Innovative 7E Learning Cycle E-Worksheets: Improving Fraction Learning and Numeracy Literacy in Elementary Students

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ABSTRAK

Lembar kerja peserta didik di sekolah umumnya menggunakan lembar kerja cetak yang hanya berisi soal evaluasi tanpa gambar dan petunjuk pengerjaan yang jelas. Akibatnya, peserta didik memiliki kemampuan rendah dalam membaca dan memahami materi pembelajaran, terutama pada topik pecahan. Penelitian ini bertujuan untuk mengembangkan lembar kerja elektronik berbasis Learning Cycle 7E yang layak, praktis, dan efektif dalam meningkatkan keterampilan literasi numerasi peserta didik kelas IV sekolah dasar. Penelitian ini menggunakan jenis penelitian pengembangan dengan model 4D. Penelitian dilakukan di kelas IV dengan 21 peserta didik di salah satu sekolah dasar. Teknik analisis data yang digunakan meliputi data kualitatif dan kuantitatif. Data kualitatif diperoleh dari wawancara, lembar validasi ahli, dan angket respons peserta didik, sedangkan data kuantitatif diperoleh dari uji validasi dan angket respons. Hasil validasi ahli materi terhadap lembar kerja elektronik mencapai 99,47%, dan validasi ahli media mencapai 97,72%, keduanya masuk dalam kategori sangat layak. Uji pre-test dan post-test menunjukkan peningkatan sebesar 39,4 dengan rata-rata N-gain sebesar 0,788 dalam kategori tinggi. Respons peserta didik terhadap kepraktisan lembar kerja elektronik mencapai kategori sangat baik. Dengan demikian, lembar kerja elektronik berbasis Learning Cycle 7E pada materi pecahan dinyatakan layak, praktis, dan efektif digunakan untuk memperkuat keterampilan literasi numerasi peserta didik di sekolah dasar.

ABSTRACT

Student worksheets in schools generally consist of printed evaluation sheets with limited instructions and no visual aids, leading to low reading comprehension and difficulty in understanding learning materials, particularly fractions. This study aims to develop a 7E Learning Cycle-based electronic worksheet that is valid, practical, and effective in improving the numeracy literacy skills of fourth-grade elementary school students. This research employed a developmental research method using the 4D model. The study involved 21 fourth-grade students in an elementary school. Data analysis techniques included both qualitative and quantitative approaches. Qualitative data were obtained through interviews, expert validation sheets, and student response questionnaires, while quantitative data were derived from validation tests and response questionnaires. The validation results showed that the electronic worksheet received a score of 99.47% from material experts and 97.72% from media experts, both categorized as highly valid. The effectiveness test, measured through pre-test and post-test results, indicated a significant improvement of 39.4 points, with an average N-gain score of 0.788, categorized as high. Student response questionnaires revealed that the electronic worksheet is highly practical. These findings demonstrate that the 7E Learning Cycle-based electronic worksheet on fractions is valid, practical, and effective in enhancing elementary school students' numeracy literacy skills.

1. INTRODUCTION

Learner worksheets are teaching materials and learning resources that act as support in the learning process. Learner worksheets as teaching materials used by teachers and students in the learning process that contain exercises that students will solve problems (Septian et al., 2019; Utami & Dafit, 2021).

However, the teaching materials used in schools are less interesting for students, and learning does not always use teaching materials. Teaching materials are an important part in determining the quality of learning, and are used to assist teachers/instructors in carrying out teaching and learning activities in the classroom (Nurdiyansah, 2018; Sari & Yustiana, 2021). Thus, the use of teaching materials that are less interesting and limited can cause students to be lazy to read. Students who are less able to read will be less careful in calculating (Kurniawan & Fitriani, 2020; Sri et al., 2021). Based on the results of the new PISA 2022 announced in 2023 regarding the level of literacy numeracy, Indonesia is ranked 68 out of 79 countries, this shows that Indonesia's literacy numeracy level is low. Numeracy skills include literacy numeracy, skills in the use of mathematical concepts such as numbers and formulas in solving problems encountered in everyday life is called literacy numeracy (Lechner et al., 2021; Suprawata & Riastini, 2022). Given the low level of literacy and low numeracy, learning tools such as interesting student worksheets are needed (Novitasari et al., 2023; Suardipa et al., 2023).

Learner worksheets are learning tools consisting of a series of questions and information designed to understand complex ideas, which guide students to carry out activities systematically. However, the worksheets used by teachers only contain a collection of questions equipped with sample questions, besides that the material is structured and does not contain images that motivate students (Choo et al., 2011; Oktarina et al., 2019). Learner worksheets in the form of sheets or prints are not effective as a learning tool because there are still weaknesses in terms of appearance, content, and practicality. Meanwhile, in the current era, the latest technology can be easily utilized in learning. Because technology can help the process of learning activities become more effective and enjoyable (Indraswati et al., 2023; Yaacob & Lubis, 2022). Therefore, researchers will develop a learner worksheet in the form of printed question sheets, into electronic learner worksheets using the wizer.me website. Wizer.me is a worksheet that has interesting visuals and inspires students to learn, besides that using wizer.me can save time because the assessment is done automatically (Kaliappen et al., 2021; Motlhaka, 2020). Electronic learner worksheets using wizer.me have a function to increase learner activity in learning, help students to develop the concept of learning material, as a guide for educators and students in carrying out the learning process, and assist teachers in evaluating students. With this, student worksheets will be easily accessed with smartphone devices owned by students to increase students' understanding of learning materials at school (Firdausi et al., 2023; Hau et al., 2020). One of the materials that need to be learned at school is mathematics learning material, because mathematics is a subject that must be given to all students starting from elementary school to the next level of education.

The purpose of mathematics is to develop students' abilities to think logically, analytically, systematically, critically, creatively, and cooperatively. However, some students, especially in elementary schools, still think that math is a difficult subject to understand (Fitriana, 2015; Puspita et al., 2018). This is due to the implementation of boring or unpleasant learning. So that a paradigm emerges that math is a lesson that is difficult to understand and boring, and one of the most difficult math topics for students is fractions (Febriyanto et al., 2018; Primasari et al., 2021). Meanwhile, the math material that must be mastered by students is fraction material. In fraction material, students have difficulty distinguishing denominators and numerators, and have difficulty distinguishing less than and more than symbols (Afsari et al., 2021; Setiawan & Fikri, 2022). Not only is that, students also unable to process an ordinary fractional number into a fractional number of hundredths. Therefore, teaching materials are needed to create effective learning in math learning.

Mathematics learning can run effectively if it uses the right learning tools, in accordance with the material studied and the characteristics of students. Effective learning allows students to learn easily, pleasantly, and can achieve the learning objectives set (Anwar, 2017; Mpungose, 2021). Therefore, in developing an electronic learner worksheet, it must be adjusted to the characteristics of the learners. Because the characteristics of one child are different from other children (Whiti Estari Negeri, 2020), such as the constraints on students in elementary schools whose reading and calculation skills are low (Jediut et al., 2020; Whiti Estari Negeri, 2020). Literacy is the ability to understand, use and interpret written text, while numeracy is the ability to access, use and interpret mathematical information (Lechner et al., 2021). Literacy numeracy as a new discovery in the mathematics section that functions as a measuring tool and teaches students' skills so that students can be proficient in various literacy numerical exercises (Lechner et al., 2021; Sesanti et al., n.d.). To support students' literacy numeracy skills in learning, it is necessary to find the concept of solving mathematical problems by themselves and apply the concept. The stage of finding this concept is similar to the explore stage in the learning cycle 7E model which is carried out by investigation as a provision in planning problem solving (Maghfiroh et al., 2021; Puspitasari et al., 2020). The Learning Cycle 7E model presents a meaningful, structured learning concept, and provides opportunities for students to learn more deeply (Andani & Utami, 2019; Maryuningsih & dan, 2015).

The learning cycle 7E model provides time for students to think and participate actively. Learning cycle 7E is a constructivism-based learning model in which students not only hear the teacher's explanation but also take an active role in exploring, analyzing, and evaluating their understanding of the concepts learned, thus making the learning process student centered (Puspitasari et al., 2020; Rahmadanti et al., 2021). The implementation of this learning cycle 7E model, the teacher has a role to arouse students' initial knowledge related to the material being studied, and the teacher only acts as a facilitator and mediator of learning. The learning cycle 7E model has the advantage of stimulating students, remembering previous material to relate to the material to be learned, being able to convey concepts verbally, and providing time for students to think, search, find, and explain examples of the application they are learning (Putri Utami et al., 2022; Rusydi & Kosim, 2018). Here are 7 syntaxes in the learning cycle 7E learning model, namely building students' prior knowledge (Elicit), arousing students' interest in learning (Engage), seeking knowledge or investigating (Explore), expressing opinions / explaining (Explain), providing new knowledge / applying the results of the investigation (Elaborate), assessing (Evaluated), and expanding understanding (Extand) (Andani & Utami, 2019; Rusydi & Kosim, 2018). The stages in this learning model cause the implementation of learning to take a long time.

Previous research conducted by previous study stated that the application of the learning cycle 7E learning model can maximize learning to improve students science literacy skills (Maryuningsih & dan, 2015). Previous research conducted by (Firdausi et al., 2023) stated that by developing learning cycle 7E-based student worksheets, it improved students concept understanding and science process skills (Firdausi et al., 2023). Previous research conducted by other study also stated that teaching materials based on the learning cycle 7E model are well used in elementary schools (Fembriani & Hidayat, 2018). Previous research conducted stated that interactive electronic student worksheets using wizer.me are good for social studies learning (Annisa & Musyarofah, 2023).

Based on previous research, it was conducted in elementary and junior high schools in science and social studies subjects, therefore based on the research that has been done, the novelty with this research is that it is conducted in elementary schools in mathematics subjects on fraction material and based on the learning cycle 7E using the wizer.me website. This research is important to support students literacy numeracy skills, helping teachers to recognize and utilize technology. Therefore, this research aims to develop electronic learning cycle 7E fraction worksheets to strengthen the literacy numeracy skills of grade 4 elementary school students in Malang district, and is expected to help teachers and students in supporting literacy numeracy skills in elementary schools, especially on fraction materials. This research offers innovation in the form of developing Student E-Worksheets (E-LKPD) based on the 7E Learning Cycle model which is specifically designed to improve literacy and numeracy skills in elementary school students.

2. METHOD

This research uses the type of development research or R&D (Reseach and Development), as a scientific way to research, design, produce, and test the validity of the products produced (Sugiyono, 2019). By applying the model developed by S. Thiagarajan, namely the 4D (four D) development model. The stages or design of the 4D (four D) development model consist of define, design, development, and disseminate stage. The development process at the define stage aims to establish and define learning needs by analyzing the objectives and limitations of the material, which is carried out through 5 steps in the form of initial analysis (front-end analysis), learner analysis, task analysis, concept analysis, formulation of learning objectives (specifying instructional objectives). The design stage contains planning for making electronic learner worksheets based on learning cycle 7E using the wizer.me website, which is carried out through four steps, namely preparation of test standards, media selection, format selection, and initial design. At the develop stage, researchers make the initial form of the product in accordance with the planning, namely making a product of fraction electronic learner worksheets based on learning cycle 7E on literacy numeracy skills using the wizer.me website. Products that have been developed will be tested for feasibility through validation tests and limited trials. The validation test is carried out by media experts and material experts, and limited trials are carried out by 5-10 students in class IV. The disseminate stage is carried out after the product is completed without revision, which is done by providing electronic fraction worksheets in the form of links to students in grade 4. The product that has been developed will be tested for effectiveness through pre-test and post-test.

The subjects of this research were students in grade 4 at one of the elementary schools in Malang district with a total of 21 students. This development research not only produces a product, but also tests its feasibility, practicality, and effectiveness so that the learning cycle 7E-based fraction electronic student worksheet can be used in learning to support the literacy numeracy skills of students in grade 4. The data collection and analysis techniques used in this study can be seen in Table 1.

Table 1. Data Collection and Analysis Technique

Quantitative	Qualitative
Quantitative analysis uses the validation results from the product feasibility test, and the results of the learner response questionnaire from the product practicality test, as well as the test results from the product effectiveness test of the product development of electronic fraction worksheets based on the 7E learning cycle to support students' literacy numeracy skills developed.	Qualitative analysis uses the results of interviews conducted by researchers to teachers and students, as well as criticism and suggestions from the validation results of the feasibility test.

This research instrument includes interviews, expert validation sheets (media and material), questionnaires of students responses to products. The pre-test was given before the product trial, and the post-test was given after the product trial. Pre-test and post-test given to students have gone through validation by material and media experts and there are improvements from validators. This pre-test and post-test is to determine the effectiveness of the product developed. In the validation and learner response questionnaire, using Likert scale respondent answer criteria. The Likert scale can provide alternative answers to instrument questions with very good to bad interpretations. The validation test was carried out by 1 media validator, namely lecturers, and 2 material validators, namely lecturers and driving teachers at the school. To analyze the improvement of student learning outcomes, it was calculated using the N-gain formula (Subariyanto et al., 2022).
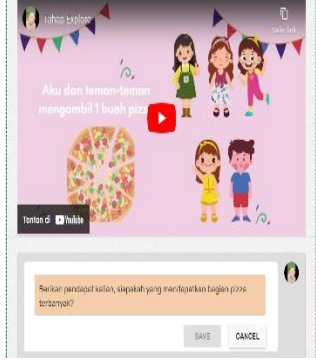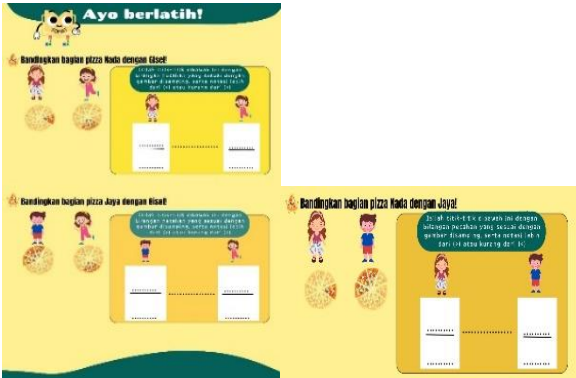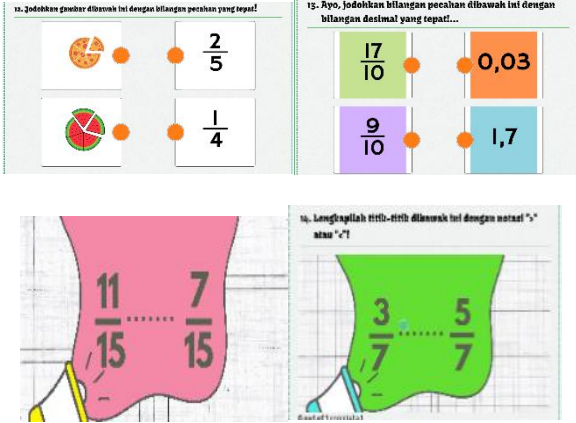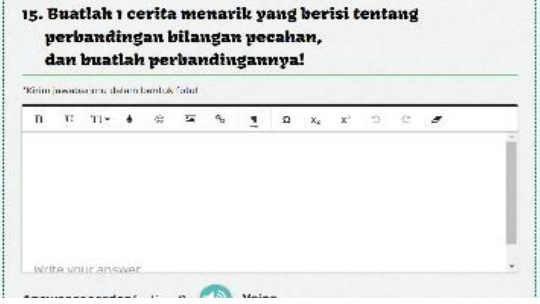
3. RESULT AND DISCUSSION

Result

Based on the problems that exist in schools, at this define stage researchers determine the fraction material used to develop student worksheets. Because of the problems that arise in learning, the literacy numeracy skills of students on fraction material are low. In developing electronic learning cycle 7E student worksheets to strengthen literacy numeracy skills, researchers conducted feasibility tests, effectiveness tests, and practicality tests. In conducting validation, researchers first designed electronic student worksheets by adjusting the seven steps contained in the learning cycle 7E this stage is included in the design stage. At the design stage, researchers made an initial design of electronic learner worksheets with fractions of learning cycle 7E to strengthen the literacy numeracy skills of grade 4 students can be seen in Table 2.

Table 2. Electronic Learner Worksheet Design

Stages	Description
Elicit (Activities to bring out learners' initial understanding). At this stage, a video containing a story problem about pizza division is shown as a triggering question.	
Engage (Activities to arouse learners' interest in learning). Pictures are provided that can awaken learners' initial thinking skills about the concept of fractions.	

Stages	Description
Explore (Investigation of the material being studied). A video is shown as a material for investigation through discussion, regarding the concept of fraction comparison.	
Explain (The activity of explaining the concept/opinion from the result of the investigation). A platform and pictures are provided to summarize the results of the investigation on the comparison of fractions.	
Elaborate (The activity of elaborating knowledge based on investigation to solve problems). A story problem about the comparison of fractions is provided, so that students can describe their knowledge of the concept of fractions in the form of mathematical sentences.	
Evaluation (Assessment activity to measure students' ability to understand fraction material). Provided some questions in the form of pictures that symbolize fractions, so that students can match with the right fraction number. And provided 2 fractions to compare, to assess students' understanding of fractions.	

Stages	Description
Extend (Activity to expand learners' understanding). Provided with an answer box, learners can create a story about the comparison of fractions to extend the concept of fractions that learners have understood.	

The development stage is carried out with product validation by material experts, and media experts. The results of validation by material experts along with their categories of electronic learner worksheets are in Table 3.

Table 3. Results of Material Expert Validation of Electronic Learner Worksheets

No.	Aspect	Nilai	Kategori
1.	Material	98.43%	Very Decent
2.	Model Applicability	100%	Very Decent
3.	Language	100%	Very Decent
	Average	**99.47%**	Very Decent

Based on Table 3, it shows that the material expert validation of the electronic student worksheet reached 99.47%, with a very feasible category. The results of validation by media experts along with their categories of electronic student worksheets are in Table 4.

Table 4. Results of Media Expert Validation of Electronic Learner Worksheets

No.	Aspect	Nilai	Kategori
1.	Language	100%	Very Decent
2.	Presentation	95.45%	Very Decent
	Average	**97.72%**	Very Decent

Based on Table 4, it shows that media expert validation of electronic student worksheets reached 97.72%, with a very decent category. Furthermore, the dissemination stage is carried out by giving a pre-test before the product trial, and giving a post-test after the product trial. The pre-test and post-test were given to determine the improvement of students literacy numeracy skills before and after using the fraction electronic student worksheet learning cycle 7E. The results of improving students' literacy numeracy skills through the pre-test and post-test are shown in Figure 1.

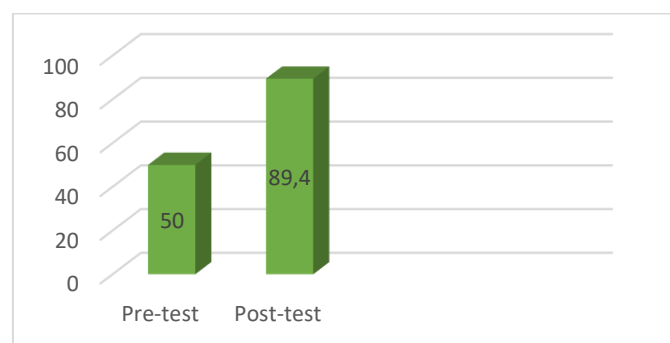**Figure 1.** Pre-test and Post-test Improvement Results

Based on Figure 1, the literacy numeracy skills of students seen from the pre-test and post-test results increased by 39.4 with an average N-gain of 0.788. Categorizing the effectiveness of the N-gain average with a percentage of $g \leq 0$ is included in the failure category, $0 < g < 0.3$ is included in the low

category, $0.3 \leq g \leq 0.7$ is included in the medium category, $g > 0.7$ is included in the high category. Based on the analysis of the improvement of students learning outcomes, the average effectiveness of N-gain is 0.788 which is included in the high category. The effectiveness of electronic learner worksheets to strengthen literacy numeracy can be seen in Figure 2 and Figure 3.
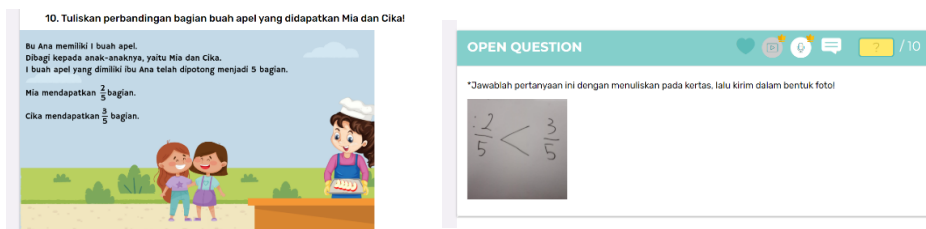

Figure 2. Effectiveness of Worksheets on Literacy Numeracy Skills

Based on Figure 2, learners can understand the statement of the problem presented, and are able to state it into mathematical sentences correctly.
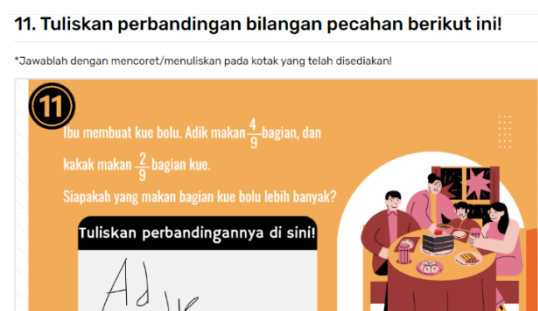

Figure 3. Effectiveness of Worksheets on Literacy Numeracy Skills

Based on Figure 3, from the math problems that have been presented, students can compare fractions appropriately. The results of the practicality assessment from the learner response questionnaire of the electronic learner worksheet are in Figure 4.

	Very good	Good	Simply	Not Good Enough	Very Poor
■ Grain	301	107	12	0	0
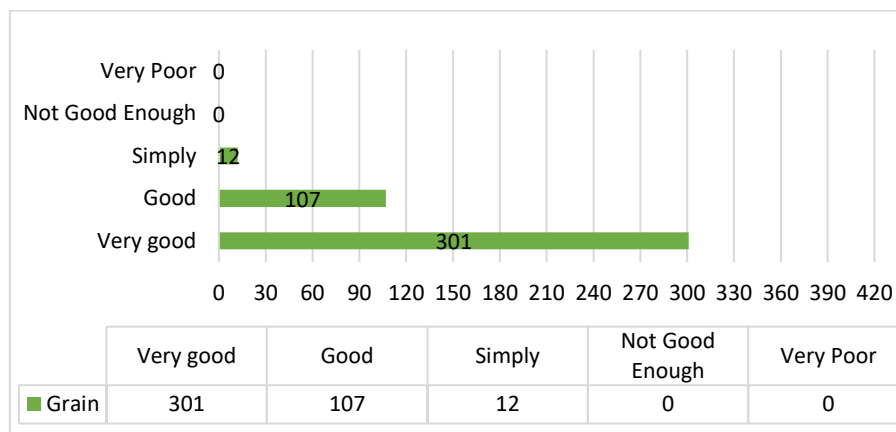
Figure 4. Results of Questionnaires of Learners' Response to E-LKPD

Based on Figure 4, the results of the students' response questionnaire to the electronic learner worksheet which reached 93.8% in the very good category. There are 301 aspects of practicality chosen by students in the excellent category. And 107 aspects of practicality chosen by students in the good category. 12 aspects of practicality chosen by students in the moderate category. And 0 aspects of practicality chosen by students in the poor and very poor categories.

Discussion

This development research uses the 4D model developed by Thiagarajan consisting of four stages, namely defining, designing, developing, and disseminating (Asmedy, 2021; Kuswidyanarko et al., 2021).

The first stage, carried out with five steps, namely initial analysis, learner analysis, task analysis, concept analysis, and formulation of learning objectives. In the first stage, researchers know that there are several problems in learning, such as the absence of the use of interesting student worksheets, boring learning activities, some students have low reading and calculation skills, and in learning mathematics students do not understand fraction material, this happens because there is no use of technology (application or web) in learning and the student worksheets used are not suitable for students' abilities (Bice et al., 2018; Septian et al., 2019). Therefore, researchers developed a teaching material as a solution to these problems, by developing a fraction student worksheet learning cycle 7E can strengthen students' literacy numeracy skills in fraction material.

The second stage, carried out with four steps, namely the first preparation of test standards. In this step, the researcher compiled the fraction material according to the learning outcomes and characteristics of the students, and determined the scoring of the questions. Second, media selection, in this step researchers make supporting materials in the form of images, audio, video, and story problems (Amallia & Unaenah, 2019; Asokan et al., 2019). This media selection is based on worksheets at school, in the form of questions that have not utilized the latest technology that can make students interested. Third, format selection, in this step the researcher compiles electronic participant worksheets on the wizer.me web. which begins by compiling a clear layout of images, videos, and sound (Istiqomah & Siswono, 2020; Wibowo & Veronica, 2022). Fourth, the initial design step, at this stage the researcher makes a design plan in accordance with the learning outcomes supported by images, videos, audio, and interesting story problems. In addition, researchers made product assessment instruments in the form of validation sheets and questionnaires. The validation sheet was used for validation activities by material experts and media experts, and the questionnaire was given to students as a response to the electronic student worksheets developed. The validation sheet and response questionnaire were used to determine the quality of the worksheets developed (Prahani et al., 2021; Ummah & Rifai, 2021).

Making electronic student worksheets, adapted to the stages of the 7E learning cycle. Researchers made an animated video at the elicit stage as an apperception to bring up students initial understanding of fraction material. Each stage is in the form of a problem, designed with attractive images and videos before being entered into the wizer.me website. Interesting videos in math learning can increase students' confidence (Asrizal et al., 2022; Bascones et al., 2024). In addition, the use of the wizer.me website can make it easier for students to learn. In addition, the use of the wizer.me website has a positive impact because it increases students understanding of learning and improves students' literacy numeracy skills (Ayuditiasni Dewi et al., 2023; Kumalasari & Julianto, 2021).

From the research results, the material expert validation results of the electronic learner worksheet reached 99.47%, with a very decent category. This is in accordance with research conducted by previous study which states that learning cycle 7E-based student worksheets are feasible to use to improve scientific literacy (Sekarsari Putri, 2017). The results of media expert validation of electronic learner worksheets reached 97.72%, with a very decent category. This is in accordance with research conducted by other study which states that wizer.me-based electronic learner worksheets are very feasible to use in the learning process (Oktaviani et al., 2023). Based on the results of validation by material experts and media experts, it can be said that this learning cycle 7E-based fraction electronic learner worksheet is very decent to use on students' literacy numeracy skills.

The fourth stage was carried out by distributing the electronic learner worksheets that had been developed. Before the developed electronic learner worksheets were given to students, researchers gave a pre-test to students to measure the effectiveness of electronic learner worksheets. From the pre-test and post-test results, there was an increase of 39.4 with an average N-gain of 0.788. Categorizing the effectiveness of the average N-gain with a percentage of $g \leq 0$ is included in the failure category, $0 < g < 0.3$ is included in the low category, $0.3 \leq g \leq 0.7$ is included in the medium category, $g > 0.7$ is included in the high category (Motlhaka, 2020; Prasetya, 2021). Based on the categorization of effectiveness, the average N-gain of 0.788 is included in the high category. Previous research conducted by other study stated that student worksheets were declared effective in strengthening students' abilities in learning. So that this electronic fraction learner worksheet based on the 7E learning cycle can be said to be very effective for strengthening students' literacy numeracy skills (Hulu & Dwiningsih, 2021). From the math problems that have been presented, learners can compare fractions correctly. With this it can be stated that the electronic learner worksheets developed, can support the literacy numeracy skills of learners in grade 4. This is in accordance with research conducted by study which states that adequate internet access and adequate devices such as Android or Ios-based smartphones are needed (Kumalasari & Julianto, 2021).

Based on the results of the students' response questionnaire to the electronic learner worksheet which reached 93.8% in the very good category. There are 301 aspects of practicality chosen by students in the excellent category. And 107 aspects of practicality chosen by students in the good category. 12 aspects

of practicality chosen by students in the moderate category. And 0 aspects of practicality chosen by students in the poor and very poor categories. This is in accordance with research conducted by study which states that wizer.me-based electronic learner worksheets are very practical to use in the learning process (Oktaviani et al., 2023). So this shows that the fraction electronic learner worksheet based on the learning cycle 7E is practical to use to support students' literacy numeracy skills (Putri Utami et al., 2022; Rusydi & Kosim, 2018).

This research provides an overview of the positive impact of using the learning cycle 7E fraction electronic learner worksheet to strengthen literacy numeracy at the elementary school level. This learner worksheet can provide feedback or feedback from the results of the work through the asses menu on the wizer.me website. Thus, teachers can provide motivation to learn privately to each learner and can find out the literacy numeracy skills, as well as understanding of the fraction material of students. Feedback from the teacher can be seen by students by re-clicking the worksheet link that has been given. This feedback is used as a reference for students to improve their understanding of fraction materials. In this study, there are limitations to the learner worksheets developed, which require a long time to make, because there are seven stages in the learning cycle 7E model. The learner worksheets that have been developed can only be accessed by one gmail account or can be used in one time access. However, the gmail account can be used to access other worksheets. In addition, an adequate wifi signal is needed, because it affects the appearance of questions and images on wizer.me. Therefore, it is better not to develop this electronic learning cycle 7E student worksheet suddenly, because it takes a long time, and there needs to be adequate signal to access it.

It is hoped that this electronic learner worksheet can strengthen the literacy numeracy skills of students. Furthermore, teachers can develop electronic participant worksheets using the wizer.me website with the learning cycle 7E learning model in learning. In addition, teachers are expected to plan the implementation of learning in accordance with the characteristics of students with an appropriate time allocation. School principals should be able to facilitate teachers to take part in training or workshops to develop electronic student worksheets that are interesting and able to strengthen students' literacy numeracy skills, and be able to achieve the learning outcomes that have been determined using the wizer.me website. Other researchers can use this research as a reference in researching electronic student worksheets and the like. In addition, it is hoped that in developing worksheets using the wizer.me website, you can design the design first, because if an error occurs, you will repeat making the worksheet from the beginning.

4. CONCLUSION

The fraction electronic learner worksheet learning cycle 7E to strengthen the literacy numeracy skills of students has a very good classification. With the results of validation by material and media experts in the very decent category, the results of practicality through a learner response questionnaire in the very good category, and there is an increase from the pre-test and post-test results, as well as the average n-gain with a high category. This shows that the electronic learner worksheets developed are decent, practical, and effective to use to strengthen the numeracy literacy skills of students in grade 4.

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