. https://doi.org/10.29303/jpft.v6i1.1514.

Alper, A. 2008. Attitudes toward problem-based learning in a new Turkish medicine curriculum. *World Applied Sciences Journal*, 4(6):830–836.

Ambaryani, S.E. 2021. Self-regulated learning strategy based on problem solving to improve the learners’ learning outcomes. *Jurnal Pembelajaran Fisika*, 9(1):83–129. Http://dx.doi.org/10.23960/jpf.v9.n1.202106.

Amini, R., Setiawan, B., Fitria, Y., & Ningsih, Y. 2019. The difference of students learning outcomes using the project-based learning and problem-based learning model in terms of self-efficacy. *IOP Publishing*, 1387(1):13-16. Http://iopscience.iop.org/article/10.1088/1742-6596/1387/1/012082.

Baidu, L. & Anggo, M. 2016. Effectiveness of metacognitive learning strategy against critical thinking skills of junior high school students. *Jurnal Pembelajaran Berpikir Matematika*, 1(1):51–60. Http://dx.doi.org/10.33772/jpbm.v1i1.5417.

Budi, W., Cari, & Sarwanto. 2016. Learning physics using search, solve, create, share and preview, questions, read, reflect, recite, review models in term of learning motivation and level of thinking. *Jurnal Inkuiri*, 5(3):49–56. Http://doi.org/10.20961/inkuiri.v5i3.9442.

Djumadi & Santoso, E.B. 2014. The influence search, solve, create, share and predict observe explain on biology learning outcomes. *Varidika* 26(1):11-20. Http://doi.org/10.23917/varidika.v26i1.728.
Fajria, F., Rahmatan, H., & Halim, A. 2017. The impact of problem-solving learning model on students' motivation and learning outcomes. *Jurnal Pendidikan Sains Indonesia*, 5(2):86–93. https://doi.org/10.24815/jpsi.v5i2.9822.

Fasha, A., Johar, R., & Ikhsan, M. 2018. Improving students' mathematical problem-solving and critical thinking skills through a metacognitive approach. *Jurnal Diddaktik Matematika*, 4185(1980):53–64. https://doi.org/10.24815/jdm.v5i2.11995.

Hakim, A., Kadarohman, A., & Syah, Y.M. 2016. Improvement of student critical thinking skills with the natural product mini project laboratory learning. *Journal of Chemical Education*, 16(3):322–328. https://doi.org/10.22146/ijc.21149.

Hatari, N. 2016. The effectiveness of sscs learning model on students' critical thinking skill. *UNNES Science Education Journal*, 5(2):1253–1260. https://doi.org/10.15294/usej.v5l2.13144.

Hidayanti, D. 2016. Analysis of critical thinking skill of students on similarity material. *Prosiding Publikasi UMS*, 1:276–285.

Himawan, W. 2018. Metacognitive strategies to improve problem-solving skill in kinetic theory of gases. *Edusains*, 10(2):265–274. https://doi.org/10.15408/es.v10i2.8021.

Indrianingtyas, D. & Kusuma, W. 2020. The impact of the development of institution repository as information service in the library of trunojoyo madura university in the knowledge. *Intelektiva*, 1(12):204–213.

Irwan. 2010. The effect of sscs model problem posing approach in an effort to improve students' mathematical reasoning abilities. *Jurnal Penelitian Pendidikan*, 12(1):1–13.

Isatunada, A. & Haryani, S. 2021. Development of science learning tools using the stem approach to train problem solving ability and students activeness in global warming material. *Jurnal Pendidikan Sains Indonesia*, 9(3):363–375.

Johan, H. 2012. The effect of sscs model problem solving to improve students' abilities in formulating and selecting problem-solving criteria in dynamic electicity. *Jurnal Exacta*, 10(2):140–142.

Khotimah, K., Nyeneng, P., & Sesunan, F. 2017. The influence of critical thinking skill and response of multi-representation teaching materials on learning outcomes. *Jurnal Pendidikan Fisika*, 5(3):1-12.

Lukitasari, C.A. 2016. The effectiveness of search, solve, create and share model to improve students' critical thinking skill on optical instrument material. *Jurnal Berkala Fisika Indonesia*, 8(1):17–28.

Marnita, Rahma, & Fatimah. 2021. Impact of e-learning media on students’ critical thinking skills at physics education study program Almuslim University. *Jurnal Ilmu Pendidikan Fisika*, 6(2):131–139. https://doi.org/10.26737/jipf.v6i2.1984.
Maulana, A. 2017. The effect of metacognitive strategies on mathematical problem solving abilities. *Jurnal Kajian Pendidikan Matematika*, 2(2):193–200. Http://dx.doi.org/10.30998/jkpm.v2i2.2492.

Milama, B., Bahriah, E.S., & Mahmudah, A. 2017. The effect of search, solve, create, and share learning model towards students critical thinking skills. *Jurnal Penelitian dan Pembelajaran IPA*, 3(2):112–123. Http://dx.doi.org/10.30870/jppi.v3i2.2574.

Mulyana, Y., Priyatno, S., & Dewi, N.R. 2018. The application of ssccs model to improve the ability to make mathematical models and students collaboration. *PRISMA: Prosiding Seminar Nasional Matematika*, 1:340–341.

Munira, J. & Safitri, R. 2018. Effectiveness of problem-solving model to improve understanding of concepts in SMA Negeri 11 Banda Aceh. *Jurnal Pendidikan Sains Indonesia*, 6(1):40–45. Https://doi.org/10.24815/jpsi.v6i1.10716.

Muslim, I., Halim, A., & Safitri, R. 2015. Application of PBL learning model to improve students mastery of concepts and critical thinking skills on elasticity and hooke law materials. *Jurnal Pendidikan Sains Indonesia*, 3(2):35-50.

Mutakinati, L. & Anwari, I. 2018. Analysis of students’ critical thinking skill of middle school through stem education project-based learning. *Jurnal Pendidikan IPA Indonesia*, 7(1):54–65. Https://doi.org/10.15294/jpii.v7i1.10495.

Ningsih, E.F. 2019. Implementation search , solve , create and share model to improve mathematical creative thinking. *GAUSS: Jurnal Pendidikan Matematika*, 2(1):25-34. Https://doi.org/10.30656/gauss.v2i1.1441.

Permatasari, C.P., Arnawa, I.M., & Musdi, E. 2019. The development of learning instruction based on problem based learning to improve problem solving ability of students in grade VII (Preliminary Research). *International Journal Of Scientific & Technology Research*, 8(8):600–604.

Prawindaswari, P.D., Suarjana, I.M., & Widiana, I.W. 2015. The effect of search, solve, create, and share model on students science learning outcomes. *Mimbar PGSD Undiksha*, 3(1):1-12. Https://doi.org/10.23887/jjjpgsd.v3i1.5661.

Purnamasari, I. 2017. Analysis physics problem-solving abilities on static fluid. *Seminar Pendidikan IPA Pascasarjana UM, vol 2*. Http://pasca.um.ac.id/conferences/index.php/ipa2017.

Purnami, A.S. 2017. The effect of metacognitive strategies on mathematical problem solving abilities in term of students perceptions. UNION *Jurnal Ilmiah Pendidikan Matematika*, 5(2):183–194. Https://doi.org/10.30738/V5i2.1241.

Rahmawati, R., Lestari, F., Umam, R. 2019. Analysis of the effectiveness of learning in the use of learning modules against student learning outcomes. *Desimal Jurnal Matematika*, 2(3):233–240. Https://doi.org/10.24042/djm.v2i3.4557.
Rezkillah, I.I. & Haryanto. 2021. The effect of problem based learning integrated high order thinking skill to critical thinking and self-confidence. *Jurnal Pendidikan Sains Indonesia*, 8(2):257–268. https://doi.org/10.24815/jpsi.v8i2.17322.

Sahin, S.M. & Kendir, F. 2013. The effect of using metacognitive strategies for solving geometry problems on students’ achievement and attitude. *Educational Research and Reviews*, 8(19):1777–1792. https://doi.org/10.5897/ERR2013.1578.

Suana, W. & Raviany, M. 2019. WhatsApp-assisted blended learning: influence on critical thinking and problem-solving skills. *Gravity Jurnal Ilmiah Penelitian dan Pembelajaran Fisika*, 5(2):37–45. http://dx.doi.org/10.30870/gravity.v5i2.4990.

Suciati, N. 2013. The effect of search, solve, create dan share with metacognitive strategies to physics problem-solving and critical thinking abilities. *Jurnal Pendidikan Sains*, 1(2):194–200. http://dx.doi.org/10.17977/jps.v1i2.4163.

Wenno, I.H. & Batlolona, J.R. 2021. The effect of problem based learning model on creative and critical thinking skills in static fluid topics. *Jurnal Pendidikan Sains Indonesia*, 9(3):498–511. https://doi.org/10.24815/jpsi.v9i3.20829.

Yasin, M.F.S.F. 2019. The effect of SSCS learning model on reflective thinking skills and problem solving ability. *EUJER: European Jurnal of Educational Research*, 9(2):743–752. https://doi.org/10.12973/eujer.9.2.743.

Yulianawati, D., Novia, H., & Suyana, I. 2016. Application of metacognitive approach in an effort to improve physics problem solving ability in simple harmonic motion material. *Prosiding Seminar Nasional Fisika UNJ*, vol 5. https://doi.org/10.21009/0305010304.

Zahroh, H. 2018. Problem solving skill with search, solve, create, and share (SSCS) model accompanied conceptual problem solving (CPS). *Jurnal Pendidikan*, 3(7):968–973. http://dx.doi.org/10.17977/jptpp.v3i7.11371.