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Development of Junior High School Biology Science Learning Tools Using STAD Strategy Through Lesson Study: Its Influence on Students' Critical Thinking Skills

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Abstract: The purpose of this study was to produce a biology science learning device for junior high school with STAD strategy through lesson study that has a significant effect on students' critical thinking skills. This study was conducted in two stages, namely the development research stage which aims to develop biology learning devices and implementation of learning with experiments. The research method is R & D by adapting the 4-D development model from Thiagarajan (1974). Data collection was carried out using tests, observation sheets, and student response questionnaires. Data were analyzed descriptively and inferentially with mancova, and previously data normality and homogeneity tests were carried out. The development of a biology science learning device for junior high school with STAD strategy through lesson study provided several results, namely the learning process was carried out according to the plan that had been made; the student learning process showed an increase towards the better, as an impact of providing motivation, guidance and continuous attention from the model teacher; interaction between students, and interaction between students and teachers increased more than the previous cycle. This is the impact of providing motivation and enthusiasm, as well as reinforcement from the model teacher during learning; Students who still do not participate in group discussions or class discussions need a process and sufficient time to be able to change. Its influence on students' critical thinking skills, the results of critical thinking skills measurements conducted before and after learning, showed a tendency for an increase in the average value of critical thinking skills from pretest to posttest. Based on the learning strategy, the highest average pretest value of critical thinking skills was obtained in the STAD strategy, namely 41.02. The highest average value of critical thinking skills both pretest and posttest was in the upper academic ability, namely 42.41 and 71.94. The results of the study showed that the STAD learning strategy had an effect on critical thinking skills in junior high school biology science learning.

Keywords: Biology science; Critical thinking skills; Learning Tools; STAD

Introduction

Human resources who have knowledge, expertise, and thinking skills can be realized through quality education. Therefore, the development of education in Indonesia today must prioritize the quality of output, which is able to adapt to the demands of the times and has a global perspective. This is a tough challenge that must be faced by the world of education in Indonesia. This challenge requires teachers at various levels of education to respond by giving real attention, thinking, and action to make changes in various aspects, especially the paradigm of education and learning towards the development of human resource competencies that meet global quality requirements (Atikah et al., 2024; Ibda, 2022; Uno, 2024). The human resource competencies needed by the nation today can be developed by teachers through biology science

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learning activities in schools, by implementing appropriate learning strategies, and supported by adequate teacher professionalism in teaching students. Some student competencies that can be developed through learning activities include critical thinking skills (Agusta & Sa'dijah, 2021; Syah & Jaeni, 2023).

Biology is one of the subjects in junior high school that is integrated into the science subject, has its own characteristics. Natural science (IPA) is related to how to find out (inquiry) about nature systematically, so that science or IPA is not only a mastery of a collection of knowledge in the form of facts, concepts or principles, but also a process of discovery. Biology as part of IPA has its own characteristics compared to other fields of science, in terms of the nature of its objects and the problems inherent in living things in their environment. In the aspect of biology, IPA examines various problems related to various phenomena that occur in living things and their interactions with various environmental factors (Pratama et al., 2020). By examining biological concepts that are associated with problems in students' lives and the environment (Mamu et al., 2022; Mamu et al., 2023), it is hoped that critical thinking skills can be trained and developed, so that students are able to overcome the problems they face (Mamu, 2014).

Biology learning in schools is generally associated with inseparable product and process aspects. The product aspect of biology consists of facts, concepts, and principles (Fausan et al., 2023; Taib et al., 2020). The process aspect of biology is the science process skills that students need to think and act in their daily lives. The biology science learning process focuses on providing students with direct experience in applying concepts, principles, facts, and findings to discuss biological problems in the natural environment through critical thinking and scientific work. Biology learning is directed at "finding out" and "doing" (inquiry), so that it can help students to gain a deeper understanding of the natural environment (Novianti, 2022). Biology science learning is expected to be a vehicle for students to learn about themselves and the natural environment and is an effective means to develop students' life skills, including critical thinking skills (Wati, 2016).

Based on the survey that has been conducted, the fact of learning biology science is still found in junior high schools in Palu City, Central Sulawesi. Learning biology science in schools that is carried out in a planned, consistent manner, and supported by teacher professionalism, is expected to facilitate students to improve their critical thinking skills.

The results of a survey on the implementation of biology learning in junior high schools in Palu City showed that 88.2% of teachers admitted that they did not understand critical thinking skills, and only 13.6% of teachers empowered them in biology learning. In addition, in biology science learning at junior high schools in Palu City, teachers have not been able to choose learning strategies that allow students with different academic abilities to collaborate and learn together in cooperative groups. Teachers' mastery of constructivist learning models, such as STAD, is still lacking, especially in the syntax of the STAD type cooperative learning model.

STAD cooperative learning was chosen in this study, based on its syntax which greatly allows students to help each other, discuss, and argue to solve problems together (Kertati et al., 2023; Mardin et al., 2024; Rahmawati, 2017). The implementation of the STAD type cooperative model is important because it encourages active collaboration between students, which effectively stimulates critical thinking processes through discussion, mutual correction, and joint problem solving. Discussion and argumentation activities help students not only work on low-level thinking domains but also refer to high-level thinking domains and metacognition. Based on the background above, it is very important to develop a biology science learning tool at the junior high school level with the STAD strategy to train students' critical thinking skills in the city of Palu.

Method

Research Stage

This study aims to produce a product in the form of a learning device for biology science for junior high school class VII. The devices developed consist of Syllabus, RPP, LKPD, and Evaluation instrument. The four types of learning devices were developed based on the chosen learning strategy, namely the STAD strategy. This study consists of two stages that are carried out in sequence, namely the development research stage, and experimental research. Development research is carried out to develop learning devices that are ready to be experimented with. The development of this learning device is carried out by combining development methods adapted from the development of the 4-D model by Thiagarajan (1974). The development of the 4-D model consists of 4 stages namely "*Define, Design, Develop and Disseminate*", which was adapted into the 4-D model, namely define, design, develop and disseminate.

Define Stage

Definition is the initial stage in developing a device whose purpose is to establish and define

learning requirements. At this stage, an analysis of objectives is carried out within the limits of the material for which the device is being developed. This stage consists of five main steps, namely upstream-downstream analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives (Thiagarajan, 1974).

Design Stage

The design stage begins with the activity of determining the format of the learning device being developed, especially the syllabus format, learning implementation plan (RPP), and student worksheet (LKPD). The goal is to prepare a prototype of the learning device according to the desired learning strategy. The prototype of the learning device produced at this stage is in the form of a syllabus, RPP, LKPD and evaluation instrument.

Develop Stage

The purpose of the development stage is to produce a revised and validated learning device. The development stage includes validation of the device by experts. The development stage includes: validation of the device by experts; development and trial of the learning device by biology science teachers as product users, through lesson study activities. Validation of the device by experts aims to fulfill the requirements for validation of the content of the learning device that has been prepared. The assessment aspects include the suitability of the content substance, the suitability of the instructional design, and the suitability of the display aspects including clarity, readability, and image display. Validation of the device by experts is carried out through a guidance process, and intensive discussions between researchers and experts. The results of the discussion and input from experts, both verbally and in writing, are used as a reference for revising the draft of the learning device. The result of the revision process is a learning device that is ready to be followed up to the next development stage through lesson study activities.

Disseminate Stage

At this stage, the learning tools that have been developed are used on a wider scale, for example in different classes or schools, and by different teachers. In this study, the *dissemination stage* has not been carried out due to time and cost constraints

The population in this study were all students of grade VII in 22 public junior high schools in Palu City. Sampling was done using the *Stratified Sample technique. sampling,* with the criteria of upper and lower school quality strata. School quality is seen from the average value of school input UAN. The following table of samples of this development research is presented in Table 1.

Table 1. Number of Students in Each Class as Research Samples

School	Class	∑ Students	∑AA	∑AB	STAD strategy
Junior high school 9 Palu	VII A	38	12	8	36 Students
Junior high school 19 Palu	VII B	31	6	10	

Data Collection Instruments

Instruments for data collection in the research on the development of learning devices include observation sheets, used by *observers* to observe the learning process; observation sheets to observe the implementation of the syntax of the STAD learning strategy; questionnaires to determine students' responses to the learning process by implementing the STAD strategy. The instruments used in this experimental research are tests to measure the dependent variable, namely critical thinking skills; assessment rubrics, which are used to determine the score of the critical thinking skills variable.

Data collection procedures

The research data collection procedure is carried out through the following stages Conducting a pretest (initial test) before the learning activity begins. The pretest is intended to determine students' initial abilities regarding students' critical thinking skills in biology science subjects, before the implementation of learning strategies; Implementing the selected learning strategy, namely the *STAD strategy*, on the established KD; Conducting observations in class, to determine the implementation of the learning syntax that has been developed. Observations are carried out during the learning process by observers (partner teachers); Conducting a posttest at the end of the learning process in all research classes. The goal is to determine students' critical thinking skills after participating in all learning activities; Distributing questionnaires to students. The goal is to find out students' responses to the learning process that has been implemented.

Data analysis

The data obtained through the research on the development of learning devices, which includes data from expert/expert tests and data from product user tests, were analyzed descriptively. The data collected in the study were analyzed using descriptive and

inferential statistics. Descriptive analysis was used to describe the critical thinking skills of junior high school students. The results of the analysis are presented in the form of tables and histograms based on the average value, and the percentage change in pretest and posttest values. Inferential analysis with Mankova was used to test the research hypothesis. Before testing the hypothesis with the Mankova test, a prerequisite test was first carried out which included normality and homogeneity tests. The normality test used a *one-sample test Kolmogorov-Smirnov,* while the homogeneity test using *Levene's Test of Equality of Error Variances* Statistical calculations using SPSS.

Result and Discussion

Results

STAD Strategy Learning Device Development Process

The implementation of *lesson study* for the development of learning devices in the *STAD strategy* took place in 4 cycles. Each cycle consists of three stages, namely the planning stage (*plan*), implementation (*do*), and reflection stage (*see). The activities were carried out by a lesson study* team consisting of 2 model teachers and 4 observer teachers. The description of the *STAD* strategy learning device development process is described as follows.

Lesson Study STAD Cycle I

This activity begins with the *planning stage*, namely planning the learning that will be implemented. The researcher and *the lesson team The study* carried out the following things: analyzing *STAD* strategy learning tools , including syllabus, lesson plans, student worksheets, evaluation instruments; discuss other instruments such as learning media, questionnaires, and worksheets observation of learning, class layout, and student numbers; agreeing on the model teacher, observer, and class where *the open* class will be held; discussing student characteristics and the classroom atmosphere where *the lesson study* will be held.

The next stage is implementation (*do*), the model teacher implements the learning implementation plan according to the syntax and learning scenario of *the STAD strategy*. At the same time, *the observer* observes the learning process by referring to the observation sheet that has been prepared. During the learning process, the observer notes the advantages and disadvantages of the learning activities.

The final stage of *lesson study* cycle I is reflection (*see*). At the reflection stage, observers convey the results of their observations, as follows: there are too many questions in the LK PD, so that students are not optimal in working on and understanding the answers; not all students have really learned about the learning topic. This is evident, there are still students who are not able to answer the teacher's questions, when exploring students' initial knowledge; the student learning process is good, but not optimal. Not all students pay attention to the lesson material being discussed; Not all students are actively involved in their group activities, some students are active in group activities outside the learning process. In discussion activities. There are still students who are less active, both in asking questions and giving responses; the presence of observers makes students' concentration on learning less than optimal. Almost all students do not concentrate on studying at the start of the lesson, there are also several students who are seen starting to lose concentration on studying during group activities, during presentation of observation results, and during discussions; The interaction that occurs between students is not optimal. It is proven that there are still students who work individually, communication about lesson materials and discussions between students is lacking, students have not utilized their friends who understand the material more quickly as peer tutors, if there are problems that are not understood; Student interaction with teachers has gone well, but not all students are able to do it. Some students do not dare to ask or answer the teacher's questions; The advantages of a model teacher during the learning process are: has self-confidence, is patient in guiding students, has a clear voice, and is very communicative.

The lesson team reflection *The study* concluded several things that needed to be followed up by the model teacher in cycle II, namely reducing the number of questions in the LKPD according to the time allocation and objectives; needing to remind students to read the lesson material before learning activities; need to provide an understanding of the importance of studying ecosystem issues for students; need proper class management and motivation, especially to students or groups of students who are not yet serious about being active in learning; need to give awards to students who actively participate in learning; need to take an individual approach to students who are not yet concentrating on learning; need to motivate students to increase interaction between students (peer tutorials), and interaction between students and teachers.

Lesson STAD Cycle II Study

The activity begins with the planning stage , researchers together with the *lesson team study* discussed the results of cycle I reflection. From the results of the discussion, several things were agreed upon as follows appointing model teachers in open

class cycle II; explaining to students the purpose of the observer's presence in class; ask students to read material about the learning topic before implementing the learning; motivate students to actively participate in group activities and discussions; visit all groups. and motivate students to participate and be responsible for group activities; motivate students to increase interaction with their friends; motivate and encourage students to dare to ask the teacher about things they don't understand, and dare to answer the teacher's questions.

The next stage is implementation (*do*), at the *do stage*, Model teachers implement the planned learning design. By referring to the lesson plan and the results *of the plan,* model teachers carry out learning from the initial activities to the end of the process. At the same time, observers conduct observation activities and record the advantages and disadvantages of the implementation of learning by model teachers. This is important for the purpose of improving the quality of subsequent learning. For observation purposes, observers use the observation sheets that have been prepared.

In the final stage, the *lesson team study* conducted a reflection some time after the learning implementation was completed. At this reflection stage, the model teacher conveyed the following things on *lesson* cycle II *study* was her first experience as a model teacher. At the beginning of her appearance, a feeling of lack of confidence arose. However, the urge to improve and develop herself as a teacher, the feeling of lack of confidence and shame disappeared; Model teachers are happy to accept input or corrections from friends peers; most students have studied well, this can be seen from their ability to answer the teacher's questions.

In the cycle II reflection, the observer teacher said that the learning process and the model teacher's performance were good, but there were still several things that the model teacher needed to pay attention to, namely: students' understanding of the material being studied and students' participation in answering teacher questions had increased. However, there were still several students who could not answer the model teacher's questions correctly; students' concentration on learning began to be seen from the beginning of the lesson and was no longer affected by the presence of the observer; interaction between students in discussion activities and working in groups has increased, but in group II there is still 1 student who is not involved in group work. When the teacher comes to the group, the student shows his activeness in the group, but when the teacher leaves, the student is busy playing with his cellphone again; interaction between students and the teacher has increased, but in some students there is still a feeling of fear and shame in asking questions, feeling ashamed if they answer incorrectly.

At the end of the reflection, the researcher and *the lesson team The study* concluded the results of the reflection as follows: everything that has been assessed as good in relation to the learning process in cycle II is further improved; taking an individual approach to students who have not been able to answer the teacher's questions correctly, or students who are still playing during the learning process; re-explaining to students the importance of studying ecosystem material; classroom management needs to be maximized; providing motivation and reinforcement continues to be done and improved; guidance and attention from model teachers to all students when studying and working in groups are continuously improved, so that students feel cared for by their teachers while studying.

Lesson Study STAD Cycle III

This activity begins with the plan stage, which aims to design learning based on the results of reflection in cycle II. The results of *the plan activity* by *the lesson team The study* agreed on several things, namely designing learning based on the results of reflection in cycle II; determining model teachers and observers in cycle II learning ; re-explaining the importance of studying ecosystem material to students who are less active in learning; providing motivation, reinforcement, guidance and attention is continuously carried out and improved; taking an individual approach to students who have problems with learning activities ; and maximizing classroom management actions.

The next stage is implementation (*do*). At this stage, the model teacher implements the learning design that has been planned together with the *lesson study team. By referring to the RPP and the results of reflection, the model teacher implements learning according to the syntax of the STAD* strategy . At the reflection stage, the team *lesson The study* discusses the implementation of learning by model teachers and the results of observer observations , model teachers convey several things, namely grateful that his experience in teaching students with *STAD strategies* is increasing, his self-confidence is increasing; Student activity in learning is increasing, although it is acknowledged that there are still some students who are embarrassed to ask questions and express their opinions to their friends and teachers.

At the reflection stage, The observer conveyed the results of his observations as follows: basically the learning process is in accordance with the syntax of the STAD strategy, and planned learning scenarios.

However, there are still some things related to student learning activities that need to be maximized; Most students have been involved in learning activities on the learning topic, but some students have not learned optimally because they forgot to bring the teaching materials that have been distributed. There are also students who are not actively learning because they are not healthy; in general, students have concentrated when the teacher shows pictures with *power point,* but when presenting the results of group work, two students began to lose concentration; interaction between students has improved and increased, but the role of students as peer tutors for other students who do not understand has not been seen; interaction between students and teachers has improved and increased from the previous cycle, but there are still students who are embarrassed to ask questions; the appearance of the model teacher has improved and is more optimal than the previous appearance.

At the end of the reflection, the *STAD lesson study team* concluded several things as follows: everything that was assessed as good was related to the learning process in cycle III is further improved; class management needs to be maximized, and teacher attention should not be focused on certain students or groups, but rather directed at all students. Thus all student learning activities can be monitored, and student learning needs are met; the role of peer tutors needs to be maximized; student interaction with teachers continues to be improved.

Lesson Study STAD Cycle IV

This activity begins with the planning stage (*plan*), which is carried out collaboratively by the *lesson team. STAD study,* researchers with *lesson team study STAD* designs learning based on the results of cycle III reflection, and agrees on several things as follows: determining the model teacher for *open class* IV and the observer who is tasked with observing the learning process in cycle III; the learning material taught in *lesson activities.* cycle IV *study* is a continuation of KD 7.1, regarding the interdependence of components in the ecosystem; increasing the role of peer tutors; motivating students to ask questions about things they do not understand to other students other or teacher; maximize the provision of attention and guidance to all groups.

The next stage is implementation (*do*). In the implementation stage, the model teacher applies the planned learning design, based on the syntax of the *STAD strategy* in the RPP. *Lesson team members STAD study* which acts as an observer in this activity, observes implementation of the learning process with a focus on observations directed at student learning activities, using previously prepared guidelines.

End of *lesson activities study* cycle IV is the reflection stage (*see*), which is carried out some time after the learning process is completed. At the initial opportunity, the model teacher conveys his impressions and experiences in carrying out learning, as follows Model teachers acknowledge the impact of *lesson activities study* for himself, especially fostering a sense of self-confidence, happiness and willingness to accept input or correction from colleagues; most students have studied well, this can be seen from their ability to answer the teacher's questions.

The observing teacher took the opportunity to convey the results of his observations regarding the learning process carried out by the model teacher, as follows: the learning process is carried out according to the plan that has been made; The student learning process shows an increase towards better, as an impact of the provision of motivation, guidance and continuous attention from the model teacher; interaction between students, and interaction between students and teachers has increased more than the previous cycle. This is the impact of providing motivation and enthusiasm, as well as reinforcement from the model teacher during learning; students who still do not participate in group discussions or class discussions, need a process and sufficient time to be able to change.

Student Responses to Learning in Lesson Study Activities

Data regarding student responses to the application of the STAD strategy in lesson study activities are described as follows.

In the statement in questionnaire number 1, that learning on this topic is very interesting and not boring, students gave different responses. The average student response to the statement was 73% agree, and 26.48% strongly agree. In the second question, what did students get from learning this topic? Students gave varying responses, including understanding the material on living creature units in the ecosystem, the interdependence of components in the ecosystem; practicing cooperation and discussion in groups; being able to conclude answers to questions in the LKPD; and training students' courage to ask questions.

In the third question, what should be improved in learning this topic? Students gave varying responses, including the teacher's attention to students during group activities, especially students who are not active or like to disturb their friends;) examples or pictures related to the material are presented in the form of power points; questions in the LKPD should be reduced, so that students can still understand the

problems well. In the fourth question, what should not be done in learning this topic? Students gave various responses, including students are not allowed to disturb friends and play with cellphones; students should not be embarrassed or afraid to ask questions and express opinions, either with friends or teachers; presentations are done when other groups have not finished completing the LKPD. In the fifth question, do students feel disturbed by the presence of observers in class? Students gave various responses, including in cycle I, students felt their concentration was disturbed by the presence of observers in class. However, after being given an explanation by the teacher about this, students have started to get used to the presence of observers and are no longer disturbed.

Critical Thinking Skills Data Description

Critical thinking skills in this study were measured before and after the implementation of the selected learning strategy. To determine the average value of students' critical thinking skills and their improvement, the data were analyzed using descriptive statistics. The research data on the average value of critical thinking skills can be shown visually through Figure 1.

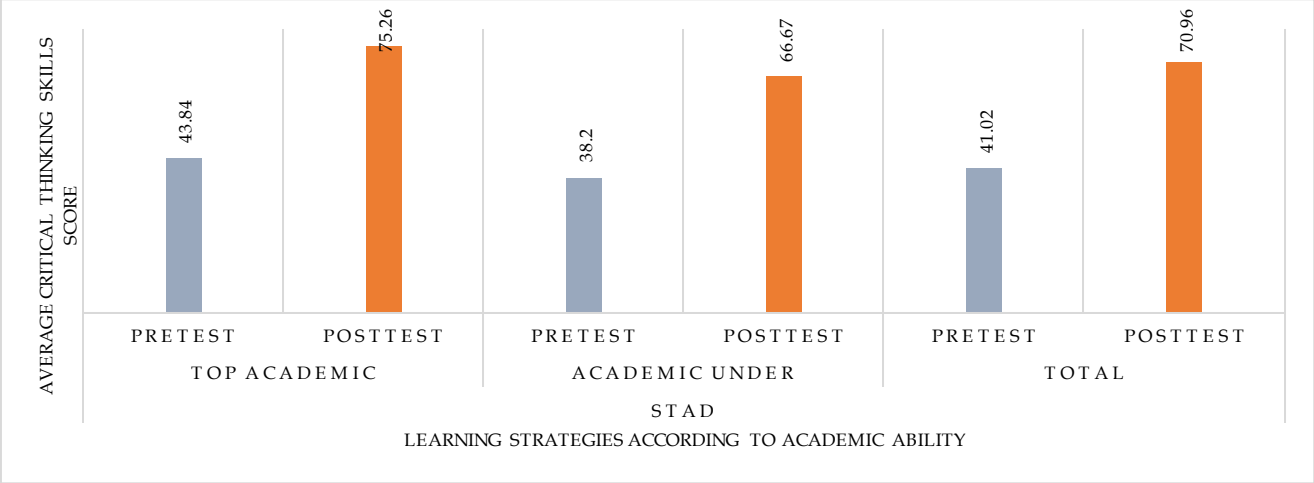

Figure 1. Mean *Pretest* and *Posttest* Scores of Critical Thinking Skills Based on Learning Strategies According to Academic Ability

Based on the data in Figure 1, it can be explained that the results of measuring critical thinking skills carried out before and after learning, show a tendency for an increase in the average value of critical thinking skills from *the pretest to the t-test.* to *posttest*. Based on learning strategies, average value thinking skills *pretest* The highest critical score was obtained in the *STAD strategy* , namely 41.02 . The average value of critical thinking skills was good. *pretest* and the highest *posttest for upper academic ability, namely 42.41 and 71.94.*

Normality and Homogeneity Test of Critical Thinking Skills Data

The results of the normality test of critical thinking skills data in all *pretest data groups* were 0.075 and *posttest* 0.068. The significance value of the *pretest* and *posttest data* for critical thinking skills was greater than alpha 0.05. Thus, the data was declared normally distributed. The results of the homogeneity test of critical thinking skills data obtained a significance value of *pretest data t* 0.258 and *posttest t* 0.131. The significance value of both data is greater than alpha 0.05. Thus, the critical thinking skills data is declared homogeneous.

Critical Thinking Skills Hypothesis Test

Hypothesis test results with mankova dependent variable critical thinking skills on learning strategy sources. Table 2 Mankova Results Effect of Treatment on Critical Thinking Skills.

Table 2. Mankova Results of the Effect of Treatment on Critical Thinking Skills.

Source	Df	F	Sig.
Critical Thinking Skills Pretest	1	1.149	0.286
Learning strategies	3	46.250	0.000
Academic Ability (AC)	1	11.315	0.001
Interaction of Strategy and Academic Ability	3	0.238	0.870

(Source: Primary Data from Research Results)

Learning Strategies for Critical Thinking Skills

The test results in Table 2 show the significance value (sig.) p = 0000. This significance value is smaller than the alpha value of 0.05 so that Ho, namely "there is no difference in critical thinking skills of students who are taught using the *STAD learning strategy* " is rejected. Therefore, the research hypothesis " there is a difference in critical thinking skills of students who are taught using the *STAD learning strategy* " is accepted. The results of this hypothesis test indicate that learning strategies have a significant influence on critical thinking skills.

To see the difference in the average value of critical thinking skills between students who are taught using the *STAD learning strategy*. then the analysis was continued with the *LSD test (Least Significance Difference)* at a significance level of 0.05. The test results *LSD* is found in the Table 3.

Table 3. Results of the LSD Test of the Average Corrected Value of Critical Thinking Skills on Learning Strategy Sources

Learning strategies	Pretest	Posts	Slice	KBKCOR	Notation
STAD	41.017	70.965	29.948	70.150	B

(Source: Primary Data from Research Results)

LSD test in Table 3 show the difference in the mean notation of the corrected critical thinking skill scores in the learning strategy.

Discussion

The process of perfecting learning devices is carried out through *lesson activities. study,* involving science teachers. The learning tools developed are syllabus, RPP, LKPD, and evaluation instruments. Learning tools, especially syllabus, Lesson Plan and LKPD according to the chosen learning strategy, namely syllabus, lesson plans and character LKPD *STAD*. Evaluation instruments, namely tests and research rubrics according to critical thinking skills indicators .

Lesson activity results *the study* which took place in four cycles showed the process of improving learning tools, especially related to RPP, LKPD and tests. The improvement of the learning tools, is the impact of the learning process through *lesson activities study*. This is very possible, because in carrying out *the lesson* Collaborative *study teachers carry out:* study the curriculum and formulate learning objectives and student development objectives; designing learning to achieve goals; implementing and observing *research. lesson* (learning that is studied); conducting reflection to discuss the learning that is studied and perfecting it, as well as planning the next learning.

Improvement of biology science learning tools through *lesson activities* This *study* is more directed at its suitability with the characteristics of students and teachers who are users of the development product. Based on the results of the initial study of learning devices, especially RPP, LKPD and tests, suggestions or input from teachers in the *lesson study team* consider the suitability of learning devices from the student aspect.

The four questions stated by Syamsuri & Ibrohim (2011) on, the answer is only the teacher who teaches the students knows. This is the reason which is the basis for consideration, so that the development of tools, especially the preparation of RPP and LKPD in this study involves science teachers through *lesson study activities.*

Lesson activities *study* in this study, not only produces learning devices that are ready to use, but also contributes to the learning process in this case teachers. The results of the reflection discussion showed that the ability of model teachers to implement strategies in learning increased from one cycle to the next (Abizar, 2017; Effendi, 2017; Wahyuni, 2020). Teacher The model is aware of all its shortcomings in implementing learning and open to improve it according to suggestions and input from other team members, especially observers. The attitude of such a model teacher will contribute to the development of the teacher's personality and social aspects which are required for a professional teacher. For students, the learning process carried out through lesson study provides important benefits to their learning process, both individually and in groups (Amrilizia et al., 2023; Kuswara et al., 2023; Rini, 2021). The learning process through lesson study allows observers to observe students learning, in various ways including activities, learning concentration, collaboration with friends, participation in groups, interactions between friends and between students and teachers (Lopo, 2025; Nurizqi, 2023; Nursafitri, 2015; Primandari et al., 2013). The results of observations during the learning process through lesson study can show that the aspects of student learning mentioned above have increased from one cycle to the next. The results of the mankova test show that the STAD learning strategy has an effect on critical thinking skills. The results of this study are in line with Ifa et al. (2023); Karmana (2010) which prove the influence of the STAD learning strategy on critical thinking skills.

In the STAD strategy, there are steps that require students to discuss with group members to complete assignments (Arifin, 2018; Samsuri & Firdaus, 2017). This activity can stimulate increased critical thinking skills in students. The ability to think critically, give opinions and listen to the opinions of others is important (Manurung et al., 2023; Sholeh et al., 2024; Yuni et al., 2024). Involving yourself in discussion activities can develop critical thinking skills (Pangestuti, 2017; A. Rahmawati, 2019; Ramadhan et al., 2016; Zunaidah, 2015). Students who work together in groups will demonstrate high critical thinking skills compared to students who study individually. In group discussion activities, there is interaction between students in the group. Interaction among students plays an important role in stimulating critical thinking skills (Ermin & Marsaoly, 2021; Harahap & Harahap, 2020; Karma et al., 2023).

Conclusion

The development of junior high school biology science learning devices using the STAD strategy through lesson study provides results that show an increase in a better direction, especially for students' critical thinking skills, the results of measuring critical thinking skills carried out before and after learning, show an increase in the average value of critical thinking skills from pretest to posttest. The results of the study indicate that the STAD learning strategy has an effect on critical thinking skills in junior high school biology science learning.

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The authors declare no conflict of interest.

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