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Development of Scientific Inquiry-Based LKPD to Improve Students Critical Thinking Ability and Collaboration Skills

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Abstract: This study aims to determine the feasibility of LKPD based on scientific inquiry to improve students' critical thinking skills and collaboration skills. The type of research used is research and development with research procedures using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). This research is limited to the feasibility test of LKPD based on scientific inquiry at the development stage. The assessment of the results of the validity test and the practicality test of the questionnaire is interpreted on a Likert scale. Based on the data analysis, the following results were obtained: the validity test of teaching materials in the form of LKPD based on scientific inquiry obtained an average validity of the eligibility media for teaching materials of 92.75% and 85% for material eligibility. The practicality test conducted by Biology educators obtained an average score of 75% and 79% for students.

Keywords: Critical Thinking Ability; Collaboration Skills; Scientific inquiry; LKPD

Introduction

The development of science and technology is rushing. It tends to get out of control and is almost unavoidable in the world of education (Budiman, 2017). This development leads people to businesses to survive and be able to compete in the era of globalization. People who can adapt quickly can face the challenges of the global world. Thus, the younger generation must have sufficient knowledge to answer these challenges. In this case, the younger generation must be equipped to be more creative, competitive, and cooperative. Therefore, learning materials need to provide a more authentic design to overcome challenges where students can collaborate and be creative in finding solutions and solving a learning problem using various available sources of information (Wijaya et al., 2016).

Learning activities in the 21st century are skills that can be taught or learned to improve ways of thinking, learning, working, and living in the world. These skills include creativity and innovation, critical thinking/problem solving/decision making, metacognition, communication, collaboration (teamwork), literacy, and responsibility (including cultural awareness and competence) (Global Partnership for Education, 2020).

Education in the 21st century demands that education is directed at improving the ability of students to be able to compete in global competition. This can be achieved if education in schools is not only centered on students' cognitive abilities but also requires students' skills which include thinking, communication, and collaboration skills (Wijaya et al., 2016).

Critical thinking skills and collaboration skills can be improved through appropriate learning systems. A learning system that encourages students to be more active in learning. In fact, student's critical thinking skills in Indonesia are still low. These results are in line with the 2012 PISA report, students' critical thinking skills are ranked 64th out of 65 countries, where students' critical thinking skills are still low and not visible in learning so it needs to be improved.

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Apart from that, in biology learning, various difficulties arise for students in acquiring knowledge, developing students' critical thinking abilities and collaboration skills. This difficulty can be seen from the low biology learning results. Based on the results of interviews with teachers at SMA N 1 Mllati, information was obtained that there were various problems. First, there is a lack of teaching materials because the teaching materials currently used are still printed books and worksheets which still use standard language and are difficult for students to understand. Then the learning methods used by educators are still demonstration and lecture methods. Second, subject matter. Based on limited interviews conducted with biology subject teachers, information was obtained that the even semester material had a high level of difficulty and low learning outcome scores in this material, namely the excretory system in humans, so it required students' critical thinking abilities and skills. Third, facilities and infrastructure. SMA 1 Mlati is a school whose laboratory is adequate for use in practical activities, but is underutilized so it requires teacher creativity in understanding subject matter. In fact, practical activities are very important in biology learning so that students' thinking abilities can improve because students are directed to analyze, build basic skills, conclude, further clarify and organize strategies, which activities are indicators of critical thinking abilities.

Based on the problems above, a learning model is needed that can accommodate students to be active and can improve students' critical thinking abilities and collaboration skills, one of which is by utilizing the scientific inquiry learning model. According to Sani, (2013) the scientific inquiry learning model is a student activity in developing knowledge and understanding scientific ideas. This is supported by research by Younis, (2017) stating that the scientific inquiry learning model is an effective learning process in improving critical thinking skills. In this case, inquiry-based learning is believed to be able to help students' critical thinking skills, but in schools there are still few who implement inquiry-based learning.

Scientific Inquiry are an inquiry learning model that contains learning process activities that lead to investigations with direct educator guidance in scientific activities to help students identify and formulate problems through an independent experimental approach (Wenning, 2010). To improve students' critical thinking and collaboration skills in understanding biological material, there needs to be a renewal in the learning process, namely the use of teaching materials in the form of Student Worksheets which have been arranged regularly during the learning process in order to build students' motivation and enthusiasm for learning.

In fact, from the results of observations in the field, it was found that there were several weaknesses in the LKPD used at Mlati 1 High School, namely (1) educators making LKPD still used questions in the book (2) LKPD used by educators was still in the form of LKPD containing sheets. questions and have not applied a scientific approach, (3) the LKPD used has not helped students in solving a problem, and (4) the questions contained in the LKPD only require students to answer without going through the process of investigation or scientific activities. In fact, as we know, student activity sheets are a guide to learning activities in the process of investigating and identifying problems. The components of the student activity sheet must inspire students to carry out the assignment. The questions on the activity sheet must encourage students to carry out experiments, investigations, discoveries and solve problems (Trianto, 2015). With the existence of scientific inquiry-based LKPD which is oriented towards scientific activities, it is also hoped that it will be able to help educators in developing students' abilities including high curiosity, honesty, responsibility and critical thinking and collaboration. So that from the learning process using scientific inquiry-based LKPD, students can measure, collect and carry out scientific investigations, use science and technology in the investigation process to solve a problem. Based on the background above, the researcher intends to conduct research entitled "Development of Biology Worksheets Based on Scientific Inquiry on Excretory System Material to Improve Students Critical Thinking Abilities and Collaboration Skills"

Method

This type of research and development method uses the ADDIE model developed by Branch (2009). This study includes five stages: analysis, design, development, implementation, and evaluation. However, this study was limited to the analysis, design, and development stages. The ADDIE model is illustrated in Figure 1.

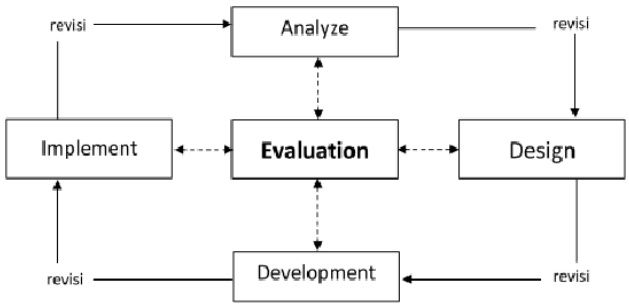

Figure 1. ADDIE model

This research was conducted at SMA Negeri 1 Mlati Yogyakarta for 3 weeks in May in class XI MIPA. This study consists of two types of data: qualitative and quantitative. Quantitative data were obtained during the analysis and design stages. The first stage is analysis: qualitative data obtained through observation and direct interviews, analyzing teacher needs, and analyzing student needs. In the second phase, qualitative data were obtained by compiling student activity designs, developing learning objectives, compiling test instruments, and compiling the initial LKPD framework. The purpose of qualitative data is to develop specifications for research objectives and create initial product development designs.

Quantitative data were obtained through the development stage, with validation by experts and practitioners. Development data with expert and practitioner validation were used for the results of the product development feasibility tests. Expert validation consists of two validators: the media expert validator and the material expert validator. Practitioner validation consists of two validators: biology teachers and students. The data obtained from the validity and practicality tests were then quantitatively analyzed using Formula 1.

$$M = \frac{\Sigma fx}{N} \quad (1)$$

Keterangan:
M : Average per aspect
fx : Total score per aspect
N : Number of components

The scores obtained were then interpreted based on the scoring system and criteria listed in Table 1.

Table 1. Eligibility Criteria

Percentage Score (%)	Interpretation
P > 80	Very worth it
61 < P ≤ 80	Worthy
41 < P ≤ 60	Enough
21 < p ≤ 40	Not worth it
P ≤ 20	Very unworthy

The validity test in this study consisted of media and materials experts. The aspects assessed by media experts include cover illustrations and designs, including shape, color, size and object proposition, font size, writing systematics, and image placement. The aspects assessed by material experts are aspects of material quality, language quality, and eligibility support quality, which includes the suitability of exercises/tests with competencies and the balance between questions/practices with the material and language used.

The practicality test in this study was conducted on biology teachers and students to respond to the results of the development of LKPD based on scientific inquiry. The aspects assessed in the teacher practicality test are material feasibility, material accuracy, didactic aspects, construction aspects, and technical aspects. The aspects assessed in the student practicality test were technical aspects, visual appearance aspects, media aspects, and content aspects of the learning material.

Results and Discussion

The initial stage in the development of LKPD based on scientific inquiry is conducting a preliminary study; at this stage, the researcher will collect various information on the teaching materials to be developed by conducting interviews with biology subject teachers and analyzing the needs of students, analyzing the curriculum used, as well as core competencies basis for learning about biology. Based on the results of the preliminary study, the teaching materials used in schools were still in the form of science package books from the 2017 Ministry of Education and Culture and LKPD/LKS, which were made by educators and used by educators in learning activities; however, students only listened to the information provided by educators and then carried out assignments in the form of sheets containing the questions in the LKPD without being actively involved in the learning process. This is due to the lack of creativity in designing teaching materials, as well as limited costs, which are obstacles for educators. The curriculum used was based on the 2013 curriculum 2016 revision.

LKPD teaching materials based on scientific inquiry are made in the form of printed LKPD consisting of a cover for the cover of the LKPD using a picture of the kidney organ as a description of the contents in the LKPD. The cover is designed in full color with a white base color coupled with the cover's supporting characteristics and consists of several components, such as the title of the LKPD material, the base of the LKPD, the name of the identity of the composer, the column for student identity, and the logo of the Yogyakarta State University.

The next stage is the LKPD product validation stage. Validation is an assessment carried out by subject-matter expert validators, the media, and practitioners. The media experts on LKPD products based on scientific inquiry were validated by a Biology Education lecturer at the Faculty of Mathematics and Natural Sciences. Yogyakarta State University. Scientific inquiry based on LKPD validation results were structured to improve students' critical thinking skills and collaboration skills.

The assessment given by media experts on LKPD based on scientific inquiry can be seen in Table 2.

Table 2. Media Validity Test Results

Assessment aspect	Average score	Results for each aspect	Criteria
Cover illustration	4.00	100	Very worth it
Content and Design	3.42	85.50	Very worth it
Average		92.75	Very worth it

Based on the results of the validity test, it showed that the results of the analysis of the LKPD values obtained from media experts obtained results on the cover illustration aspect of 100% and on the design aspect of 85.5%. The average of all aspects measured was 92.75%, with very good criteria. A media validity test can be declared valid if it has been tested by media experts (Badu et al., 2020). In addition to validating the LKPD, material experts validated it to assess aspects of material quality, language quality, and eligibility support quality. The assessment given by the material experts is shown in Table 3.

Table 3. Material Validity Test Results

Assessment aspect	Average score	Results for each aspect	Criteria
Material Quality	2.20	55	Enough
Language Quality	4.00	100	Very worth it
Qualities Supporting Feasibility	4.00	100	Very worth it
Average		85	Very worth it

The validity of the material on LKPD was tested based on scientific inquiry in accordance with basic competencies, core competencies, and learning indicators. By using language that is easy to understand and supported by information in the form of videos and discourse presented in the LKPD. The results of the analysis of the LKPD values obtained by material experts from each aspect obtained scores on the material quality aspect, 55% on the language quality aspect, 100% and on the eligibility supporting quality aspect by 100%. The overall average value of the material expert validity test was 85%, with very good criteria. These data indicate that the LKPD product meets the feasible criteria and can be continued at the practical test stage.

Practicality tests are conducted by biology teachers and students to determine the feasibility of the products that have been developed. The teacher practicality test consisted of five aspects: material feasibility, material accuracy, didactic, construction, and technical aspects. The results of the assessment by the biology teacher are shown in Table 4.

Table 4. Teacher Practicality Test Results

Assessment aspect	Average score	results for each aspect	criteria
Material Feasibility Aspects	3.00	75.00	Worthy
Aspects of Material Accuracy	2.60	65.00	Worthy
Didactic Aspect	3.00	75.00	Worthy
Construction Aspect	3.30	82.50	Very worth it
Technical Aspect	3.25	81.25	Very worth it
Average		75.00	Worthy

Based on the results of the assessment in Table 4, it is known that the results of the biology teacher's assessment of LKPD based on scientific inquiry products stated that the value obtained from the material feasibility aspect was 75% on the material accuracy aspect by 65% on the didactic aspect by 75% on the construction aspect by 82, 5%, and on the technical aspect, a score of 81.25 was obtained. The average value of all aspects of the teacher's practicality test was 75% with the appropriate criteria for use.

After that, a practicality test was carried out by students consisting of four aspects: technical aspects, visual appearance aspects, media aspects, and content aspects of the learning material. The practicality test of the students was carried out by a small group in class XI MIPA. The results of the student responses are shown in Table 5.

Table 5. Student Practicality Test

Assessment aspect	Average score	results for each aspect	criteria
Technical Aspect	3.16	79.00	Worthy
Aspects of Visual Display	3.15	78.85	Worthy
Media aspect	3.00	75.99	Worthy
Content Aspects of Learning Materials	3.38	84.44	Very worth it
Average		79.00	Worthy

Based on the data from students' responses to Inquiry lesson-based LKPD conducted by students in class XI MIPA in the form of a questionnaire distributed by the researchers, a random sampling technique was used for class selection. Based on the results of the practicality test of students from each aspect, a score of 79% was obtained for the technical aspect, 78.85% for the visual appearance aspect, 75% for the media aspect, and 84.44% for the content aspect of the learning material

with an overall average score. The average student response rate was 79%, with feasible criteria.

Based on the achievement of critical thinking ability indicators obtained from the average value, it can be concluded that the Scientific Inquiry-based LKPD has increased students' critical thinking abilities, this is in line with previous research from Tri Reka Enjela, (2020) the experimental class experienced a higher increase in critical thinking abilities compared to the control class. So it can be proven that the teaching and learning process using scientific inquiry-based LKPD can influence the level of students' critical thinking abilities. Based on research conducted by Rinawati, (2017) entitled the influence of the scientific inquiry learning model on the scientific literacy abilities and scientific attitudes of Class the lower score is 68. So it can be concluded that learning biology using the scientific inquiry model has an effect on students' scientific literacy abilities and scientific attitudes.

Based on research conducted by Fadilah et al. (2015), the development of inquiry-based biology teaching materials has The potential to improve students' critical thinking and collaboration skills, as shown by the completeness of the critical thinking indicator obtained at 94.6% and students' high collaboration skills, namely mutual respect for group members with a score of 87.3%. According to Din, (2020) critical thinking skills consist of basic abilities, basic knowledge, the desire to ask questions and self-reflection. Students who have critical thinking skills not only have the basic ability to think critically, but also have the ability to apply it in evaluation.

Solihah and Sulistyani, (2018) said that students can learn to think critically with consistent practice and habits. This inquiry-based LKPD learning is very good for improving high school students' critical thinking skills on excretory system material. One of the results of increasing students' critical thinking is that they have the ability to speak independently with teachers and fellow students. This critical thinking ability can indirectly help teachers in learning, because students can provide strong opinions. Apart from that, inquiry is effective when viewed from students' learning outcomes and reasoning. So that when there are discussion activities during the inquiry learning process, it effectively shows collaboration skills. This is supported by the opinion of Prasetyono & Hariyono (2020), who state that critical thinking is not only an ability that can be learned independently but can be developed through collaboration or cooperation. The importance of learning in a group to achieve certain goals, apart from being able to improve critical thinking skills, is also able to increase student collaboration.

The scientific inquiry-based student worksheet developed has characteristics that are appropriate in terms of content, construct and language. According to Joice & Wells (2010), the characteristics of LKPD have also been adapted to the stages of scientific inquiry, namely problem orientation, data collection and verification, data collection through experimental activities, organizing and analyzing the inquiry process. The scientific inquiry LKPD has met the practical criteria based on the practicality test. This is in line with research (Astuti, 2021) showing that the results of the research carried out have met practical criteria with the characteristics that the LKPD is easy to use, has clear instructions for use, and how to carry out activities is shown at each meeting. This makes it easier for students to use LKPD products. Apart from that, the LKPD also meets the eligibility criteria. It is explained that the LKPD is feasible if the eligibility percentage reaches 51%-75%. Inquiry LKPD is also effectively used in learning the biology of the excretory system through effectiveness testing. As research conducted by (Annajmi & Asra, 2017) states that scientific inquiry-based LKPD can help students' learning activities. So that the LKPD product produced in this research meets practical, feasible and effective characteristics, the use of this LKPD in learning can make students further increase students' understanding in solving a problem presented.

Conclusion

The validity test was carried out on teaching materials in the form of inquiry lesson-based LKPD, obtaining an average value of 92.75% from media experts and 85% of material experts. In the practicality test conducted by the biology teacher, an average score of 75% was obtained, and students obtained a value of 79%. Based on the validity and practicality tests that have been carried out, the teaching material product in the form of inquiry lesson-based LKPD to improve students' critical thinking skills and collaboration skills is stated in the criteria of being feasible and can be used for further research.

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Conflicts of Interest
The authors declare no conflict of interest

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