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LEARNING OF INQUIRY SEQUENCES-BASED E-STUDENT WORKSHEET ASSISTED BY CANVA TO STIMULATE HANDS-ON SKILLS, MIND-ON ACTIVITY, AND SCIENCE PROCESS SKILLS

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ABSTRACT

The covid-19 pandemic has changed educational policies regarding learning and teaching methods that were initially conventional and must now be integrated with technology. It takes teaching materials that can help students in learning. This study aims to develop an E-student worksheet using the Canva-assisted learning of inquiry sequences (LOIS) learning activity model that can be applied as a physics learning material that can practice hands-on skills, mind-on activities, and science process skills. This study uses research and development research methods. The E-student worksheet development procedure uses the ADDIE development model. The results of the experts show that the average score of the assessment of the E-student worksheet is 3.58, which is included in the very valid criteria. The limited trial of the E-student worksheet on the teacher's perception obtained results of 91% in the very good category, the test results for class XI students could be applied with a very good 88% score. The results of the effectiveness of working on the E-student worksheet obtained an average score of 89% in the highly trained category. It can be concluded that which means the E-student worksheet can train hands-on, minds-on activity, and science process skills.

E-STUDENT WORKSHEET BERBASIS *LEARNING OF INQUIRY SEQUENCES* BERBANTUAN CANVA UNTUK MENSTIMULASI KEMAMPUAN *HANDS-ON*, *MIND-ON ACTIVITY*, DAN *SCIENCE PROCESS SKILLS*

Kata Kunci:

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Minds-on activity
Science process skills

ABSTRAK

Adanya pandemi Covid-19 menjadikan pelaksanaan kebijakan pendidikan mengalami perubahan dalam pelaksanaan pembelajaran, cara mengajar yang awalnya konvensional saat ini harus terintegrasi dengan teknologi. Dibutuhkan bahan ajar yang dapat membantu peserta didik dalam pembelajaran. Penelitian bertujuan mengembangkan *E-student worksheet* dengan menggunakan model aktivitas pembelajaran LOIS berbantuan Canva yang layak diterapkan sebagai bahan pembelajaran fisika yang dapat melatihkan kemampuan *hands-on*, *mind-on activity*, dan *science process skills*. Penelitian ini menggunakan metode penelitian *research* and *development*. Prosedur pengembangan *E-student worksheet* menggunakan model pengembangan ADDIE. Hasil ahli menunjukkan skor rerata penilaian terhadap *E-student worksheet* sebesar 3,58 termasuk dalam kriteria sangat valid. Uji coba terbatas *E-student worksheet* pada persepsi guru diperoleh hasil sebesar 91% dengan kategori sangat baik, hasil uji coba peserta didik kelas XI dapat diterapkan dengan skor 88% sangat baik. Hasil keefektifan pengerjaan *E-student worksheet* diperoleh skor rata-rata sebesar 89% dengan kategori sangat dilatihkan. Dapat disimpulkan bahwa yang berarti *E-student worksheet* tersebut dapat melatihkan *hands-on, minds-on activity,* dan keterampilan proses sains.

1. INTRODUCTION

The development of information technology and the emergence of various complex environmental problems are future challenges that must be faced, namely the challenges of the 21st century. The 21st century requires everyone to have both hard and soft skills, of which 18 kinds of 21st Century Skills need to be provided. One of the 21st-century skills is Learning and Innovation Skills, which consists of 4 aspects: critical thinking, communication, collaboration, and creativity [1].

The challenge to develop learning skills in the 21st century is the reason for the government to implement the improvement of the 2006 curriculum into the 2013 curriculum [2], [3]. The changes in the 2013 Curriculum are expected to enable students to have better skills, knowledge, and attitudes toward learning. The 2013 curriculum will use a learning approach, namely, a scientific approach. This requires teachers to guide students to practice several scientific activities, including hands-on activity, mind-on activity, and science process skills.

Science process skills are crucial to develop students' scientific attitudes and problem-solving skills to create critical, creative, innovative, open, and world-class competitive students [4]. Some science process skills (SPS) students must include the ability to observe, classify, interpret, predict, apply, plan research and communicate [5]. Some SPS are developed through hands-on experiments and mind-on activities such as measurements, and others are related to direct experiments. For example, concluding based on the results obtained from hands-on experiments [6]. Physics learning does not only use one method in reviewing material that relies on the mind (minds-on) but also needs to pay attention to the learning process to the skills of students who can also be honed (hands-on) [7].

Data from the analysis of physics material in class XI showed that there are several basic competencies that have operational verbs up to the level of analyzing the basic competence of knowledge and the level of creating the basic competence of skills. However, the results of interview data given to several physics teaching teachers in Lampung stated that the teaching materials used rarely or even never reached the basic competency skills because of the insufficient time to teach all the materials and carry out practical activities, let alone make a product. It was limited to discovery to investigative activities. This makes learning not yet optimizing science process skills. Science creativity and process skills play an essential role in education, especially in science learning that has met the national standards of science education [8].

One of the physics materials that accommodate activities to train hands-on activity, mind-on activity, and science process skills are dynamic fluid. The material is one of the physics materials applicable in everyday life. Students have not reached basic competencies on dynamic fluid material as a whole. Several reasons underlie this issue, namely: (1) dynamic fluid material is one of the materials that is classified as difficult for students to master, where students have difficulty applying the two basic principles of fluid dynamics, namely the continuity equation and Bernoulli's law [9], [10], and (2) students experience misunderstandings or misconceptions in dynamic fluid material by assuming that the greater the fluid velocity, the greater the pressure [10]–[12]. The process of learning dynamic fluid concepts in schools is still informative and does not provide a real experience to students [13] so that the material for changing the dynamic fluid environment is considered suitable to be applied using the Learning Of Inquiry Sequences (LOIS) based learning model.

LOIS is a learning that emphasizes students looking for and investigating solutions to the problems presented with the help of instructions in the form of several questions and learning steps so that students gain new knowledge based on the results of their investigations. LOIS consists of 6 levels: discovery learning, interactive demonstration, inquiry lesson, inquiry laboratory, real-world applications, and hypothetical inquiry [14].

Table 1. Basic Practice Level of Inquiry

Discovery Learning	**Interactive Demonstration**	**Inquiry Lesson**	**Inquiry Lab**	**Real-world Application**	**Hypothetical Inquiry**
Low	⇠ Intellectual Sophistication ⇢				High
Teacher	⇠ Locus of Control ⇢				Student

Based on Table 1, the more to the right, the more sophisticated or higher intellectual thinking students need, and the learning control center is on the students. On the other hand, the more to the left, the intellectual level of students' thinking is still low, so the learning control center is greater than the teacher.

In addition, science process skills need to be trained through hands-on experiments, and minds-on activities, given the differences in learning styles used during the pandemic. The limitations of practicum tools during online learning, a long time to prepare practicums, and the absence of face-to-face activities are hindering factors for carrying out practical activities in the laboratory, so electronic learning is needed. Hence, we need an E-student worksheet that presents several activities with the PhET Simulation program, which can stimulate problems at the activity level, reasoning, and product creation, and an E-student worksheet that applies a learning process that follows the demands of the curriculum that can be used online. This is done to create a learning process that directs students to train in hands-on activities, mind-on activity, and science process skills, as well as actively finding concepts from various learning sources, one of which is the internet, using the LOIS learning model.

Numerous research on E-student worksheet has been carried out until 2020, as the research on the development of E-student worksheet using flipbooks that have been carried out [15], [16], and the development of problem-based E-student worksheet on dynamic fluid materials foster digital literacy and collaboration skills of students [17]. In addition, the development of an E-student worksheet with the help of 3D Professional Pageflip has also been carried out [18]. However, none of these studies has developed a LOIS-based E-student worksheet assisted by Canva to stimulate hands-on activity, mind-on activity, and science process skills.

In previous studies, the E-student worksheet used was generally electronic. However, some did not contain audio, video, and task links that could be directly connected to the google form, and the learning model used had never used a learner-centered learning model. Therefore, this study aims to improve the previous research. The variation used in this study is that the E-student worksheet used uses the LOIS learning model and is designed with the help of Canva so that the product has attached videos, audio, and links connected to the google form. This is expected to increase hands-on, mind-on activity, and science process skills.

2. METHODS

This research is included in the type of Research and Development (R&D). The product produced in this study, namely, E-student worksheet teaching materials using the ADDIE development procedure developed by [19]. This procedure consists of five steps: analysis, design, development, implementation, and evaluation.

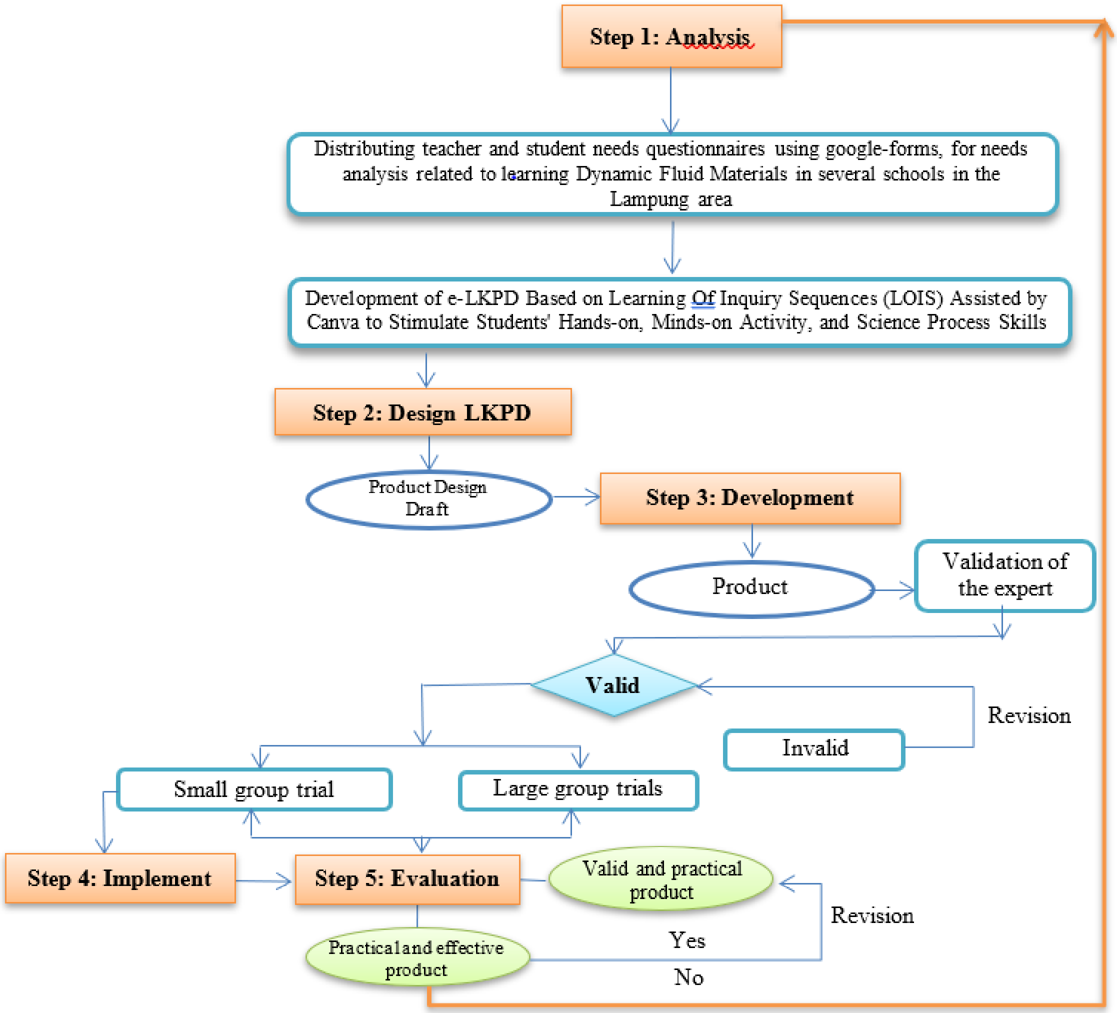


Figure 1. Research Flow

In Figure 1, the first stage of this research is conducting a needs analysis related to E-student worksheet teaching materials. The second would be the design stage, where the researcher designs the E-student worksheet and the questionnaire used during the research. The next stage is development, where the designed E-student worksheet will be tested for validity. After the product is declared valid, the product is revised based on suggestions for improvement provided by the validator. The fourth stage is intended to determine the effectiveness of the E-student worksheet based on Learning Of Inquiry Sequences (LOIS) assisted by Canva on dynamic fluid materials to improve students' hands-on, minds-on activity, and science process skills. This study uses a needs analysis questionnaire, observer observation questionnaire, and pretest and posttest ability tests. A needs analysis questionnaire was administered before the research was conducted, while the observer's observation questionnaire was conducted during the learning process.

The last stage is an evaluation which consists of formative and summative evaluation. It is carried out to improve the resulting product. The formative evaluation stage is carried out at each stage of the study. In contrast, the summative evaluation is carried out after a small group test involving two high school classes: the experimental and control classes. The experimental class received LOIS learning with E-student worksheet teaching materials for Dynamic Fluids, while the control class received learning with Discovery Learning. The instruments in this study were student response sheets and teacher perception sheets. Researchers made this E-student worksheet design because the E-student worksheet related to dynamic fluid materials generally does not exist in high school. The design of the E-student worksheet uses the Canva platform. Data collection techniques use questionnaires, while data analysis techniques use student response questionnaire analysis and teacher perception questionnaires.

The data obtained from the validity test results were then analyzed and calculated by looking for the overall average value. The calculated results are then interpreted to get the quality of the developed product. Score interpretation adapted from previous studies [20]. The data used to determine the product's practicality was obtained based on filling out the readability test questionnaire (quantitative data). The answers to the questionnaire were analyzed using percentage analysis [21].

Data from the results of filling out the readability test questionnaire were analyzed using percentage analysis [22] as there was data to determine the product's practicality. The researcher limits that the product developed will be categorized as practical if it reaches the score determined by the researcher, which is at least 60% with a fairly good validity criterion.

The data used to determine the product's effectiveness was obtained through observation sheets on the achievement of hands-on, minds-on activity, and science process skills based on students' responses after reading and studying the E-student worksheet that had been developed and analyzed with qualitative descriptive. The results of the scores that have been obtained are then calculated for the average and converted to assessment statements to determine the level of student response, which is at least 51% with good enough criteria [20].

The data used to determine the teacher's perception regarding the use of the E-student worksheet was obtained based on the filling in the teacher's perception test questionnaire regarding the use of the E-student worksheet (quantitative data). The data from the teacher's perception test questionnaire regarding the use of the E-student worksheet were analyzed using percentage analysis as in the data to determine the practicality of the product. The analysis of the assessment of the trained hands-on ability, minds-on activity, and science process skills of students was obtained from the average of the assessment results on the E-student worksheet carried out by students. The results of the hands-on analysis, minds-on activity, and science process skills analysis using the percentage analysis formula [21]. The results of the percentage of assessment data obtained are converted according to the criteria adapted from [22], which is a minimum score of 40.1%, with the criteria being adequately trained.

The researcher limits that the E-student worksheet product developed by the researcher can train hands-on, mind-on, and science process skills if the product reaches the score that the researcher determines, which is a minimum percentage of 60% with the criteria being sufficiently trained.

3. RESULTS AND DISCUSSION

This research resulted in a Canva-assisted LOIS-based E-student worksheet on dynamic fluid materials to train hands-on, minds-on, and science process skills worthy of review based on the E-student worksheet's validity, effectiveness, and practicality. The LOIS learning model includes six levels: discovery learning, interactive demonstration, inquiry lesson, laboratory inquiry, real-world applications, and hypothetical inquiry [14]. The advantages of this LOIS E-student worksheet are, being able to develop concepts based on experience, identify and deal with alternative conceptions, identify scientific relationships, make empirical laws based on variable measurements, solve problems with problem-based and project-based approaches, and generate hypotheses and test hypotheses or explanations for observed phenomena [14]. The results of each stage are described as follows.

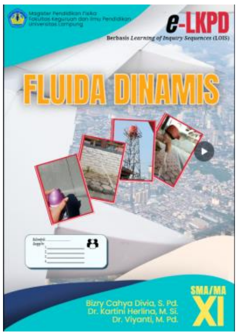
The first stage, namely the analysis stage, is carried out by conducting literature studies and field studies to discover the needs and problems teachers and students face. The literature study results were obtained by reviewing several articles to find information on quality teaching materials to stimulate hands-on, mind-on activity, and science process skills in students. The results of field studies were carried out by giving questionnaires to 10 physics teachers and 36 second-grade high school students to obtain information in the form of problem identification and the needs of teachers and students.

The second stage is the design stage. After getting the data for analyzing the needs of teachers and students, the researcher makes an initial draft of the E-student worksheet. The initial E-student worksheet design is prepared by dividing the structure of the material that will be presented in the E-student worksheet and adjusted to the achievement indicators to be achieved at each meeting. Based on the needs map in basic competencies 3.4 and 4.4, it is concluded that the E-student worksheet is prepared for learning in two meetings. The lesson plan is prepared concerning the revised 2013 curriculum. After dividing the material's structure, the researcher created a storyboard, an E-student worksheet on the Canva platform, and instruments for validity, product readability, and product practicality.

In the third stage, namely the development stage, the researcher compiles the E-student worksheet according to a predetermined design, then conducts an initial validation test on the E-student worksheet that has been made. The development stage aims to determine the feasibility of the E-student worksheet that has been developed so that the final form of the E-student worksheet follows the advice and input of experts/practitioners. The following is a presentation of the results obtained at the development stage.

The results of the E-student worksheet development refer to the design stage that has been made. The E-student worksheet that has been developed consists of three parts: introduction, content, and closing, as shown in Table 2.

Table 2. Results of E-student Worksheet Development

Part	Description
Introduction 	This section consists of a cover, introduction, table of contents, instructions for using E-student worksheet, core competency, and basic competencies, as well as indicators and learning objectives. The cover on the E-student worksheet contains an illustration of the material consisting of the title of the material, pictures of magnetic field applications in everyday life, the name of the developer, the name of the supervisor, the developer agency, the logo of the agency, the learning model used, and the level and level of the school. The preface, instructions for using the E-student worksheet, and table of contents follow the General Guidelines for Indonesian Spelling.

Contents		The content section is grouped into two sub-materials: the principle of continuity and Bernoulli's law. Each sub-material is presented in one learning activity. Each activity contains a LOIS level starting from level 1 discovery learning to level 6 hypothetical inquiry on worksheets that stimulate hands-on, minds-on activities and student science process skills. The end consists of an evaluation and a bibliography. Learning activities are designed for online learning by stimulating hands-on, minds-on activities and student science process skills. The student analysis begins with the stage of a phenomenon at the beginning of each learning activity in the E-student worksheet to guide students to find problems and solve them on the worksheets that have been provided. The display on the E-student worksheet can be seen in the picture below.
Closing		The closing part of the E-student worksheet consists of an evaluation section. Students are expected to be able to complete the practice questions after completing the learning activities on the E-student worksheet. The last part of the E-student worksheet is a bibliography containing references used to compile materials and content in the E-student worksheet.

3.1 *Validation Results*

Experts test the validation stage to determine the feasibility of teaching materials regarding design, materials, and constructs. The validation test is carried out before the initial E-student worksheet product is tested on students. Expert validation was carried out by two expert lecturers and one expert practitioner with the following results.

Table 3. Expert Validation Test Results

Test Type	Score Result Assessment	Validity Criteria
Media and Design	3.58	Very Valid
Material and Content	3.84	Very Valid
Construction	3.00	Valid

The results of the validity test questionnaire explained that the material contained in the E-student worksheet is under the curriculum and pays attention to the achievement of core competencies, basic competencies, and learning indicators that follow the LOIS learning model. Validation of the feasibility of the content can be seen from the suitability of the content/description of the material described, viewed based on the topics discussed as a whole [23]. Judging from the media validation in line with previous research [24], several aspects of media feasibility, including content suitability and display design (cover design, typeface, text layout, images, and combinations), are considered feasible to be used as independent teaching materials. Aspects of the feasibility of teaching materials include the completeness of the components of teaching materials and the display format of teaching materials [25].

The fourth stage, namely, the implementation stage, the E-student worksheet, which has been declared valid, is then tested at the implementation stage. The main objective of this stage is to find out the practicality and effectiveness of the LOIS-based E-student worksheet with the help of Canva, which was developed. The results obtained from the implementation phase consisting of the practicality and effectiveness of the developed E-student worksheet.

3.2 *Practicality Test*

The summary of the results of the practicality test in the form of a readability test, a teacher's perception test, and a student response test with the following results.

Table 4. Readability Test Results

Question	Quantity Per statement	Max Score	Percentage
1	36	40	90%
2	36	40	90%
3	40	40	100%
4	36	40	90%
5	36	40	90%
6	36	40	90%
7	37	40	93%
8	35	40	88%
9	36	40	90%
10	38	40	95%
Total	403	440	92%
Category	Very Practical		

The readability test results were obtained from a readability test questionnaire filled out by ten SMAN 5 Bandar Lampung students who had worked on the E-student worksheet. A percentage score of 92% was obtained in the very practical category, which means that this E-student worksheet can be used in learning dynamic fluid materials. The product developed is practical because this E-student worksheet can train students in hands-on, mind-on activities and science process skills. Besides that, this E-student worksheet is also very interesting, easy to use, and can help online learning during Covid-19.

Teaching materials can be useful and suitable tools for alternative (practical) learning materials [26]. This shows that the teaching materials developed for learning physics are suitable for use during learning. Practicality is seen from the ease of use and implementation, including costs and time.

3.3 Teacher's Perception Test

The results of the teacher perception test obtained from a teacher perception questionnaire filled out by ten teachers from 10 different schools in Lampung Province can be seen in Table 5 below.

Table 5. Teacher's Perception Test Results

Learning Level	Per Level	Max Score	Percentage	Category
Conformity Level 1	186	200	93%	Very good
Match Level 3	188	200	94%	Very good
Conformity Level 4	181	200	91%	Very good
Conformity Level 5	185	200	93%	Very good
Conformity Level 6	170	200	85%	Very good
Total per level	1093			
Average Score			91%	Very good

Based on Table 5, the percentage of learning outcomes on the average level of learning is 91%, with a very good category. Learning activities using LOIS-based E-student worksheets assisted by Canva facilitate students understanding the concept of dynamic fluid that is applicable through videos, images, and website links. For example, students can more easily find examples of everyday phenomena applied to dynamic fluid materials according to the LOIS stages. The use of the stages of learning activities is adjusted to the thinking characteristics of students in understanding the concept of the material [27].

3.4 Student Response Test Results

The results of the student response test after using the E-student worksheet can be seen in Table 6.

Table 6. Student Response Test Results

Aspect	Total Score per Statement	Max Score	Percentage	Category
Characteristics of interactive teaching materials	252	280	90%	Very good
Application of knowledge and skills	394	440	90%	Very good
Students' perceptions of satisfaction	322	360	89%	Very good
Learners' Perception of Individual Features	167	200	84%	Very good
Statement of Use of Canva app-assisted interactive teaching materials	140	160	88%	Very good
Total	1275	1440		
Average Percentage			88%	Very good

Based on Table 6, the percentage of the average learning level results is 88% with a very good category, which means that the product developed can be well received by students. Student's response to the use of E-student worksheets is considered very effective. This is because the LOIS-based E-student worksheet assisted by Canva contains 3D animations (virtual labs), which are packaged in the video to make it easier for students to understand dynamic fluid material, which is then considered applicable. This follows the character of students as Generation Z, who cannot be separated from technology. Generation Z is a generation that is very close to technology and has a hyperactive tendency. Therefore, innovation and breakthroughs in teaching methods are needed, where teachers act as facilitators [28].

3.5 Results of the Skills Analysis that was trained

The assessment related to whether the developed E-student worksheet can train students' hands-on skills, mind-on activity, and science process skills. The average score of 87% has been obtained in the highly trained category. The results of the analysis can be seen in Table 7.

Table 7. Results of the Skills Analysis

No.	Skills Trained	Percentage	Category
1	Hands-on activity	87%	Very well trained
2	Minds-on activity	82%	Very well trained
3	KPS	93%	Very well trained
Average of percentage		87%	Very well trained

Hands-on, minds-on activity is positively correlated to student learning outcomes, not only mastery of concepts (minds-on activity) but by doing the hands-on activity, students' science process skills become better with several theories supports [29]. For example, is the social constructivist learning theory, where all students' knowledge is socially constructed and forms part of the learner-centered constructivism field. Social constructivist learning has been trusted in education [30], whereas, according to schema theory [31], the understanding of a text is very dependent on the schema that the reader has. One of the most important is the content schema.

4. CONCLUSION AND SUGGESTION

Based on the results of the research and analysis of the findings during the study, it was concluded that the Canva-assisted LOIS-based E-student worksheet on dynamic fluid materials in SMA is very feasible to be used as a learning tool with an average percentage score of the validator assessment, which is 3.58. Obtained the percentage of teacher perception test results is 91% with a very good category. Learning activities using LOIS-based E-student worksheets assisted by Canva facilitate students understanding of the concept of dynamic fluid that is applicable. E-Canva-assisted LKPD on dynamic fluid materials in high school can be applied as a learning tool based on the average percentage score of students, which is 88%. The results of the E-student worksheet work obtained an average score of 87% in the highly trained category. Based on the research that has been done, the researcher hopes that further research can develop LOIS-based E-student worksheets more interactively.

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