ELIGIBILITY OF ELECTRONIC STUDENT WORKSHEET BASED ON TWO STAY TWO STRAY TO TRAIN ANALYSIS THINKING SKILLS IN INHERITANCE TOPIC

Kelayakan E-LKPD berbasis Two Stay Two Stray untuk Melatih Keterampilan Berpikir Analisis Peserta Didik pada Materi Pewarisan Sifat

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Abstract

This research aims to describe the validity and effectiveness of the TSTS-based electronic student worksheet on inheritance topic that has been developed to train students' analytical thinking skills. The development of electronic student worksheet used ADDIE method (Analysis, Design, Development, Implementation, and Evaluation). The validity was reviewed from the validation results carried out by expert validators using the validation sheet instrument which contains several aspects including didactic, construction, and technical requirements. The effectiveness was seen from students' learning outcomes from pretest-posttest results, also students' responses from filling out open-ended questionnaires after participating in the learning process. The implementation was carried out in a limited implementation to 16 F-phase students at SMAN 3 Sidoarjo. The results showed that the developed TSTS-based electronic student worksheet obtained an average score of 3.7 from the expert validator so that it was called very decent category in the eligibility criteria. Student learning outcomes data shows that all students' learning outcomes were increasing with N-gain score > 0.70 with an average score 0.94, which means that they have high criteria for learning outcomes improvement. Student response questionnaire data that has been analyzed using the NVivo 12 produces a project map visualization that showed that the use of electronic student worksheet has a positive effect on improving students' analytical thinking skills. The TSTS-based electronic student worksheet that has been developed is valid and effective to train students' analysis thinking skills in inheritance topic, based on the results of validation, as well as students' learning outcomes and responses.

Keywords: inheritance topic student worksheet, validity, effectiveness, learning outcomes, student responses

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan validitas dan efektivitas e-LKPD berbasis TSTS materi pewarisan sifat yang dikembangkan dalam melatih keterampilan berpikir analisis peserta didik. Pengembangan e-LKPD menggunakan metode ADDIE (Analysis, Design, Development, Implementation, and Evaluation). Validitas e-LKPD ditinjau dari hasil validasi yang dilakukan oleh validator ahli menggunakan instrumen lembar validasi yang berisi beberapa aspek meliputi syarat didaktik, syarat konstruksi, dan syarat teknis. Efektivitas e-LKPD ditinjau dari hasil belajar peserta didik yang diperoleh dari hasil pretest dan posttest, serta ditinjau dari respon peserta didik yang diperoleh dari pengisian angket pertanyaan terbuka oleh peserta didik setelah mengikuti pembelajaran menggunakan e-LKPD yang dikembangkan. Uji coba dilakukan secara terbatas pada 16 peserta didik fase F SMAN 3 Sidoarjo. Hasil validasi menunjukkan bahwa e-LKPD berbasis TSTS yang dikembangkan memperoleh skor rata-rata 3,7 dari validator ahli sehingga termasuk dalam kategori sangat layak ketika diinterpretasikan pada kriteria kelayakan. Data hasil belajar peserta didik menunjukkan seluruh peserta didik mengalami peningkatan hasil belajar dengan skor N-gain seluruh peserta didik > 0,70 dan rata-rata skor 0,94 yang artinya memiliki kriteria peningkatan hasil belajar tinggi. Data angket respon peserta didik yang telah dianalisis menggunakan aplikasi NVivo 12 dan menghasilkan visualisasi project map menunjukkan bahwa penggunaan e-LKPD memiliki keterkaitan (relationship) yang positif yang menandakan bahwa penggunaan e-LKPD memiliki pengaruh positif dalam peningkatan keterampilan berpikir analisis peserta

didik. e-LKPD berbasis TSTS yang telah dikembangkan valid dan efektif dalam melatih keterampilan berpikir analisis ditinjau dari hasil validasi serta hasil belajar dan angket respon peserta didik.

Kata Kunci: e-LKPD pewarisan sifat, validitas, efektivitas, hasil belajar, respon peserta didik

INTRODUCTION

Analytical skill is a high-level thinking skill that is needed by students in solving global issues and problems. Analytical skill is an element in the cognitive domain of student learning outcomes, especially at level four (C4), after knowing (C1), understanding (C2), and applying (C3). Analytical skills involve three processes, namely students can analyze relevant pieces of information, determine the relationships between these relevant pieces, and determine views about the purpose of studying information (Anderson & Krathwohl, 2010). Students will easily form thinking concepts in analyzing problems if they can follow the cognitive processes of distinguishing, organizing, and connecting which are indicators of analytical thinking skills (Pratama et al., 2022).

The results of interviews and observations by Hilda et al. (2021) shows that students tend to be more active in speaking and arguing during teaching and learning activities, but it is not the result of analytical thinking. One of the causes of students' low analytical skills is that the teacher does not provide many practices in the learning process that require analytical thinking skills and proper use of learning media (Assegaff & Sontani, 2016). Another reason why students have low analytical skills also because students memorize more than interpret the material. Analytical thinking skills can be trained through the habit of answering questions that require skills and making decisions (Maghfiroh & Sugianto, 2011).

Arrangement of the learning environment by the teacher as a planner, director, leader, and guide toward learning centers, also planning according to the background, study habits, experience, and knowledge of students, as well as appropriate learning models also influence students in processing learning (Zein, 2016). Using the right learning model can create an active classroom atmosphere, achieve learning goals, and maximize students' skills and learning outcomes (Arga, 2017). Meanwhile, inappropriate arrangement can become an obstacle for students to achieve learning goals. One form of inappropriate arrangement is the implementation of learning models and media that are not in accordance with the background conditions of the students and the material being taught so that teaching and learning activities become less effective. In reviewing this, teachers need to try learning media with learning models that are more effective and efficient so that they can achieve the expected competency of learning outcomes and student skills (Bachri, 2017).

Two stay two stray (TSTS) is one of the cooperative learning models where students learn to analyze problems with their group members, then two group members exchange information with two other group members (Lie, 2006). The TSTS learning type can be used for all subject materials and all levels. This type of learning involves the activeness and participation of students, which emphasizes the use of certain structures designed to influence students' creative thinking and analysis while providing time to learn, think, react, and help each other solve a given problem (Bachri, 2017).

The use of the TSTS learning model trains students' analytical skills in teaching and learning activities conducted in the classroom. Students' analytical thinking skills can be seen when discussing to find and solve a given problem in groups, then sharing their opinions in the group. The application of the TSTS learning type is expected to be able to train students' analytical skills in teaching and learning activities.

Learning models need to be supported by appropriate teaching materials so that learning objectives can be achieved. One of the teaching materials that is widely used as an alternative in supporting learning is student worksheet. Student worksheet is a teaching material that can help students understand the material easier. The use of student worksheet in learning activities aims to help students feel easier in learn independently so they can solve problems in their daily life by practicing thinking skills through the activities provided in there (Novitasari & Puspitawati, 2022).

Student worksheet is considered practical as teaching material, because there are exercises equipped with interesting features, which in the learning process can train students to be active and think creatively regarding the subject matter being studied (Astari, 2017). In its use, there are printed and electronic worksheet. Student worksheet used in schools is generally in the form of printed sheets, but as technology develops there is an innovative student worksheet that is designed in an online form or is called electronic student worksheet (Kholifahtus et al., 2022).

Student worksheet is used to facilitate students in understanding topic that is considered difficult and

requires thinking skills in the learning process. One of the materials in the learning process that requires media to make it easier for students to understand the material by using their thinking skills, is inheritance topic. Based on the results of research by Nusantari (2012), many students cannot answer questions about inheritance.

In crossbreeding subtopic, students experience difficulties in analyzing the results of crosses and also determining the genotype and phenotype of the parents (Hambokoma, 2007). Inheritance topic is considered to have many difficult concepts so students have difficulty understanding them. Based on research by Tekkaya et al. (2001), three groups of concepts in inheritance topic are included in material that is difficult for students to understand, including linkage gene, crossing over, and Mendel's Law which contains monohybrid and dihybrid crosses.

The inheritance topic in the latest curriculum, Kurikulum Merdeka, is in Phase F. To achieve learning outcomes from the Kurikulum Merdeka, such as students being able to describe, analyze, apply, and evaluate, teaching materials with learning models that are appropriate to the material being taught are needed. As stated by Corebima & Ramdiah (2014), students' thinking skills, questions, and high quality answers appear after the teacher models and facilitates them.

One form of effort that can be made is the development of TSTS-based electronic student worksheet with the aim of training students' analytical thinking skills. Research conducted previously by Maulana & Megayani (2017) regarding the application of the TSTS model on the excretion system topic in class XI on student achievement gained effective results, with indicators that could significantly improve student learning outcomes. Another research was conducted by Natasha & Wisanti (2020), namely in the form of research on the development of student worksheet as a learning medium for class X fern classification and kinship topic which was declared valid and practically used in learning to train students' analytical thinking skills. Similar research was also conducted by Bierera & Muchlis (2021) which stated that student worksheet was appropriate for use in training students' analytical thinking skills in electrolyte and non-electrolyte topic. Student worksheet is developed in electronic form because it is more practical, easy to access, and available all the time because of its digital presentation. TSTS-based electronic student worksheet on inheritance topic that focuses on the hereditary disorders sub-topic in humans has never been developed before.

Based on the descriptions above, it is necessary to conduct research on the development of electronic student worksheet based on two stay two stray model in the inheritance topic which is valid and effective in training students' analytical thinking skills. The validity of the electronic student worksheet is described from the validation results carried out by the validator. The effectiveness of the electronic student worksheet is described from the learning outcomes and student response questionnaires.

METHODS

This research type is research and development (R&D), which aims to develop teaching materials and then implemented on a limited in the classroom. The product of this research is electronic student worksheet-on the inheritance topic based on two stay two stray models. The electronic student worksheet was developed using the ADDIE model which consists of 5 stages, which are Analysis, Design, Development, Implementation, and Evaluation. The development of the electronic student worksheet was carried out at FMIPA, Unesa in April 2023. The validation of the electronic student worksheet was carried out in May 2023 at FMIPA, Unesa. And the electronic student worksheet was tested in June 2023 at SMA Negeri 3 Sidoarjo, using a sample of 16 students from Phase F of SMA Negeri 3 Sidoarjo.

The validity of the TSTS-based electronic student worksheet is determined based on the results of the validation of the electronic student worksheet by the expert referring to the validation sheet instrument. The validity of the electronic student worksheet developed in this research was viewed from several aspects, which are aspects of the concept discovery process, accommodating differences in students' academic abilities, identity, language, content, appearance, and conformity with the skills being trained. In analyzing electronic student worksheet validation data, the following formula was used:

$$\text{Validity score} = \frac{\sum validation\ component\ score}{\sum maximum\ score} \times 4.0 \ldots\ldots\ldots 1$$

Then the validity score was interpreted into eligibility criteria (Table 1). Electronic student worksheet is appropriate for use in learning if it achieves an average score ≥ 2.51.

Table 1. Eligibility Criteria

Average score	Description
3.26-4.00	Very Decent
2.51-3.25	Decent
1.76-2.50	Fairly Decent

1.00-1.75	Inadequate

The effectiveness of electronic student worksheet was based on student learning outcomes and responses. Student learning outcomes were reviewed from the results of the pretest and posttest, while the student responses are obtained from the questionnaire given to students. The effectiveness of electronic student worksheet in the learning process was analyzed using the N-gain test. N- gain is the difference between the pretest scores and posttest scores of the students given before and after learning activities using the TSTS-based electronic student worksheet on the inheritance topic. This reflects an increase in students' ability or mastery of a concept after being trained (Susanto, 2012). Students' test scores can be calculated by the following formula:

$$Student's\ score = \frac{\sum score\ obtained}{\sum maximum\ score} \ x\ 100 ……… 2$$

Students are called complete if the test score is $\geq$ 75. Furthermore, the increase in students' test scores can be calculated using the formula for the gain score as follows:

$$N - gain = \frac{Posttest\ score - pretest\ score}{100 - pretest\ score} …………… 3$$

The N-gain score was then interpreted into the learning outcomes improvement criteria as follows:

Table 2. Learning Outcomes Improvement Criteria

N-gain score	Description
$0.70 < score \leq 1.00$	High
$0.30 < score \leq 0.70$	Medium
$0.00 < score \leq 0.30$	Low

(Source: Hake, 1999)

The effectiveness of the electronic student worksheet in the learning process was also reviewed from the results of the student response questionnaire which was analyzed using the NVivo 12. The qualitative data analysis process in NVivo 12 aims to analyze the open questionnaire answer data of students' responses to learning using electronic student worksheet which have been developed effectively and efficiently. The output results from NVivo 12 showed the use of TSTS-based electronic student worksheet on the inheritance topic was related or not to the improvement of students' analytical thinking skills.

The use of electronic student worksheet is

(Source: Ridwan, 2013)

effective if the output results of NVivo 12 state that students' responses to indicators of analytical thinking skills have a relationship.

RESULTS AND DISCUSSION

This research produced electronic student worksheet based on TSTS in inheritance topic that valid and effective in training students' analytical thinking skills. The analytical thinking skills trained in this electronic student worksheet are differentiating, organizing, and connecting. The TSTS-based electronic student worksheet in inheritance material consists of features and learning activities that train students' analytical thinking skills (Table 3).

Table 3. Features in TSTS-based electronic student worksheet in in heritance topic

No.	Feature	Description
1.	LAMAN LITERASI	This feature facilitates students to understand the information presented.
2.	STUDI KASUS A	This feature invites students to analyze the problems presented with their groups starting with identifying, examining, evaluating, analyzing data, and making conclusions.
	Mengidentifikasi Masalah	Contains activities to train analytical thinking skills in differentiating.
	Mengkaji Masalah	Contains activities to train analytical thinking skills in differentiating.
	Mengevaluasi Masalah	Contains activities to train

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		analytical thinking skills in organizing.
	Mengolah Data	Contains activities to train analytical thinking skills in organizing.
	Menarik Kesimpulan	Contains activities to train analytical thinking skills in connecting.
3.	TUKAR INFORMASI	This feature invites students to convey the results of their group discussions to other groups in the two stay two stray format.
4.	AYO PRESENTASI	This feature invites students to present the results of discussions and exchange information in front of the class.

Validity

The TSTS-based electronic student worksheet for inheritance topic has been validated by two expert validators with assessments based on didactic, construction, and technical requirements. Based on the results of the recap validation data, a diagram was obtained as shown in Figure 1. The validity of the TSTS-based electronic student worksheet that has been developed obtains an average score of 3.7 from the validator so it was called very decent category when interpreted to eligibility criteria. This showed that the developed TSTS-based student worksheet was very decent to use in the learning process to train students' analytical thinking skills on inheritance topic when viewed from the validity test results.
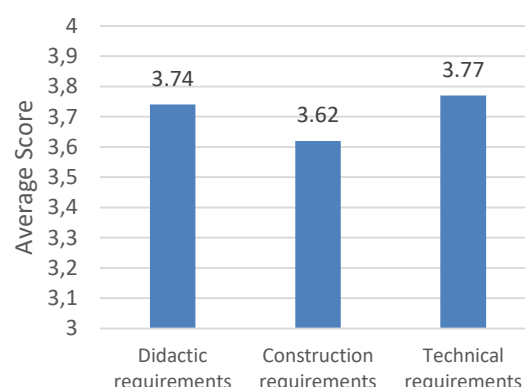

Figure 1. Electronic student worksheet validation score data

The didactic requirements in the TSTS-based electronic student worksheet on inheritance topic obtain an average validity score of 3.73 and are called very decent category after being interpreted into eligibility criteria. In this didactic requirement, there were two aspects, namely the concept discovery process aspect with an average validity score of 3.87 and the accommodation of students' academic ability differences with an average validity score of 3.6. Aspects of the concept discovery process get the highest average score, while the aspect of accommodating differences in students' academic ability gets the lowest average score. This can be caused by the activities in the electronic student worksheet requiring students seeking information and studying it when they have never learned this topic before, so it is considered that not all students can follow it properly. According to Arianti (2015), a good electronic student worksheet is a worksheet that follows the principles of effective learning such as paying attention to differences in students' ability. The developed TSTS-based electronic student worksheet has an average score of validity that was quite high for this aspect, so it can be categorized as a valid teaching material with very decent eligibility criteria.

The electronic student worksheet's construction requirements obtain an average validity score of 3.64 and were called very decent category after being interpreted into eligibility criteria. The didactic requirements consist of several aspects, including aspects of title identity with an average validity score of 3.87, time allocation with an average validity score of 3.73, learning objectives with an average validity score of 3.47, instructions for use with an average validity score of 3.6, bibliography with an average validity score of 3.87, linguistic aspects of grammatical suitability with an average validity score of 3.33, use of simple sentences with an average validity score of 3.6, and kind of questions in the electronic student worksheet aspect with an average validity score of 3.6. As stated by

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Kurniawan (2015), that a quality worksheet must contain appropriate linguistic elements and use a sentence structure that is easy to understand. The identity aspect of the title and bibliography got the highest average validity score, while the linguistic aspect got the lowest score. This can be caused because there were many sentences that were confusing or have double meanings, as well as the presence of several writing errors.

In this TSTS-based electronic student worksheet, the technical requirements obtain an average validity score of 3.77 and were called very decent category after being interpreted into eligibility criteria. The technical requirements consist of several aspects, including aspects of the electronic student worksheet cover display with an average validity score of 3.87, images in electronic student worksheet with an average validity score of 3.6, writing in electronic student worksheet with an average validity score 4, and the aspect of training analytical thinking skills with an average validity score of 3.6. According to Hasanah (2016), electronic student worksheet is appropriate to use if it can provide opportunities for students to play an active role in discovering a concept to practice their thinking skills. The aspect of displaying writing in the electronic student worksheet got the highest average validity score, while the aspect of displaying pictures and aspects of practicing analytical thinking skills got the lowest score. This could be due to the lack of pictures presented in the electronic student worksheet, as well as activities on electronic student worksheet features that still need to be adjusted a little more with analytical thinking indicators.

Based on the results of the validation of the aspects contained in it, this electronic student worksheet was stated to be very decent when interpreted in eligibility criteria because it meets the criteria for good teaching materials in terms of didactic, construction, and technical requirements (Widjajanti, 2008). The developed electronic student worksheet also meets the requirements in training students' analytical thinking skills using the TSTS-based learning model. This was because the developed electronic student worksheet has a syntax that has been adapted to the syntax of TSTS-based learning by paying attention to indicators of students' analytical thinking skills such as differentiating, organizing, and connecting.

Learning Outcomes

Student learning outcomes data obtained from the results of the pretest and posttest assessments were used to describe the effectiveness of using the TSTS-based electronic student worksheet in inheritance topic in

training students' analytical thinking skills. The pretest and posttest were used to find out the differences in students' analytical thinking skills before and after being trained using the TSTS-based electronic student worksheet. Based on the results of the assessment tests that have been carried out, the learning outcomes data were obtained as shown in Figure 2.
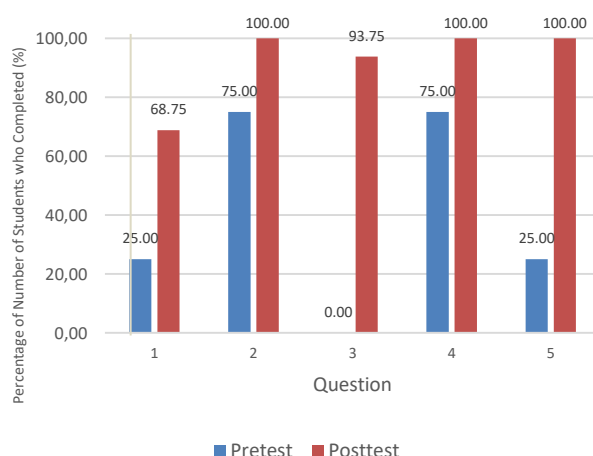

Figure 2. Students' pretest and posttest completeness data

The electronic student worksheet is stated to be effective if students have an N-gain score which called a high level of learning outcomes improvement criteria, that is $0.70 < \text{score} \leq 1.00$ (Hake, 1999). The N-gain score was obtained from calculations obtained from pretest and posttest score data. Based on the results of the analysis of the calculations that have been carried out, the N-gain score data was obtained as shown in Figure 3.
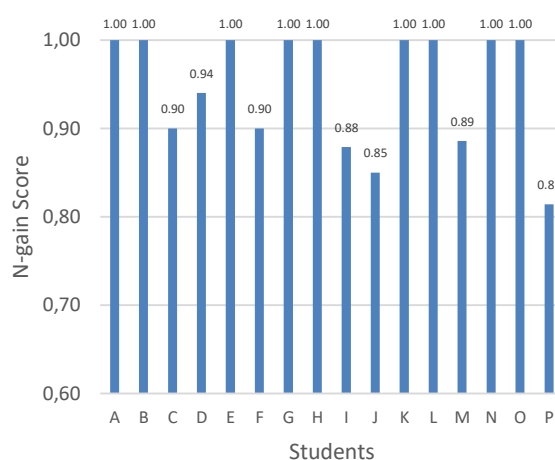

Figure 3. N-gain score of student learning outcomes data

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Based on Figure 3 it was known that all students have an N-gain score > 0.70 with an average score of 0.94, which means that they have high learning outcomes improvement criteria. The lowest N-gain score was 0.81 and the highest N-gain score was 1.00. From these data it can be stated that the use of TSTS-based electronic student worksheet on inheritance topic was effective in training analytical thinking skills when viewed from student learning outcomes. As stated by Sulistiyono (2017), learning that trains students' thinking skills can also improve student learning outcomes.

The pretest and posttest which were given to the students each consisted of five questions. At the pretest, all students were unable to answer question number 3 which asked students to make a cross chart, and 25% of students were unable to answer questions number 1 and 5 which asked students to make a cross chart and process data from the results of the study and prove. Question number 1 contains indicators of analytical thinking skills "differentiating" which contain study activities, where students were asked to make a cross chart for the next possible filial after studying the pedigree presented in the problem. Question number 3 contains indicators of analytical thinking "organizing" which contains evaluating activities, where students were asked to provide proof of the hypothesis that has been compiled in question number 2. Question number 5 contains indicators of analytical thinking "organizing" which contains data processing activities, where students were asked to answer questions from the results of processing data obtained from working on previous questions. This was because most students do not know how to write genotypes for albino disorders, and have difficulty crossing them with genotypes of fellow albinos, normal, or carriers.

In the posttest, students were able to understand what was asked for in each question but there were some who were still confused when making cross charts and writing individual genotypes. This was indicated by some students who were not quite right in answering posttest question number 1 which has indicators of analytical thinking skills "differentiating" which include studying activities, where students were asked to make a cross chart of the next possible filial after studying the pedigree presented in the question. Some of the students experienced confusion in writing recessive or dominant genes, and some experienced miscalculations.

Based on the data from the students' pretest and posttest results as illustrated in Figure 2, it shows that all students experienced an improvement in each indicator of analytical thinking skills. The first indicator of analytical

thinking skills was "differentiating" includes studying and identification activities, which were found in questions number 1 and 2. The percentage of students who can answer correctly on question number 1 has increased, from 25% at the pretest to 68.75% at the posttest. The increase in the percentage of students who can answer correctly the questions also occurred in question number 2, from 75% during the pretest to 100% during the posttest.

The second indicator of analytical thinking skills was "organizing", includes activities to evaluate and process data, which were found in questions number 3 and 5. The percentage of students who can answer correctly questions number 3 has increased, from 0% at the pretest to 93.75% at during the posttest. The increase in the percentage of students who can answer correctly also occurred in question number 5, from 25% during the pretest to 100% during the posttest.

The third indicator of analytical thinking skills was "connecting", includes the activity of making conclusions, which was contained in questions number 4. The percentage of students who can answer correctly question number 4 has increased, from 75% during the pretest to 100% during the posttest. The highest improvement in the percentage of student completeness occurred in question number 3 which was evaluating activities, 93.75%. Meanwhile, the lowest increase in the percentage of student completeness occurred in questions number 2 and 4, which were 25% each. This was because at the pretest 75% students had been answered correctly on questions numbers 2 and 4, and during the posttest all students can answer correctly these questions. So that there was not much increase in percentage.

Student completeness on each question was viewed from the score obtained, and if students do not get a full score then completeness was viewed from the total score by paying attention to certain parameters such as students' understanding in answering the questions from the way they answer. But overall, all students have increased learning outcomes that were included in the criteria of high learning outcomes improvement. Therefore, the TSTS-based electronic student worksheet are stated effective and decent to use to train students' analytical thinking skills when viewed from the improvement of student learning outcomes.

Student Responses

Student response questionnaire data was used to describe the effectiveness of the electronic student worksheet in training students' analytical thinking skills. At the end of the learning activity, students were given a questionnaire containing open-ended questions to describe their responses after participating in learning using the TSTS-based electronic student worksheet on inheritance

topic. The aspects contained in the questionnaire include activities that contain indicators of analytical thinking skills such as identifying, studying, evaluating, processing data, and making conclusions. Based on the response questionnaire that was filled out by the students and analyzed, it showed that the use of the TSTS-based electronic student worksheet has a relationship with students' analytical thinking skills. The analysis result is shown in Figure 4.

In each activity that contains indicators of students' analytical thinking skills, the results of the analysis were projected with a project map. The project map displayed student responses regarding their abilities in activities that train indicators of analytical thinking skills using TSTS-based electronic student worksheet material on inheritance. The results of student responses to the ability to identify physical traits and characteristics inherited in humans after participating in learning using the TSTS-based electronic student worksheet on inheritance material were projected with the project map in Figure 5. About 6.25% of students responded that they understand a little. Meanwhile, 12.5% of other students responded that their abilities had improved, 62.5% of students responded that they understood more, and 18.75% of students responded that they understood enough.
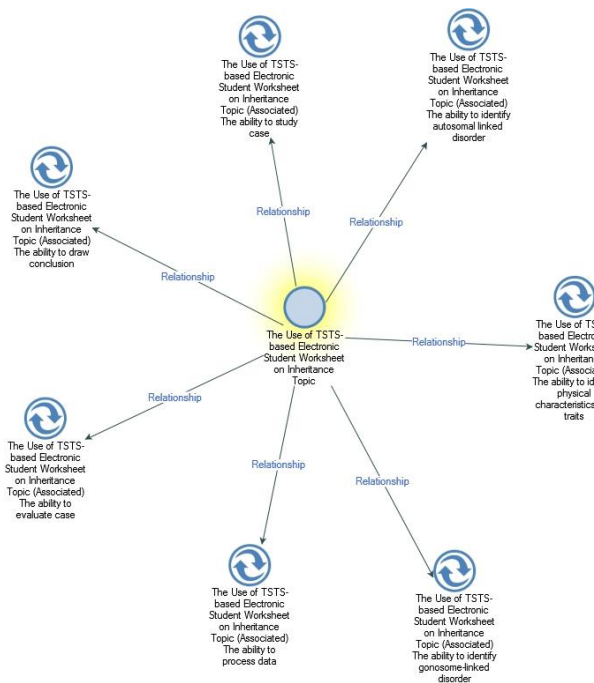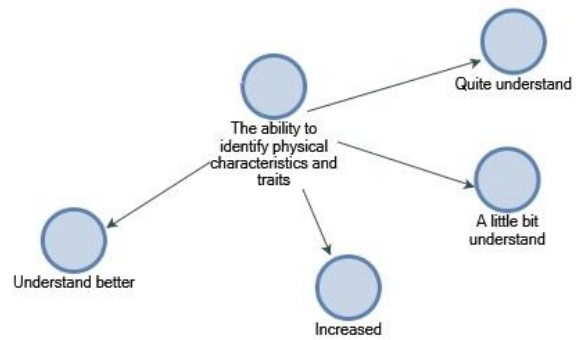

Figure 5. Project map ability to identify physical traits and characteristics that are inherited in humans

The results of students' responses to the ability to identify cases regarding inherited disorders in humans due to linkage with autosomes after participating in learning using the TSTS-based electronic student worksheet on inheritance topic were projected with the project map in Figure 6. About 12.5% of students responded that they understand a little and 12.5% of other students understand enough. Meanwhile, 18.75% of other students responded that their abilities had increased, and 56.25% of students responded that they understood better.

Figure 4. Relationship between the use of TSTS-based electronic student worksheet with students' analytical thinking skills
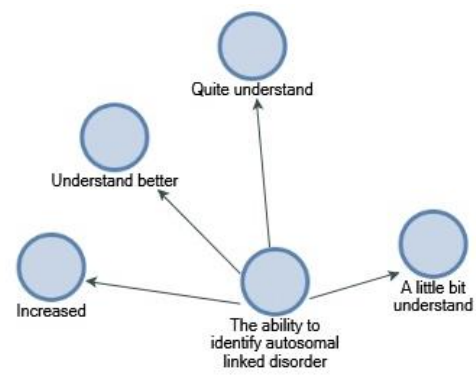

Figure 6. Project map ability to identify cases regarding inherited disorders in humans due to linkage with autosomes

The results of students' responses to the ability to identify cases regarding inherited disorders in humans due to linkage with gonosomes after participating in learning using the TSTS-based electronic student worksheet on inheritance topic were projected with the project map in Figure 7. Around 25% of students responded that they were a little helped and 6.25% of other students understand a little. Meanwhile, 18.75% of other students responded that their abilities had improved, 25% of students responded that they were more helpful, and 25% of students responded that they understood more.
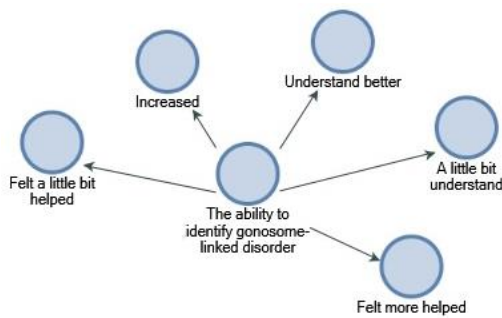
Meilinda, Alfina dan Lisdiana, Lisa: Eligibility of Electronic Student Worksheet

Figure 7. Project map ability to identify cases regarding inherited disorders in humans due to linkage with gonosomes

The results of students' responses to the ability to study cases presented after participating in learning using the TSTS-based electronic student worksheet on inheritance topic were projected using the project map in Figure 8. About 12.5% of students responded that they understood enough. Meanwhile, 18.75% of other students responded that their abilities had improved, and 68.75% of students responded that it became easier for them to study cases.
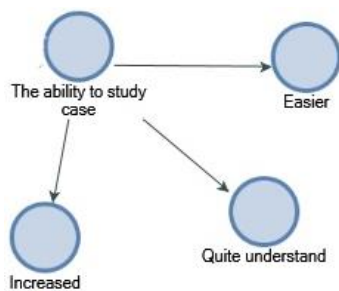

Figure 8. Project map ability to study cases presented

The results of students' responses to the ability to evaluate the cases presented by conducting proofs after participating in learning using the TSTS-based electronic student worksheet on inheritance topic were projected with the project map in Figure 9. About 12.5% of students responded that they felt their abilities had increased, and 87.5% of students responded that they understood better in making proofs after being trained using the TSTS-based electronic student worksheet.
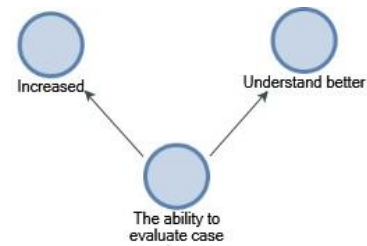

Figure 9. Project map ability to evaluate the cases presented

The results of students' responses to the ability to process data found from cases presented by doing proof after participating in learning using the TSTS-based electronic student worksheet on inheritance topic were projected with the project map in Figure 10. About 12.5% of students responded that they were understand enough. Meanwhile, 12.5% of other students responded that their abilities had improved, and 75% of students responded that they felt their ability to process data found from case presented was better after being trained with the TSTS-based electronic student worksheet.
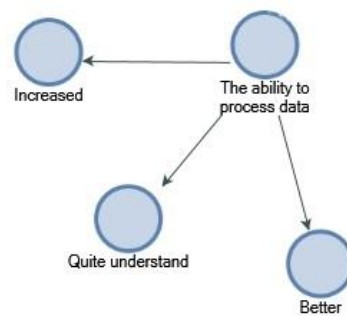

Figure 10. Project map ability to process data found from cases presented

The results of students' responses to the ability to draw conclusions based on the proof by proving after participating in learning using the TSTS-based electronic student worksheet on inheritance topic were projected with the project map in Figure 11. About 6.25% of students responded that they understood enough. Meanwhile, 12.5% of other students responded that their abilities had improved, and 81.25% of students responded that they felt their ability to draw conclusions based on the results of evidence had gotten better after being trained with the TSTS-based electronic student worksheet.
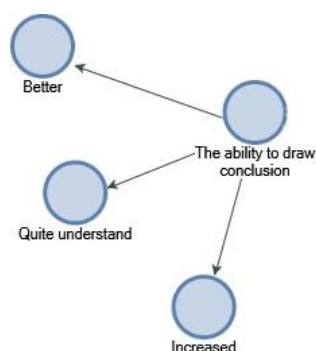
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Figure 11. Project map ability to draw conclusions

In general, the use of TSTS-based electronic student worksheet on inheritance topic has a positive effect on improving students' analytical thinking skills. This was shown by the students responding that their abilities which were included in the indicators of analytical thinking increased, from those who previously could not understand to become more understand, felt more helped, and quite understanding. As stated by Hasanah (2016) that electronic student worksheet is appropriate to use if students can play an active role in discovering a concept in practicing their thinking skills. Therefore, the TSTS-based electronic student worksheet can be stated as effective and appropriate to be used to train students' analytical thinking skills when viewed from the results of the student response questionnaire.

CLOSING

Conclusion

From the research that has been done, it can be concluded that the electronic student worksheets based on two stay two stray on inheritance topic that has been developed are valid and effective for training students' analytical thinking skills on inheritance topic, based on the results of validation by expert validator, as well as students' learning outcomes and responses.

Suggestion

Further research is needed on actual classroom conditions because this research was tested in a limited implementation with only 16 students. As well as the need for similar research on other biology materials to train students' analytical thinking skills.

ACKNOWLEDGMENT

The researchers deliver their gratitude to the validator Prof. Dr. Endang Susantini, M.Pd and Guntur Trimulyono, S.Si., M.Sc. who have provided advice on

the developed electronic student worksheet. As well as XII F2 students of SMAN 3 Sidoarjo who have helped with the limited implementation of the electronic student worksheet that was being developed.

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