The Development OF PQ4R-TPS Learning Strategies for Empowering Students' Scientific Attitudes and HOTS

HENNY SETIAWATI*

Abstract

Biology in secondary schools is still largely oriented to mastery of concepts and has not attempted to empower students' scientific attitudes and higher order thinking skills (HOTS). It has implications for the attitudes and cognitive abilities of students who tend to be low. The problems found in the learning process are related to the lack of application of students' scientific attitudes and HOTS. Teachers do not have learning tools that support the development of scientific attitudes and HOTS. The development of learning tools using constructive strategies is an effective alternative solution that can be used by teachers to overcome these problems. One of the constructive strategies that are considered appropriate to be developed is the PQ4R and TPS strategies. Therefore, this research aims to develop an oriented biology learning tool for empowering students' scientific attitudes and HOTS. Efforts to combine PQ4R and TPS strategies to maximize the potential of these two strategies. The strategy development method follows the Thiagarajan 4D learning design model. The results of this strategy development will be implemented into learning tools.

Keywords

Critical thinking skills, HOTS, metacognitive skills, PQ4R-TPS learning strategy, scientific attitude

Article History

Received 28 July 2022
Accepted 18 September 2022

How to Cite

Setiawati, H. (2022). The development of PQ4R-TPS learning strategies for empowering students' scientific attitudes and HOTS. *Indonesian Research Journal in Education |IRJE|*, *6*(2), 188–205. https://doi.org/10.22437/irje.v6i2.19992

*Faculty member of Biology Education Study Program, Faculty of Teacher Training and Education, Universitas Muhammadiyah Parepare, Indonesia; Corresponding author: hennysetiawati030473@gmail.com

Introduction

Policy in the 2013 curriculum (K13) describes the competencies that graduates must achieve in three aspects, namely affective, skills, and cognitive. These three aspects of competence are interrelated to produce independent graduates. However, in reality, learning is still oriented to mastery of concepts and has not sought the empowerment of high-order thinking skills and attitudes. It is also seen in Biology learning in secondary schools that have not conditioned the empowerment of scientific attitudes and high-order thinking skills yet which are the needs to build an independent generation and have life skills in the 21st century. One of the objectives of learning biology in secondary schools is to develop a scientific attitude in students to achieve objective knowledge (Surajiyo, 2008). Another problem in learning biology in secondary schools is that they have not made efforts to empower higher-order thinking skills. Some research results show that the scientific attitudes and learning to think about the application are not optimal. According to Setiawati, Rahman, and Jafar (2019) attitude competence and thinking skills in biology learning in high school have not been empowered, even though Corebima (2009) stated that the thinking skills of students do not develop by themselves in line with the development of their age. The thinking skills of students will develop well if it is done intentionally. Critical thinking and metacognitive skills are related to solving problems through the ability to analyze, synthesize, evaluate, generalize, compare, deduce, classify information, conclude, make decisions, and solve problems (Corebima, 2009; Darling-Hammond et al., 2003).

Based on the problems that have been disclosed, learning strategies are needed to empower students' scientific attitudes and higher-order thinking skills at the same time, including the PQ4R (Preview, Questions, Read, Reflect, Recite, Review) and TPS (Think Pair Share) learning strategies. The PQ4R proved beneficial for deep understanding and reconstructive learning (Bibi & Manzoor, 2011). Research by Wahyuningsih (2012); Setiawati and Corebima (2017) stated that the PQ4R strategy improves student learning outcomes. The PQ4R strategy has the potential to help empower students' thinking skills and scientific attitudes through 6 stages of learning. The Preview, Question, Read, Reflect, Recite, and Review stages direct student-centered independent learning through reading activities. According to Handayani and Dewanti (2020), the PQ4R strategy improves analytical skills, attention, and students in science learning. Likewise, Ramdiah (2015) stated that the PQ4R contributed to the empowerment of students' critical thinking and metacognitive skills.

The PQ4R strategy has revealed various advantages. However, there are individual shortcomings (Setiawati & Corebima, 2017). The PQ4R is difficult to implement if the facilities such as student books (packaged books) are not available in schools and the number of students is too large. The TPS learning strategy was chosen to help to overcome the weaknesses of the PQ4R and empower the students' scientific attitude and thinking skills at the same time. The TPS learning strategy provides opportunities for collaboration, higher-order thinking, and optimizing participation so that all students can improve their learning outcomes together. The incorporation of the PQ4R strategy syntax into the TPS strategy then referred to as PQ4R-TPS, is expected to be able to overcome the shortcomings of PQ4R, which will provide opportunities for students to develop and demonstrate abilities at the individual and group levels to empower students' scientific attitudes and thinking skills. Based on this rationality, it needs a PQ4R-TPS strategy in biology learning in secondary schools to empower students' scientific attitudes and thinking skills. The combination of these two learning strategies aims to produce a new strategy formulation which is the integration of the PQ4R strategy into the TPS strategy to mutually reinforce the potential of each other in empowering students' scientific attitudes and thinking skills.

Literature Review

Scientific attitude

Students with a high scientific attitude will have fluency in thinking, so they will be motivated to always excel and have a strong commitment to achieving success and excellence (Setyobudi, Boleng, & Lumowa, 2012). Aspects of scientific attitude include curiosity, respect for data, critical reflection, perseverance, creativity and discovery, open-mindedness, cooperation with others, willingness to accept uncertainty, and sensitivity to the environment. The American Association for the Advancement of Science places emphasis on four dimensions of scientific attitude, namely honesty, curiosity, open-mindedness, and doubt (Bundu, 2006). The same thing was also conveyed by Subagia (2013) that noble morals, attitude-free demo, and learner responsibility will be built with getting used to being scientific, such as curiosity, openness, perseverance, not easy to believe, honesty, objective, not in a hurry in making decisions, and respecting the opinions of others.

Some information related to scientific attitudes application in schools shows a lack of student participation in learning. According to Tursinawati (2013), the inculcation of the value of scientific attitudes is still lacking in science learning which results in obtaining the nature of science that is not intact, and the lack of scientific attitudes of students is formed. The emergence of scientific attitudes of students in science learning obtained an average of 60% in the category of enough because students have carried out scientific activities well, especially in collaborative activities. It means that it is essential to empower scientific attitudes in learning. According to Oktarian (2019), students lack curiosity in solving problems, lack of students' critical thinking attitudes, manipulating data, and showing the same task as friends. It can push students' scientific attitudes in a negative direction.

Critical thinking skills

Critical thinking is the ability to give reasons in an organized manner and evaluate a reason's quality systematically. Six variables of critical thinking ability that need to be observed in high school students are 1) formulating problems, 2) argumentation, 3) deduction, 4) induction, 5) evaluation, and 6) deciding and implementing. Critical thinking skills have the potential to increase students' critical analytical and intellectual abilities. Therefore, developing critical thinking skills in learning is an effort to improve student learning outcomes (Adnyana, 2007).

Thinking skills are not automatically owned by students because students rarely transfer these thinking skills themselves, so they need guided practice. If teaching critical thinking skills to students has not reached the stage where students can understand and learn to use them. It means thinking skills will not be used much. Students' critical thinking skills can be trained, among others, by giving problems in the form of various questions. These critical thinking skills can be used as a potential tool to filter information and improve character formation and with this ability, students can achieve increased cognitive abilities. Thomas, Anderson, and Nashon (2008) suggested that critical thinking skills are one of the crucial skills that need to be developed because these skills help students in selecting and sorting information properly, expressing opinions or reasons, and being able to solve problems. Students need to repeat to practice thinking skills even though these skills have become part of their way of thinking. Routine practices carried out by students will impact the efficiency and automation of students' thinking skills.

Metacognitive skills

Students' metacognitive skills refer to skills of prediction, planning, monitoring, and evaluation (Veenman et al., 2006). Darling-Hammond et al. (2003) also stated that metacognitive skills have an essential role in many types of cognitive activity including understanding, communication, attention, memory, and problem solving, so students' metacognitive skills can direct their learning. Metacognition plays an essential role in determining learning success. Therefore, teachers need to teach metacognitive strategies to students. Empowerment of metacognitive skills in students aims to make students understand how they think about biology, like the thinking steps of a biologist (Tanner, 2009). Metacognition plays an essential role in solving problems, and teachers are obliged to activate students to reflect, choose, monitor, and evaluate their performance results. Developing a metacognitive culture in the classroom encourages students to develop this kind of awareness starts with making the goals of learning activities and performance to students. Chikmiyah and Sugiarto (2012) also stated that metacognitive is an ability that significantly increases the effect resulting from learning considered for its empowerment.

Empowerment of metacognitive skills in the learning process can be done by teachers. According to Corebima (2009), empowerment of metacognitive skills can be done to students during the learning process, either through habituation of metacognitive learning strategies or the implementation of appropriate learning strategies. Metacognitive skills training can increase students' awareness to learn, make learning plans, control the learning process, and evaluate their self-efficacy, strengths, and weaknesses as students. Drew and Mackie (2011) stated that teachers are obliged to activate learning that involves students to reflect on the learning activities they are doing. Students need to be encouraged to plan and define learning objectives clearly, choose learning strategies that are appropriate to their learning styles, and monitor and evaluate the results of their performance.

PQ4R learning strategy (preview question read review recite reflect)

The stages in the PQ4R strategy are the part that encourages students to use their thinking skills. It is also stated by Rodli (2015) that each stage of the PQ4R strategy can empower students' thinking skills through the preview, question, read, reflect, recite, and review activities. Stage P (Preview) is a stage that guides students to read quickly on a reading. Students can find out the overall picture of the reading by checking the book's table of contents. According to Bibi and Manzoor (2011), in the preview activity, students already have an idea of what they will learn. Stage Q (Question) is the stage when students are asked to formulate questions for themselves. Questions can come from prior knowledge. The formulation of questions made by students themselves can help students to develop their thinking skills. According to Rogers (2006), learning activities carried out by relating previous knowledge encourage students to think at a higher level. The first R stage (Read) is the reading stage in detail from the reading material he studied. Students' reading activities are directed to find answers to all the questions they have previously formulated.

The second R stage (Reflect) is a stage that requires students to understand the reading. When reading activities, it is not just remembering, but must be able to connect with previous knowledge and with reality. The most important part of this stage is that they have a dialogue with what they read. The third R stage (Recite) is the stage of contemplating or recalling what has been read. The most important thing in the R part is that students can formulate concepts, explain the relationship between these concepts, and articulate the important points they have read with their editors (Huber, 2004). This activity is better if students do not only convey orally but also in written form. The fourth R stage (Review) is a student activity that repeats thoroughly by summarizing or formulating the essence of the material he has read. According to Suprijono (2011), the most important part of this stage is that students can formulate conclusions as answers to the questions that have been asked.

Learning strategies TPS (think pair share)

The TPS strategy is a cooperative learning strategy consisting of 3 main stages, namely think, pair, and share (Kennedy, 2007), which allows students to think, discuss, and share with other students (Setiawati & Corebima, 2017). Think stage, directing students to carry out the thinking process by answering questions that have been provided by the teacher. Furthermore, the second activity is the pair stage. It is a discussion activity carried out cooperatively with a partner (2 people) so that students can correct and perfect their assignments. Finally, the third stage is share. It is the stage to discuss with all students in the class. This activity provides opportunities for students to complement each other and help students to understand the assignments that have been given. According to Kennedy (2007), the TPS strategy encourages all students to be active in class through writing, thinking, listening, and speaking skills. The TPS learning strategy has an explicitly defined procedure to give students more time to think, answer, and help each other (Miranda, 2010). Thus, it is helpful in empowering metacognitive skills and critical thinking in students.

Methodology

Research design

This research follows the stages of developing a learning design (instructional design) 4 D (Thiagarajan, 1974). This research consists of the stages of defining, designing, and developing PQ4R-TPS strategies and tools in biology learning in high school, as well as a limited-scale dissemination stage. Research conducted in high school in Parepare with research subjects is teachers and students. The research procedure consists of the Define, Design, Development, and Disseminate stages which are generally described as follows.

Define stage, the purpose of this stage is to determine and define the learning requirements starting with an analysis of the objectives of the material limits, including the main steps, namely Front end analysis aims to determine the basic problems faced in learning biology. Analysis of students is also to determine their academic abilities of students. Task analysis includes content structure analysis and procedural analysis. Concept analysis includes the identification of the concepts being taught and the formulation of learning objectives. ***Design phase,*** this stage aims to produce a design strategy and learning tools. The design of learning tools consists of five steps, namely (a) selecting the syllabus format and learning implementation plans, (b) the initial design of the syllabus preparation and learning implementation plans, and (c) the preparation of essay tests to measure critical thinking and metacognitive skills (d) preparation of questionnaires for measuring students' scientific attitudes (f) compiling observation sheets on the implementation of learning syntax, critical thinking skills rubric, metacognitive skills rubric and questionnaire responses to learning strategies. The results of this stage are prototypes of learning tools, including syllabus, lesson plans, worksheet learners (LKPD), and evaluation tools.

Critical thinking and metacognitive skills test, this test is in the form of an essay (Anderson & Krathwohl, 2001). Before using the test, a validity analysis was carried out, including content validation, construct validation, and empirical validation. Furthermore, the reliability value was determined. Content validity regarding the Determination of all aspects covered in the conceptual framework or subject matter represented in the conceptual understanding test. Validity content refers to the extent to which the conceptual understanding test instrument reflects the entire subject matter. Construct validity aims to determine the extent to which a test measures the dimensions of cognitive processes based on the revised Bloom's taxonomy and how far the construction of the questions meets the rules of drafting a concept understanding test. Dimensions of cognitive processes include the categories of remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6). Construct validity is carried out by experts. Empirical validity is done by testing the conceptual understanding test on students. The empirical validity used is the item validity. The validity of the test is calculated using the product moment correlation formula. The calculation is assisted by the SPSS 16.0 for the Windows program. The results of the validity test are compared at = 0.05 to determine whether the item is valid or invalid with the criteria if the p-value > 0.05, then it is valid, and vice versa if p < 0.05, then it is invalid. Reliability refers to the level of reliability which is trustworthy and reliable (Arikunto, 2006). The reliability of the conceptual understanding test was determined using the Alpha Cronbach formula (Arikunto, 2006).

$$r11 = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum\sigma_b^2}{\sigma t}\right)$$

Information:

r11 : instrument reliability

k : the number of questionnaire items or the number of questions

$\sum\sigma_b^2$: the number of item variances

σt : total variance

The r-count value obtained is compared with rtable to determine whether the concept understanding test is reliable or not with the criteria if rcount > rtable, then the instrument is reliable, and vice versa if r-count < r-table, then the instrument is not reliable. The test criteria according to Arikunto (2006) are as follows.

0.80 – 1.00	: very high
0.60 – 0.79	: high
0.40 – 0.59	: enough
0.20 – 0.339	: low
0.00 – 0.199	: very low

Critical thinking and metacognitive skills rubric, critical thinking skills are measured by a rubric that refers to Hart (1994) on a scale of 0-5. The metacognitive skills rubric used is the MAD Rubric consisting of 7 scales (0-7) (1) answers in their sentences, (2) the order of exposure to coherent, systematic, and logical answers, (3) grammar or language, (4) reasons (analysis). /evaluation/creation), (5) answers (true/less/incorrect/blank) (Corebima, 2008). ***Metacognitive skills inventory****,* the metacognitive skills questionnaire was measured using the Metacognitive Skills Inventory (MSI) adapted from the MAI (Schraw & Dennison, 1994) and SEMLI-S (Thomas et al., 2008). This inventory consists of 34 statement items which are divided into planning, monitoring, evaluation, and revision skills. The grid and the metacognitive skill inventory instrument were developed based on the indicators of metacognitive skills, namely, planning, monitoring, evaluation, and revision (Lee & Baylor, 2006).

Scientific attitude questionnaire*,* this questionnaire was given at the time after the posttest was conducted. This scientific attitude questionnaire was developed by Harlen (1992) in terms of the dimensions of an open-minded and cooperative attitude which include: 1) respecting the opinions/findings of others, 2) willing to change opinions if data are lacking, 3) accepting suggestions from friends, 4) not feel always right, 5) assume every conclusion is tentative, 6) participate actively in groups (Anwar, 2009). This questionnaire was developed using a Likert scale with options strongly agree, agree, disagree, and strongly disagree, which was modified with a score of 1-4 so that the attitude or interest of the respondent is clear. Questionnaire of students' responses to learning strategies*,* this questionnaire reveals students' responses to the learning strategies used. ***Develop Stage (development)****,* produce learning tools that have been revised based on input from experts, followed by testing of test instruments by students, which are then used as a basis for determining item validity and test reliability. This stage resulted in learning tools used in experimental research that have been validated. ***Disseminate stage (modified into experimental research stage),*** this stage is the second-year research stage, which is the stage of using the tools that have been developed and modified into experimental research on 3 subject classes (PQ4R, TPS, and PQ4R-TPS) that have been validated.

Data collection and analysis

The instruments used in data collection consisted of validation sheets of learning tools, questionnaires for teacher and student responses to learning tools, tests of critical thinking and metacognitive abilities, scientific attitude questionnaires, and learning implementation observation sheets. The learning device validation sheet contains instruments to measure the validity of the TPS integrated PQ4R, TPS, and PQ4R learning tools. The teacher and student response questionnaires are the questionnaires used to reveal the responses of students and teachers about the learning strategies used. The thinking skills test is given integrated into the form of an essay. Scientific attitude questionnaires were given to students to measure the development of students' scientific attitudes in learning. The learning implementation observation sheet is used to record the implementation of the learning steps according to each learning strategy, which has been planned in the Learning Implementation Plan (RPP).

The techniques used consist of documents techniques, interviews, questionnaires, and tests. Documentation techniques are used at all stages of the data collection procedure, starting from the Define, Design, Development, and Disseminate stages. Interviews were used to dig up information during preparation for the preparation of learning tools to be developed. Interviews with teachers about suggested methods, learning concepts, and the direction of scientific development. Interviews were also conducted with students to find the difficulties, weaknesses, and learning advantages they had obtained. The questionnaire technique consists of 3 questionnaires, namely student responses to learning strategies, metacognitive inventory, and scientific attitude questionnaires. The data analysis technique was in the form of descriptive statistical analysis. The research data were analysed using descriptive statistics to show the description of students' metacognitive skills, critical thinking skills, and scientific attitudes toward biology. Descriptive statistical values include the mean, standard deviation, the highest mean, the lowest mean, and the percentage change between pre-test and post-test. In addition, some data is displayed in the form of graphs.

Ethical considerations

In my study, all participants' data were concealed to keep the confidentiality of their identity and all participants agreed to participate in the study.

Findings

The findings of this study are the availability of learning tools that integrate scientific attitudes and HOTS. This learning tool has been tested on a limited scale for its use. Based on the analysis results of the learning device trials and suggestions/inputs from the observers, revisions/improvements of the learning tools were carried out (draft II). The results of the revision/improvement of draft II learning tools resulted in draft III learning tools that can be used on a wide scale.

The field test implementation results

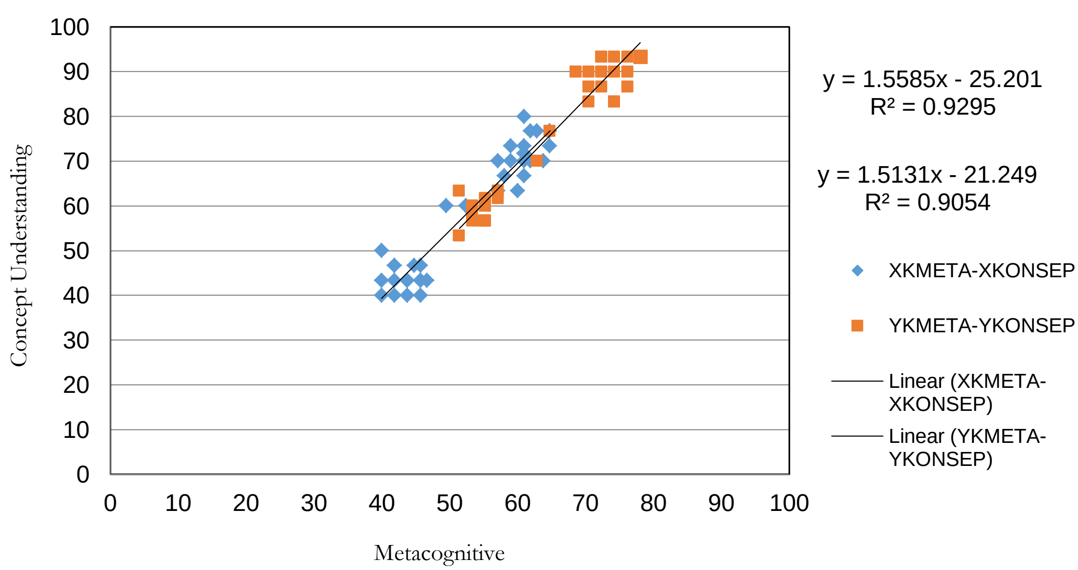
Average implementation of the lesson plan (RPP) on the *PQ4R*, TPS, and PQ4R-TPS learning strategy respectively, the average implementation of the teacher activity components is 98.42%, and the implementation of student activities is 97.36% in the PQ4R RPP. The average implementation of the teacher activity components is 98.33%, and the implementation of student activities is 97.78% in the TPS RPP. The average implementation of the teacher activity components is 98.82%, and the implementation of student activities is 97.84% in the PQ4R-TPS RPP. The implementation of the learning strategy syntax is supported by the results of the consistency test. The consistency test of the implementation of the syntax of the learning strategy was carried out by using regression analysis between metacognitive skills and understanding the concepts of both Pre-test and Post-test.

The results of the implementation of the RPP consist of 3, namely the implementation of the RPP PQ4R, RPP TPS, and RPP PQ4R-TPS at meetings 1 and 2. The data obtained are as follows. The regression summary of the results of the PQ4R learning syntax consistency test shows that YPretest and Yposttest are parallel and coincide. It means that the syntax of the PQ4R strategy has been applied consistently from the beginning to the end of the lesson. The summary of the regression results of the PQ4R learning syntax consistency test is shown in Table 1 and Figure 1.

Table 1. *Summary of PQ4R learning syntax consistency test results regression*

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	19737,757	3	6579,252	366.576	0.000
b1,b2	3,127	1	3,127	**0.174**	**0.678**
b1,b2,b3	27,022	2	13,511	**0.753**	**0.473**
Residual	1292,244	72	17,948		
Total	210300.001	75			

Figure 1. *Regression line for PQ4R learning syntax application*



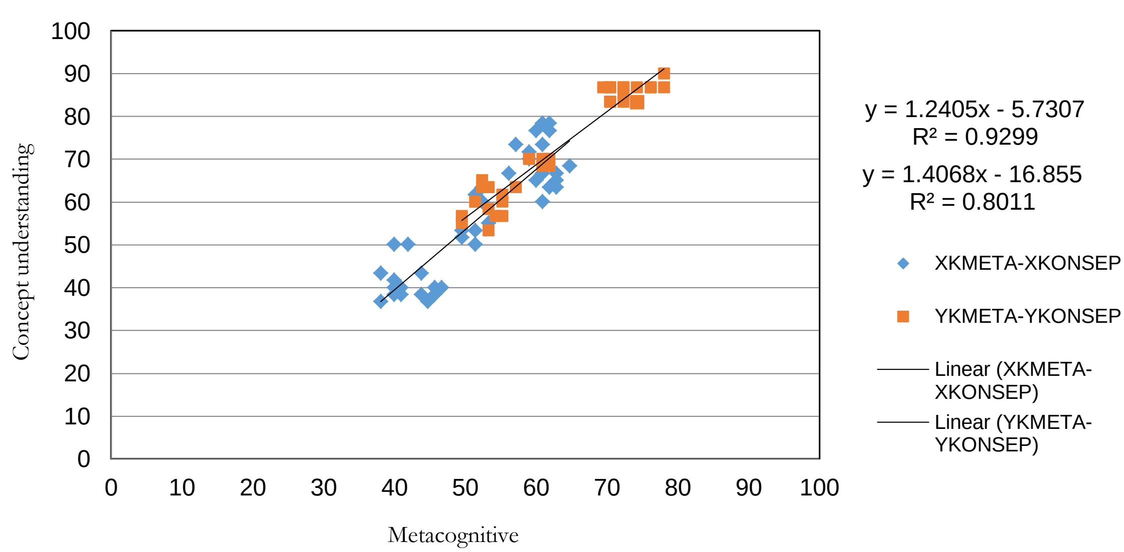
Regression summary of learning syntax consistency test results of *TPS* shows that YPretest and Yposttest are parallel and coincide. It means that the syntax of the TPS strategy has been applied consistently from the beginning to the end of the lesson. The summary of the regression results of the TPS learning syntax consistency test is in Table 2 and Figure 42. How the lecturers have well handled the class is approved by the students. The data showed that 100% of the students agree that the lecturers always reviewed and concluded each discussed material in every meeting. It means that the lecturers did not just let the students take the total center of the class without guidance afterward. The lecturers always concluded the results of each discussion to clarify the students' understandings.

Moreover, 92.9% of the students agreed that the lecturers were actively involved during the discussion process. The lecturers still monitored and kept an eye on the students to make the discussions run well. In addition, 92.9% of students also agreed that the lecturers tried to make all students participate and voice their opinions. The lecturers ensured that all students must speak in the class forum, and there was no student left behind. In other words, although the case-based learning method is a student-centered learning process, the lecturers still have to take their roles in guiding students. Thus, all students' discussions, presentations, and participation could run well. Especially in online classes, lecturers must monitor the screen more often and mark students' names to ensure that every student speaks their arguments.

Table 2. *Summary of regression results of TPS learning syntax consistency test*

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	16670,023	3	5556,674	224,366	0.000
b1,b2	44,543	1	44,543	1,799	0.191
b1,b2,b3	81,767	2	40,884	1,651	0.193
Residual	1882,222	76	24,766		
Total	18552.245	79			

Figure 2. *Regression line for TPS learning syntax application*

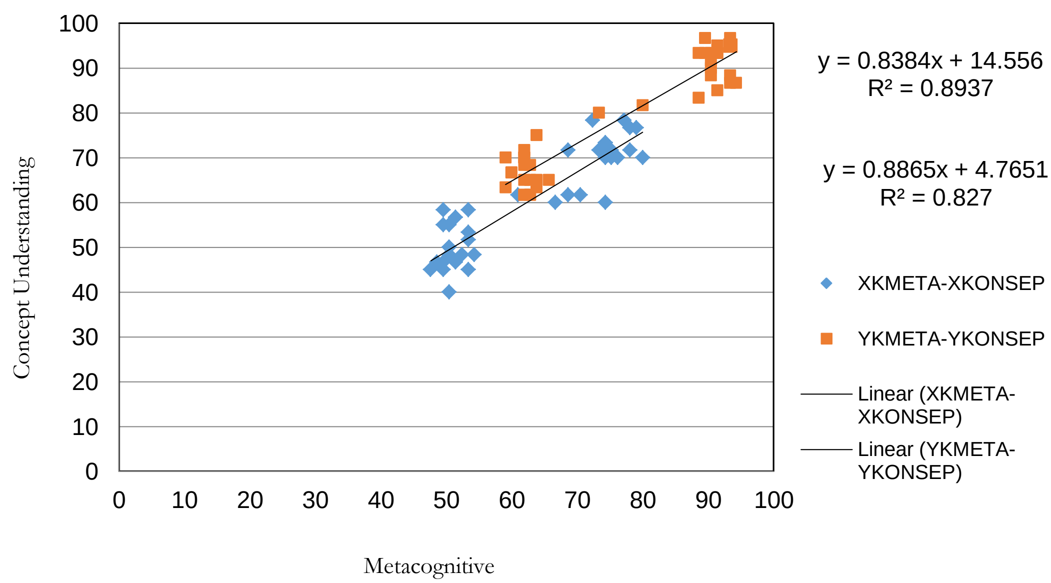


Regression summary of learning syntax consistency test results*PQ4R-TPS* shows that YPretest and Yposttest are parallel and do not coincide. It means that the PQ4R-TPS strategy syntax has been applied consistently from the beginning to the end of the lesson. The summary of the regression results of the PQ4R-TPS learning syntax consistency test is in Table 3 and Figure 3.

Table 3. *Summary of regression results of PQ4R-TPS learning syntax consistency test*

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	15922,911	3	5307,637	249.919	0.000
b1,b2	7,334	1	7,334	**0.345**	**0.558**
b1,b2,b3	646,150	2	323,075	15,213	0.000
Residual	1529,094	72	21,237		
Total	17452.006	75			

Figure 3. *Regression line for PQ4R-TPS learning syntax application*



The effectiveness of learning devices

The indicators used to determine the effectiveness of the learning tools are; (1) the results of the learning outcomes test, (2) student activities, (3) student responses, and (4) learning management. The results of the data analysis of the effectiveness of learning devices after the trial were below:

Learning outcomes data were obtained after the trial using the learning outcomes test instrument. The learning outcomes test is given after three meetings which aim to determine the level of student mastery of the material after the learning process is carried out with a scientific approach. Based on the analysis results of the learning outcomes test, from 38 students, 33 students managed to get a complete category score, so the percentage of completeness was 86.84%. Furthermore, there were five students who scored in the incomplete category, so the percentage of the number of students who received incomplete scores was 13.16%. Individual learning completeness requirements for Biology subjects if students get a minimum score of 75 (KTSP SMA Negeri 1 Parepare sets the KKM value = 78). Learning is said to be classically successful if at least 85% (T total of 85 %) of students achieve a minimum score of 75. Therefore, with a mastery percentage of 86.84%, the learning is classically successful. Assessment for spiritual attitude competence (KI.I), social attitude competence (KI.II), and skill competence (KI.IV) although not used as a reference in determining the effectiveness of learning tools, researchers still carry out assessments for these competencies to students.

Student activity data were obtained from the observations of two observers using the student activity observation sheet instrument. The first observer observed the activities of students in group 1, while the second observer observed the activities of students in group 2. The activities of students observed during the learning process were in accordance with the syntax of each learning strategy, namely PQ4R, TPS, and PQ4R-TPS syntax activities. which is integrated into the 5 M scientific approach; (1) listening/paying attention to the teacher's explanation/guidance (2) being active in conducting activities/experiments according to the LKPD guidelines, (3) being active in conducting observations to collect data/information, (4) actively asking questions both among students and between participants, learning with the teacher, (5) active discussion in working on/answering questions in the LKPD, (6) Presenting the results of group work, and (7) behaviours that are not relevant to learning. Student activities are categorized as effective because the time used in engaging themselves for each learning activity is in accordance with the ideal time tolerance that has been set.

Student response*,* percentage of students who are taught by learning strategies of *PQ4R*, TPS, and PQ4R-TPS considered fun. The percentage of students who were taught the PQ4R, TPS, and PQ4R-TPS learning strategies were more likely to consider it easy to follow the lesson when compared to those who thought they were hesitant and did not make it easier to follow the lesson. The percentage of students who were taught using the PQ4R, TPS, and PQ4R-TPS learning strategies, considered the learning strategies not confusing when compared to those who thought they were doubtful and confusing; while the percentage of students who are taught by conventional learning, the percentage who think the learning strategy is not confusing and doubtful is the same when compared to those who think it is confusing. Percentage of students who are taught by *PQ4R*, TPS, and PQ4R-TPS learning strategies more consider learning strategies to make students able to share information when compared to those who think they are doubtful and do not make students able to share information. Percentage of students who were taught using the PQ4R and TPS learning strategy considered that learning strategies made students learn more when compared to those who thought they were doubtful and did not make students learn more; while in the PQ4R-TPS learning strategy, the percentage of students who feel doubtful about the learning strategy that makes them learn more when compared to those who think that the learning strategy makes students learn more and not.

Percentage of students who are taught by *PQ4R*, TPS, and PQ4R-TPS learning strategies more consider learning strategies to make students able to work together when compared to those who think they have doubts and do not. The percentage of students who were taught using the PQ4R, TPS, and PQ4R-TPS learning strategies considered the learning strategies to add clarity to the learning material when compared to those who thought they were doubtful or not. The percentage of students who are taught with *PQ4R*, TPS, and PQ4R-TPS learning strategies is more considered learning strategies to improve their thinking skills when compared to those who thought they were doubtful and not. Percentage of students who are taught by *PQ4R*, TPS, and PQ4R-TPS learning strategies assume that learning strategies make students able to regulate their learning methods when compared to those who think they are doubtful and not. The percentage of students who were taught using the PQ4R, TPS, and PQ4R-TPS learning strategies more considered learning strategies to make students able to evaluate learning when compared to those who thought they were doubtful and unable to evaluate learning.

The analysis results also show that the average percentage of students who give positive responses to *PQ4R-TPS* is greater than TPS, PQ4R learning strategy; and TPS learning strategies are greater than PQ4R. The same is shown by the percentage of students who consider the PQ4R-TPS strategy to make them learn more when compared to the PQ4R, TPS, and conventional learning strategies which are still doubtful for students as a strategy that makes them learn more. In addition, learning Biology using the PQ4R-TPS combination strategy makes students more able to evaluate the learning that has been followed compared to the other two strategies. It means that the PQ4R-TPS blend strategy is superior to the other two learning strategies. The findings of this study indicate that the PQ4R-TPS strategy is better than the PQ4R and TPS strategies.

Learning management data were obtained through observations made by two observers using the learning management observation sheet. Observations on learning management were carried out three times, which is done each meeting. The observation aspects contained in the observation sheet include; (1) initial activities, (2) core activities, (3) final activities, and (4) the learning atmosphere in the classroom. The results of the data analysis of learning management by the teacher showed that the teacher's ability to manage to learn was stated to be adequate because all aspects of observation in the management of learning by the teacher had met the criteria. The teachers' ability to manage to learn can be declared adequate if the minimum KG score is in the high category (Arsyad, 2007). Learning tools developed after going through trials have met the criteria for effectiveness. Based on the analysis results of the learning device trials and suggestions/inputs from the observers, a revision/improvement of the learning tools was carried out (draft II). The results of the revision/improvement of draft II learning tools resulted in draft III learning tools.

Development stage, the distribution of learning tools is done in a limited way through socialization among Biology subject teachers at SMA Negeri Parepare through MGMP activities. The socialization was carried out in the science laboratory of SMA Negeri 1 Parepare and was attended by 11 biology subject teachers. In this activity, the researcher explained how the use of tools related to the learning steps in the lesson plan (RPP) according to the characteristics of learning using the PQ4R, TPS, and PQ4R-TPS which is integrated with a scientific approach. Furthermore, biology subject teachers who have participated in the socialization are asked to write down their responses and give suggestions regarding the learning tools that have been developed. Based on suggestions and responses from subject teachers, it becomes the basis for improvement/revision of draft III learning tools. The results of the revised draft III resulted in a final draft learning tool that can be used for class X students in the odd semester of the next academic year.

Discussion

This study examines the development of learning tools that integrate scientific attitudes and HOTS through the PQ4R-TPS strategy. This learning strategy is considered appropriate to be an alternative solution for the low empowerment of students' scientific attitudes and HOTS in learning biology. The PQ4R and TPS strategies have the advantage of empowering scientific attitudes and HOTS, which can complement the weaknesses of each strategy if they stand alone. The integration of PQ4R syntax into TPS supports students to actively think and work together during the learning process. Much research has been done on the respective PQ4R and TPS strategies before, but not in the form of integration of PQ4R into TPS. This research is still on a limited trial scale which requires time to determine the effect of this PQ4R-TPS strategy on a wide scale and can be used as a reference for implementing scientific attitudes and HOTS in biology learning. The next planned activity is to pilot it on a wide scale to all high schools in Parepare and its surroundings.

Based on the results of expert validation data, information was obtained that the syllabus and lesson plans that had been developed by the researchers had quality with good valid categories and few revisions. According to Ellis and Levy (2010), valid devices can provide a significant difference from learning using conventional devices. It means that the lesson plans that have been developed can be used in Biology learning in SMA Class X Science. The developed LKPD has been validated by two experts in the field of Biology. The validation results obtained that the quality of this LKPD was categorized as good for all aspects of the assessment with a slight revision with an average score of 3.5. It can be seen from the limitations in experimental observations related to the complexity of the organizational structure of life around schools, for example, biological objects that are less varied. This can be overcome by bringing some samples from the environment around the students' homes. The developed LKPD should have fulfilled the components of the LKPD preparation. According to Ana (2010), the involvement or activity of students in the teaching and learning process can be increased by using LKPD which is a means to optimize the achievement of learning outcomes and develop critical thinking skills, metacognitive, and scientific attitude, and arouse students' interest in the natural surroundings. LKPD with PQ4R, TPS, and PQ4R-TPS characters help students to develop critical thinking skills, metacognitive, and scientific attitudes. The syntax of each learning strategy has advantages in monitoring, regulation, and problem-solving.

The results of expert validation on student teaching materials obtained information that the developed teaching materials received an average validation score of 3.5, which indicated that the teaching materials were good and slightly revised. It is supported by Pramita (2014) that students will first be interested in the outer appearance of the material, not in its content. The use of images in teaching materials and LKPD can convey the message/content of the images effectively so that the images presented must be clearly visible in the appearance of the teaching materials.

The observation results of the implementation of the lesson plan in the small group test during meetings 1 and 2 which include preliminary, core, and closing activities. The syntax implementation of the learning strategy is supported by the results of the consistency test. It means that the syntax of the PQ4R strategy has been applied consistently from the beginning to the end of the lesson. The response of students to the learning strategy shows that the PQ4R-TPS strategy is superior to the PQ4R and TPS strategies. The combination of these two strategies supports each other in empowering students' thinking skills and scientific attitudes. The six stages of PQ4R syntax are integrated into a cooperative TPS strategy that makes learning more enjoyable. The combined PQ4R-TPS strategy is a strategy that involves total and independent student-centered activities. The existence of individual and group work patterns in the PQ4R-TPS strategy causes individual responsibility and cooperation among group members to be formed. According to Rodli (2015), each stage in the PQ4R strategy is a part that encourages students to use their metacognitive skills. Likewise, the TPS learning strategy, according to Corebima (2016), TPS is one of the learning strategies that have been reported to have the potential to empower thinking skills. The positive response of students to the PQ4R-TPS learning strategy is also since students are directly involved in the learning process 3 main activities in Think (preview, question, read), Pair (reflect, recite), and Share (review). Integrated into the 5M scientific approach (observing, asking, reasoning/collecting data, associating, and communicating). It is also supported by Hala (2015) that stated positive responses arise in students because of their direct involvement in observing, asking, reasoning, trying, and communicating activities.

Conclusion

Based on the results of the validation and implementation of learning tools, the conclusion is as follows: (1) Overall, the learning tools developed were good quality and suitable for use in biology learning for class X SMA; (2) the implementation of Class X Biology learning for two meetings overall is good with the consistency of implementation from the beginning to the end of the lesson; (3) the activities of students during the implementation of Class X Biology learning with the PQ4R-TPS learning strategy according to the stages of learning and increasing reliability for each meeting. It is recommended that further research be carried out on a wide scale to produce better learning tools.

Disclosure statement

This research was carried out on the needs of developing studies related to learning strategies, scientific attitudes, and higher-order thinking skills of students as a form of readiness to apply the applicable curriculum and not based on certain interests.

Acknowledgments

Thank you to those who have helped carry out this research, especially to the Chancellor of the Muhammadiyah University of Parepare, the Principal of the Parepare City High School, the Parepare City MGMP, the Parepare City Senior High School 1 Students, the data analysis and documentation team.

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Biographical Note

Dr. HENNY SETIAWATI is Faculty member of Biology Education Study Program, Faculty of Teacher Training and Education, Universitas Muhammadiyah Parepare, onesianIndonesia; Corresponding author: hennysetiawati030473@gmail.com