DESIGN AND DEVELOPMENT OF EDUCATIONAL DEVICES PLANT DIVERSITY INQUIRY GUIDED BY PODCASTS AND GOOGLE CLASSROOM TO INFLUENCE STUDENTS' SCIENTIFIC WORK ABILITIES AND CRITICAL THINKING

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Abstract: The globe is currently in the twenty-first century. The 21st century requires 4C (Critical Thinking, Communication, Creative Thinking, and Collaboration) abilities, as well as scientific work. In an effort to prepare students for the difficulties of the twenty-first century, the Indonesian government developed the 2013 curriculum via a scientific method. Inquiry in line with the 2013 curriculum. Due to the pandemic Covid-19, educational activities must be conducted online. Online education necessitates creativity in learning activities. Podcasts may be utilized as a kind of educational material that can be accessed from any location and at any time. The objectives of this research and development are to: (1) design and develop plant diversity-based inquiry-based podcasts and Google Classroom; and (2) influence the scientific work abilities and critical thinking of class X students at Malang's State Senior High School 8. (SMAN 8 Malang). The improvement of student abilities may be determined by comparing the pretest value to the posttest value using n-gain. Addie from Branch was utilized as the development model. Instruments for data collection include validation sheets, questionnaires designed to assess learning, student response surveys, and pretest and posttest questions. The research was performed at Malang's State Senior High School 8 (SMAN 8 Malang), using students from class X MIA-4 as subjects. The validation results for the design and learning tools generated are 82.4 valid categories, 89 and 82.3 highly practical categories, and 0.06 for the efficacy of scientific work students' skills 0, 2 and critical thinking.

Keywords: Draft learning, guided inquiry, scientific work, critical thinking

INTRODUCTION

At the present, the globe is considered as the globalization century or century of openness in the twenty-first century. The fast expanding technology in numerous spheres of life, including education, in the twenty-first century. The global period and the incorporation of technology into education have aided in the acceleration of cross-field knowledge synergies (Sudarisman, 2015). The Partnership for 21st Century Abilities (P21), based in the United States, defines the 21st century skills that are required, including critical thinking, communication, creative thinking, and collaboration. These are referred to as 4C abilities.

Critical thinking is a form of logical and reflective reasoning that focuses on deciding what to believe or work on (Ennis, 2011). According to Ennis (2011), someone with critical thinking skills will strive to do something correctly; will present opinions honestly and clearly; will show concern for others; will have a clarification skill, will look for and judge well for reviewing; will conclude wisely; and will imaginarily assume and integrate. Students who possess critical thinking abilities can reason reasonably and logically when it comes to processing information and thinking in a systematic manner. According to Ennis (2011), critical thinking abilities can be classified into 5 indicators: (1) providing a simple explanation (elementary clarification), (2) developing fundamental skills (Basic

Support), (3) concluding (inference), (4) providing an explanation Furthermore (advance clarification), and (5) regulating strategies and tactics (strategy and tactics).

According to Regulation of the Minister of Education and Culture No. 21 of 2016, one of the competences that high school students studying biological topics must possess is the ability to use scientific and safe work processes in the Biology Laboratory. The term "scientific work skills" refers to the ability to tackle issues in a systematic or sequential fashion (Rasmawan, 2017). When conducting scientific research, it is necessary to be critical, rational, and scientific (Rustaman, 2003). According to Ibrohim in Kholifah (2018), indicators of scientific work skills include the following: (1) formulating questions / problems; (2) formulating hypotheses / opinions; (3) conducting experiments and/or data observations (assembling, observing, measuring, manipulating variables); (4) processing data; (5) organizing data, grouping, classifying, comparing, and analyzing; and (6) formulating conclusions / inferences.

Indonesia's government created the 2013 or K-13 curriculum in an effort to prepare students for the difficulties of the twenty-first century. The 2013 curriculum takes a scientific or process-based approach to learning. The scientific method is designed to provide students with the knowledge, comprehension, and ability to apply what is being studied scientifically (Musfiqon, 2015). At least three learning paradigms are applicable to the scientific method, namely: (1) project-based learning, (2) problem-based learning, and (3) inquiry-based learning (Musfiqon, 2015).

The inquiry-based approach of education attempts to educate students how to think (Arends, 2011). Guided inquiry is a method of inquiry learning that actively engages students in the learning process and enhances their understanding of topics, rather than relying on a passive technique that is frequently employed in education (Minner, 2010). Mulyana et al. (2018) highlighted that the guided inquiry learning methodology enables students to directly learn how to discover facts, concepts, and principles. The inquiry learning model's syntactic structure is presented in Table 1.

According to the common Indonesian Dictionary, design is a plan or anything that has been planned, whereas device is an item that has been designed (KBBI). Based on a Minister of Education and Culture regulation. 2016 No. 22 Learning Planning entails the development of a Learning Implementation Plan, the development of media and learning resources, the development of learning assessment devices, and the development of learning scenarios. The syllabus, lesson plan, student worksheet utilizing guided inquiry learning syntax, assessment instrument (scientific work and critical thinking), and podcasts all explain the learning design.

Coronavirus 2019 caused respiratory system illnesses in December 2019 in Wuhan, China (Covid-19). Covid-19 has been confirmed in Indonesia as of March 2, 2020. The educational impact of Covid-19 is the closure of educational institutions like as schools, colleges, and Islamic residential schools. The Ministry of Education and Culture has decided to undertake learning online or via distance learning in this respect (Ministry of Education and Culture, 2020).

Online learning can be implemented in a synchronous or asynchronous fashion. Google Classroom enables asynchronous learning. Bondarenko (2016) discusses the benefits of Google Classroom, including how it maintains classroom integrity and tasks outside of class (group, independent, and individual); allows for editing and commenting on student duty status; compiles individual assignments into thematic modules; and establishes deadlines for individual tasks.

According to the findings of an interview conducted on December 17, 2020 with biology teachers at Malang's State Senior High School 8 (SMAN 8 Malang), online learning obstacles and challenges included limited face-to-face interaction between students and teachers, quota-credit limitations, and unfamiliarity with online learning. The students wanted learning media that facilitated accessible online learning whenever and whenever, and could be downloaded without consuming a large amount of quota-credit.

Tabel 1. Syntax of Guided Inquiry Learning Model according to Arends (2011)

Phase	Teacher Behavior
1. Gain attention and explain the inquiry process.	Teacher provides students to learn and absorb information and then outlines the lesson's process.

2. Present the inquiry problem or discrepant event.	Teacher presents students with the problematic circumstance or discrepant occurrence.
3. Have students formulate hypotheses to explain the problem or event.	Teacher encourages students to inquire about the issue scenario and to create hypotheses to explain what is occurring.
4. Encourage students to collect data to test the hypothesis.	Teacher subsequently inquires as to how students can collect data in order to test their ideas. In some instances, experiments can be conducted in class.
5. Formulate explanations and/or conclusions.	Teacher concludes the inquiry by encouraging students to draw conclusions and generalizations.
6. Reflect on the problem situation and the thinking processes used to into it.	Teacher encourages students to reflect on their own thinking processes and on the inquiry process.

Podcasts are one type of educational material that promotes online learning. Podcasts are digital video files that are delivered through the internet via a personal computer or cellular device (McGarr, 2009). Podcasts have been used in education to record and distribute learning (Griffin et al., 2009). Sudarmoyo (2020) explains in his research that media podcasts as an alternative to distance learning can be a supporter of learning materials that we will convey to pandemic periods such as today, so that the submission of material is more creative and withdrawing for the flexibility of listeners to listen to this material when the mood strikes them.

The information on plant diversity is divided into basic competence (K.D) 3.8 and 4.8 class X. Students can use the Plantianth material to observe, desert, identify, and categorize (Erinda, 2018). A guided inquiry is one type of supporting learning approach for basic competence (K.D) 3.8 learning. Sabiran (2013) explains learning through guided inquiry models that allow students to practice conducting investigations to gather and analyze data in accordance with the facts in the environment in order to independently construct a concept to address the teacher's issue.

According to the results of the questionnaire provided to students, an average of 6.8 % have more than adequate scientific work abilities, 9 % possessed adequate critical thinking skills, and 54.5 % possessed more than adequate critical thinking skills. According to interviews with Biology Teachers Class X of State Senior High School 8 of Malang (SMAN 8 Malang), certain students can be encouraged to think critically, particularly about patterns.

The objective of this research and development is to (1) design and develop plant diversity-based inquiry-based podcasts and Google Classroom, as well as (2) influence the scientific work abilities and critical thinking of class X students at State Senior High School 8 of Malang (SMAN 8 Malang).

METHOD

ADDIE from Branch was utilized as the study model and development (2009). Five steps comprise the ADDIE development model: analysis, design, development, implementation, and evaluation. Figure 1 illustrates the steps of research and development using the Addie development model.

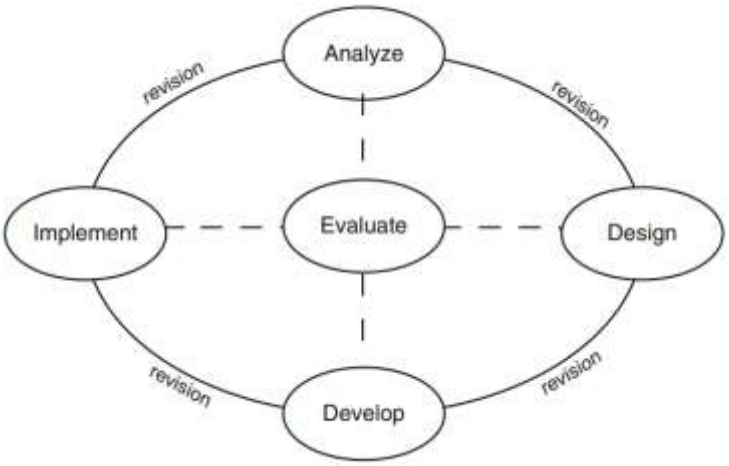

Figure 1. ADDIE Development Procedure
Source: Branch, 2009

The study was conducted at State Senior High School 8 of Malang (SMAN 8 Malang) located on Jalan Veteran No. 37 in Malang City. This investigation was carried during the even semester of the 2020/2021 academic year, from February to April 2021. Students from class X MIA-4 of State Senior High School 8 of Malang (SMAN 8 Malang) served as research participants. Learning devices, material experts, and field practitioners were validated by experts, namely (1) Drs. H. Triastono Imam Prasetyo, M.Pd as a learning device expert, (2) Dr. Murni Sapta Sari, M.Si as a material expert, and (3) Wiedia Carullina Purwanti, M.Pd, as a field practitioner.

Validation sheets, questionnaires for applying learning, student response questionnaires, and pretest and posttest questions were utilized as data collecting devices. The data collected is qualitative and quantitative. Qualitative data is gathered through the validator's remarks and suggestions. Quantitative data in the form of a validator questionnaire score evaluation, student effectiveness questionnaires, and n-gain scores for pretest-posttest outcomes.

RESULTS

The study's results include the development of design and learning devices, the validation results, the validator's recommendations, the study's practicality, and the outcome of the design and learning tools' efficacy.

a. *Analysis*

The analysis phase's objective is to discover discrepancies between ideal and actual circumstances for implementing biology instruction in the classroom. The analysis was conducted to ascertain the gap between desired learning expectations and field reality, to ascertain the indicators of competence (IK) and learning objectives (TP) from Basic Competence (KD) 3.8 and 4.8, to ascertain the research subject, to ascertain the resources required, to ascertain the potential delivery systems, and to ascertain the implementation plan.

b. *Design*

The design stage's objective is to plan and create a device for learning and design. At the design stage, (1) Basic Competence (KD) 3.8 and 4.8 class X are examined to determine the learning indicator, (2) the competency indicator is examined to determine the learning objectives, and (3) a testing strategy is developed, specifically using data collection instruments.

c. *Development*

The development stage's objective is to create and validate the goods. At the creation stage, activities included (1) gathering material and building learning tools, (2) selecting and producing media to accomplish goals, (3) utilizing use instructions for students in the form of student worksheets, and (4) utilizing use instructions for teachers. Syllabuses, lesson plans, student worksheets, assessment tools, and podcasts; (5) validate and modify the product; and (6) perform product trials.

d. *Implementation*

The implementation phase entails the deployment of a guided plant-based plant diversity and learning device that has been designed via teacher preparation and student preparation.

e. *Evaluation*

The evaluation stage's objective is to determine the product's quality both before and after deployment. At each step of progress, an evaluation is conducted. Calucidan, practicality, and efficacy are all assessed on the goods created.

Following the development of design and learning tools, validation activities on the final products are conducted, namely the experts of learning devices, material experts, and field practitioners described by Figure 2. Validation criteria using Akbar (2013).

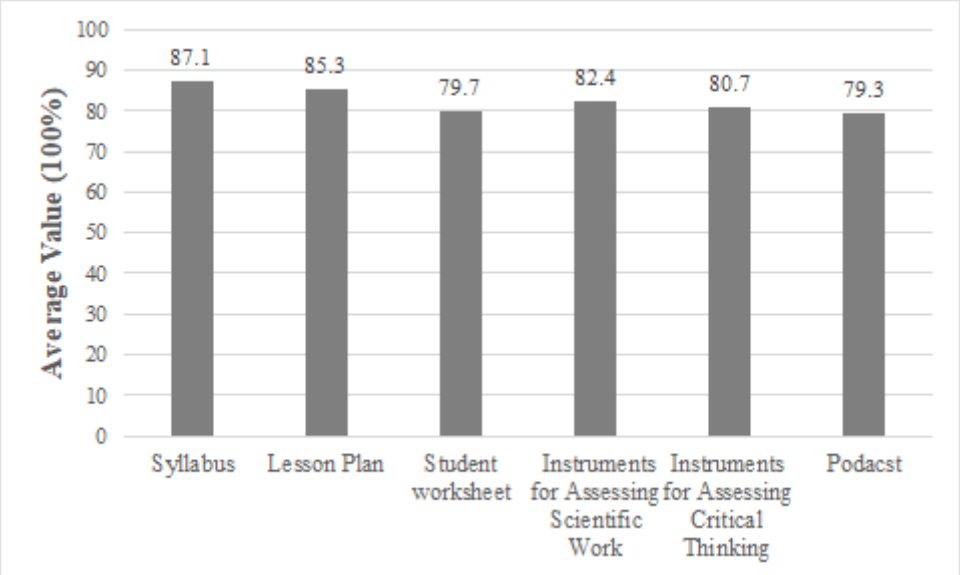

Figure 2. Draft Validation Results and Learning Devices

Based on the figure 2, which represents the outcome of the syllabus validation for 87.1% using a highly valid criterion. Validation results for lesson plan average of 85.3% with valid criteria. With appropriate criteria, the average level of student worksheet validation is 79.7%. The scientific work assessment instrument has an average validation score of 82.4% using valid criteria. The average score for validating critical thinking assessment tools is 80.7%. With appropriate criteria, the average podcast validation result is 79.3%. The average number of design and learning devices generated is 82.4%, with valid criteria indicating a suitable learning device for use in learning.

At the validation stage, the validator conducts an assessment and provides advice for product development to be better. Advice from validators as follows.

Suggestions for the development of syllabus, namely:

a. We recommend that the numbering indicator follows the basic competence (KD) number.
b. Learning activities are adjusted to guided inquiry models.

Advice for the development of lesson plan, namely:

a. The formulation of learning objectives has not yet shown ABCD (Audience, Behavior, Conditional, Degree)
b. Learning outcome assessment is more adjusted to the indicator of competency achievement.

Advice for the development of lesson plan, namely

a. **Determine what plants first is so it will be more appropriate to describe the characteristics in the table.**
b. **The reading source used should use local news (utilizing local resources) so that it is more meaningful and related to everyday life.**

Suggestions for the development of scientific work assessment instruments, namely

a. We typically propose comparing low and high level plants in terms of basic comptence (KD).

b. We propose that the plant's examples in response to inquiries be more meticulously constructed (more than 2 plants).

Advice for the development of critical thinking assessment instruments, namely:

a. Because there are more questions regarding plants, you should include questions on their qualities.
b. The questions should be focused on local issues and should assess students' abilities to criticize and propose solutions.

Advice for the development of podcasts, namely

a. Included pictures to assist students in comprehending the content.
b. Sensation If you're looking for further content, and according to basic competence (KD), it's more acceptable to discuss Indonesia, which is rich in flora.

Dualded learning gadgets are then deployed in four sessions in class X MIA-4 of State Senior High School 8 of Malang (SMAN 8 Malang). Implementation is conducted to ascertain the scores of scientific job skills, the importance of critical thinking skills, the practicality, and the efficacy of design and learning gadgets.

The findings of the learning and student response questionnaire sheet are used to determine the practicality of learning gadgets. The evaluation of the application of learning devices is based on observations made by the Observer, who is the Biology Teacher at State Senior High School 8 of Malang (SMAN 8 Malang). Student response data were gathered utilizing a response questionnaire distributed at the completion of learning activities in class X MIA 4. The results of the practicality test are depicted in Figure 3. Validation criteria using Akbar (2013).

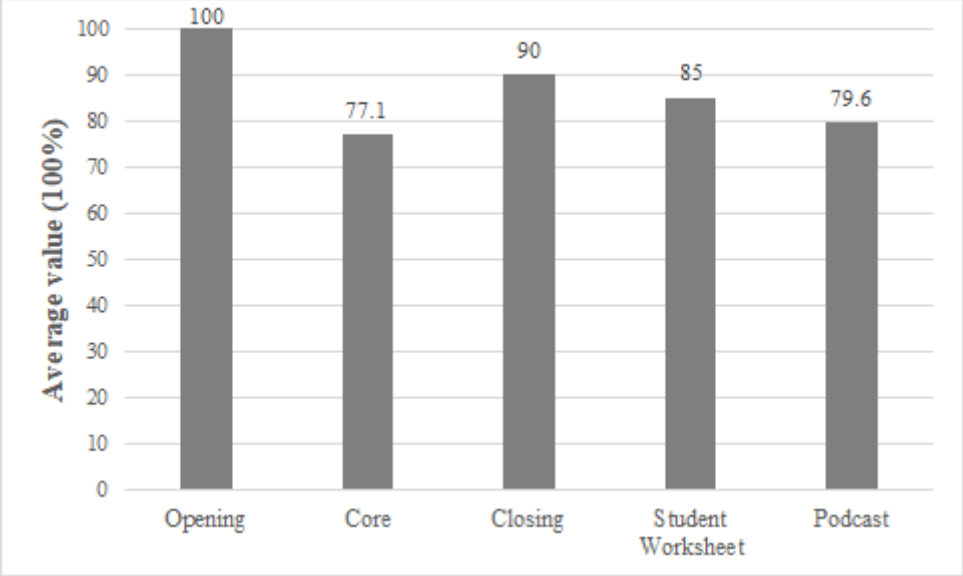

Figure 3. Results of practicality by field practitioners and students

Figure 3. Shows practical test through the implementation of learning devices by teachers and student response questionnaires. Introduction Activities of 100% Criteria are very practical, core activities of 77.1% practical criteria, and cover activities of 90% of criteria are very practical. The average implementation of learning devices is 89% of the criteria very practical. Student response questionnaire about student worksheet is 85% of the very practical criteria and podcasts of 79.6 practical criteria. The average practicality of learning devices based on student response is 82.3% of the very practical categories. Based on the average value of the practicality of learning devices it can be concluded that learning devices developed are very practical.

The specific test of learning devices is known from increasing the value of the pretest and posttest students using n-gain. Pretest and posttest are used to determine scientific work skills and critical thinking of students. The N-gain formula is as follows.

$$g = \frac{post\ score - pre\ score}{\max score\ - pre\ score}$$

Problem tests and rubrics of scientific work skills assessments are guided by indicators of scientific work skills from Ibrohim in Kholifah (2018). Criteria for the scientific work skills category are guided by the Association of American Collages and University in Rasmawan (2017). Prexion Scores Pretest and posttest Scientific Work Skills Students described on Figure 4.

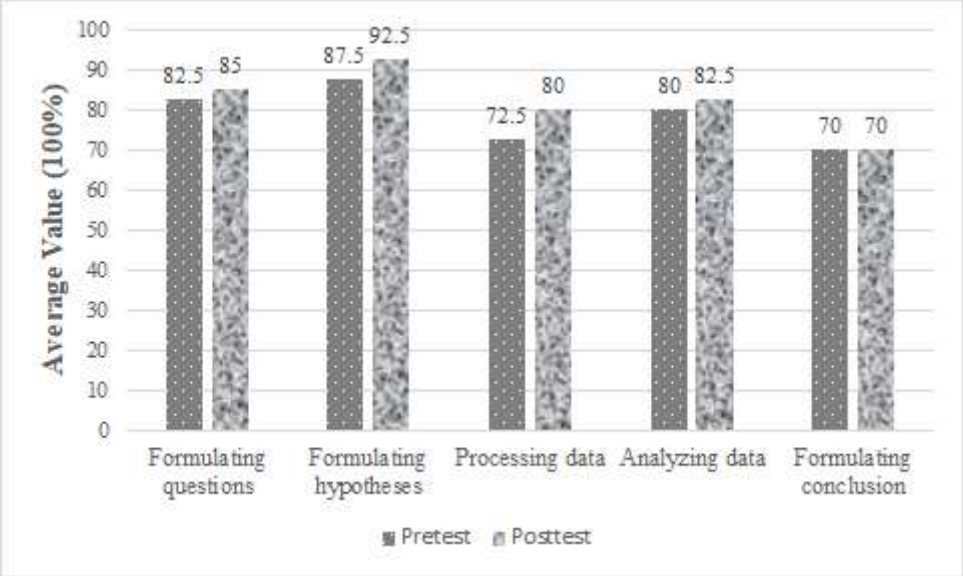

Figure 4. Pretest Score and Posttest Scientific Work Skills

Figure 4. Shows the pretest average and posttest student scientific work skills on each indicator. The average pretest results are 77.5% with skilled criteria and posttest results are 82.5% with skilled criteria. Improving student scientific work skills is known to use n-gain values. N-gain score is 0.2. Based on the interpretation criteria for the effect score of the effectiveness of Hake (1999) the level of effectiveness of learning devices is relatively low.

Problem of testing critical thinking skills is guided by the indicator of Ennis's critical thinking skills (2011). Rubric Rating Critical thinking skills are guided by Zubaidah (2015). Criteria for the critical thinking skills category are guided by Arikunto in Hidayati (2016). Recapitulation of critical thinking skills test results students described on Figure 5.

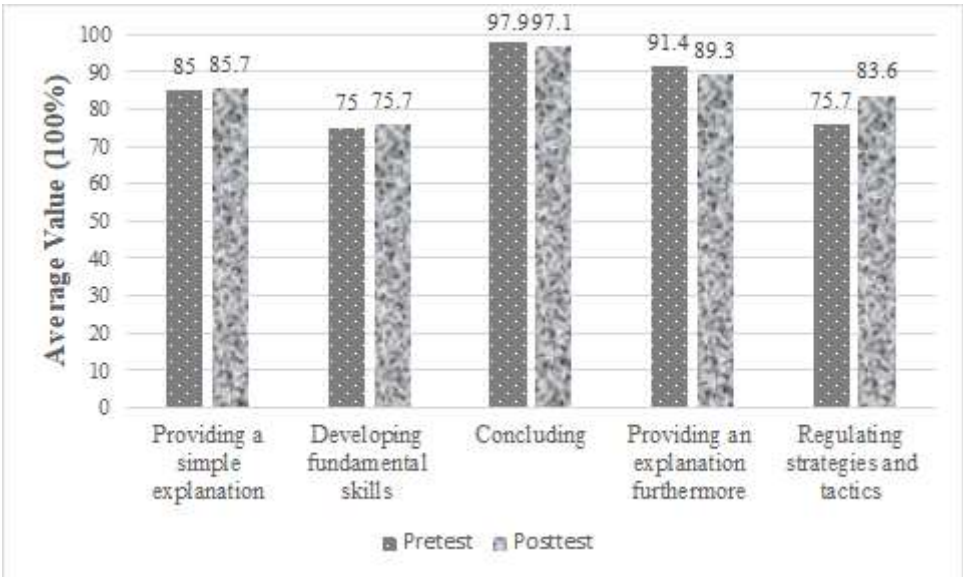

Figure 5. Pretest value and posttest critical thinking skills

Figure 5. shows the average pretest and posttest critical thinking skills of students in each indicator. The mean pretest result is 85% with the criteria very well and posttest results are very good 86% criteria. Increasing students' critical thinking skills known to use N-gain value. N-gain score is 0.06. Based on the interpretation of test scores effectiveness criteria adopted from Hake (1999) the effectiveness of the learning device is low.

DISCUSSION

a. Product Evaluation of Development Outcomes

The syllabus, class plan, student worksheet, assessment tools (scientific work and critical thinking), and podcasts are all expected to be produced. A syllabus serves as a guide for constructing the learning framework for each topic studied (Ministry of Education and Culture, 2016). Excellent Syllabus According to Ministry of Education and Culture Regulation No. 22 of 2016, the most time-consuming components are: 1) Identity (Subjects and Schools), 2) Competence (Core and Fundamentals), 3) Basic Material, 4) Learning, 5) Assessment, 6) Time Allocation, and 7) Learning Resources. Learning activities are organized in the syllabus in line with the phases of guided inquiry, ensuring that learning is student-centered.

A lesson plan is a strategy for doing face-to-face learning activities at one or more meetings (Kemendikbud, 2016). Making RPP or racing from the curriculum is developed. RPP seeks to direct students' learning activities in order to achieve KD. The developed RPP consists of several components, including the following: 1) Identity (School and Subjects), 2) Class / Semester, 3) Time Allocation, 4) Learning Objectives, 5) Knowledge Development, 6) Learning Methods, 7) Learning Models, 8) Learning Media, 9) Learning Resources, and 10) Learning Steps.

A lesson plan was negotiated over the course of four meetings. The first and second meetings in an outline provide information on plant traits, metagenesis, and data comparison between plants (bryophyte, ferns, seeds). The third meeting in an outline comprises actions that categorize plants according to their division and function. In an overview, the fourth meeting comprises activities for analyzing the impact of decreased plant variety.

The student worksheet (LKS) is one of the instructions for students that is used to promote and assist students in the learning process by allowing them to conduct investigations or problem solving exercises (Rahma, 2019 and Nur, 2018). LKS is used as a guide for implementing learning activities and as a tool for learning (Ferdiana et al, 2012). Student worksheet was created utilizing a guided inquiry methodology that included the following components: 1) Title, 2) Student Identity, 3) Basic Comptence (KD), and 4) Learning Objectives. 5) Lesson Plan Usage Instructions, 6) Problems / Events, 7) Hypotheses, 8) Data Collection, 9) Data Communication, 10) Data Analysis, 11) Conclusion, and 12) Reflections. Anggraini et al. (2015) describe that LKS is organized, colorful, and includes pictures to pique students' interest in learning it.

Assessment is the process of gathering and analyzing data in order to evaluate whether or not students have met their learning objectives (Ministry of Education and Culture Regulation No. 23 of 2016). Assessment is used to: 1) determine and quantify student competency attainment, 2) enhance the learning process, and 3). Prepare a progress report on the attainment of learning objectives (attitudes, knowledge, and abilities) (Ministry of Education and Culture, 2016).

Podcasts are previously recorded media files that may be downloaded and distributed to practically any user or computing platform (Allen, 2006). Podcasts provide novel methods for promoting learning. According to Chan and Lee (2005), studying through podcasts is convenient for students since they may select when and where to learn. Five episodes were created for the podcasts: apperception, bryophyta, pteridophyta, gymnosperme, and angiospermae.

b. The Results of Applied Learning

The goods are used in class X MIA-4 of State Senior High School 8 of Malang (SMAN 8 Malang), which has a total of 28 students. The design and learning devices are evaluated for their practicality using a learning implementation sheet and a student response questionnaire. Practical learning gadgets are ones that are simple to use for people who utilize them (nieven in Nur, 2018). Dewi et al. (2013) have a similar view, namely that learning gadgets are practical, as evidenced by the ease with which teachers and students may apply them in the classroom.

The assessment of design effectiveness and learning devices is measured using n-gain formulas based on the pretest value and posttest scientific work skills and critical thinking. Increasing Scientific Work Skills Score using n-gain by 0.2 with low criteria. The indicators of the scientific work skills measured are formulating questions / problems, formulating hypotheses / opinions, creating data, analyzing data, and forming conclusions.

Increasing the value of critical thinking skills using n-gain by 0.06 with low criteria. The indicator of the measured critical thinking skills is to provide a simple explanation, build basic skills, conclude, provide further explanation, and regulate strategies and tactics.

The learning strategy in Inquiry is a series of learning activities that emphasize the process of thinking critically and analytically students to find and find their own answers to a questionable problem (Damayanti, 2013). Vlasses, et al (2013) argue that lifting inquiry learning can facilitate students to increase science investigations and support the formation of scientific work skills. Students who have scientific work skills can solve problems, think critically, make decisions, find answers, and satisfy curiosity (Ergul et al, 2011).

Hidayah (2015) reports the findings of its research, which indicate that inquiry learning was led by the application of effective conservation character values in order to increase high school students' scientific job skills. In agreement with this, ULFA et al. (2016) said that his research found variations in students' scientific work skills before and after they were exposed to guided inquiry-based learning. Additionally, the usage of guided inquiry learning models using the V (Vee) diagram has been shown to improve student critical thinking abilities in biology (Pertiwi et al, 2012). Sunarya (2018) explains that the guided inquiry learning methodology has a good effect on students' critical thinking abilities.

Podcasts as appropriate learning material are utilized in online learning because they may be accessible via a variety of channels, as Cin and Savitri demonstrate (2020). Podcasts can be used to introduce content prior to learning or to record material to allow students to listen to it again if they are unable to attend in person or to reinforce their knowledge (Rajic, 2013). The submission of information via podcasts is done in video and audio format to provide students more freedom, and they are common aspects of distance learning programs (MCGRAR, 2009).

The low effectiveness is due to students' unfamiliarity with online education. According to Yazdi et al. (2012), the benefits of the Internet for online learning have a number of drawbacks, including a lack of connection between professors and students. Without this connection, the creation of assessment and reasoning might be slowed down during the learning and teaching processes. Yulia et al. (2020) discuss the challenges that frequently arise when students learn online and from home. 1) Because students have been unable to initiate their own learning, they rely on the teacher for instructions or tasks in order to learn. 2) the objectives or targets of online learning students for math lessons remain limited to the acquisition of values, regardless of the process or ability of students to comprehend the material; and 3) some students continue to be unable to monitor, regulate, and control online learning at home, despite appearing to learn what is required.

c. Suggestions on The Use and Development of Additional Goods

Suggestions on The Use and Development of Additional Goods as follows

a. Teachers may utilize plant diversity in their local region to teach students about perception, as well as land removal examples in their local area to demonstrate the consequences of decreasing plant diversity.
b. Teachers can post podcasts to SoundCloud or Spotify to make them accessible to a large number of students.
c. The produced design and learning devices should be experienced to ascertain comparisons between the developed design and learning devices and those typically utilized by teachers.

CONCLUSION

Based on the findings and discussion, it can be concluded that (1) Design and Learning Devices Plant diversity-based inquiry-based trusted podcasts and Google Classroom are valid and extremely practical criteria for (2) improving scientific work skills of 0.2 low categories and critical thinking of 0.06 low categories.

SUGGESTION

The created design and learning tools fall into a valid, extremely practical, and low-effective category, which means they may be utilized in the classroom with additional improvement and modification to help students improve their scientific work abilities and critical thinking.

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