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DEVELOPMENT OF LIVE WORKSHEETS ASSISTED DIAGNOSTIC ASSESSMENT INSTRUMENTS TO MEASURE UNDERSTANDING OF SCIENCE CONCEPTS PROSPECTIVE ELEMENTARY SCHOOL TEACHERS

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Abstract: Understanding the material's content is one of the main competencies a teacher must possess, so it is necessary to diagnose the extent of understanding the level of understanding of science concepts for prospective teachers. This study aims to produce a valid and practical diagnostic assessment instrument assisted by live worksheets to measure the level of understanding of science concepts for elementary school teacher candidates. This research is development research using a 4-D model (define, design, develop and disseminate). In the define stage, science concepts that are difficult to understand for prospective elementary school teacher students have been identified, namely the material of temperature and heat, electricity, magnetic fields, and the solar system. The next stage is to design the right instrument to diagnose the level of understanding of science concepts for elementary school teacher candidates, namely a diagnostic instrument with three-level multiple choice questions integrated into the live worksheet application. Furthermore, in the development stage, the questions pay attention to the final abilities expected to be achieved in students based on the semester learning plans for special science education courses on materials identified at an early stage. The instrument that has been developed is then tested for validity and practicality. The validity test results obtained an average score of 3.8 which means the instrument is very valid, and the results of the practicality test show a practical instrument with an average score of 3.5. The final stage of this research is dissemination, namely the process of disseminating research and development products in the form of diagnostic assessment instruments assisted by live worksheets to measure the level of understanding of the science concepts of elementary school teacher candidates that have been developed. In conclusion, the live worksheet-assisted diagnostic assessment instrument developed is valid and practical for measuring the level of understanding of elementary school teacher candidates.

Keywords: *Understanding of Scientific Concepts, Diagnostic Assessments, Liveworksheets*.

INTRODUCTION

At this time, technological advances have become a necessity in various fields, including education. The phenomenon of the coronavirus pandemic outbreak or known as covid-19, reinforces the importance of the role of technology [1]. In various countries, including Indonesia, since the announcement of the status of the virus pandemic, learning activities at the elementary, secondary, and tertiary levels have begun to experience changes from face-to-face to online learning as well as blended learning [2]. During the Covid-19 pandemic, educators must ensure that learning activities continue, even though students are at home or in their respective places. An educator can use various online applications to support the achievement of learning objectives [3]. The application of learning with online applications is expected to help students learn optimally and effectively with a more interesting learning process even without having to do it face-to-face [4].

Such conditions certainly require the skills of educators, teachers, and lecturers' skills to manage to learn well so that the objectives of these learning activities can be achieved optimally [5]. One way to determine the success of the learning activities that have been carried out is to conduct an evaluation. The form of evaluation can be done online or through blended learning, one of which is through assessment or assessment [6]. Assessment is one of the important stages in learning activities [7]. According to one opinion, assessment is one of the important factors determining the success of the learning process and outcomes [8]. The results of the assessments they receive can be used to measure students' success in understanding a concept or material for students. Edelenbos & van Buuren, (2005) stated that assessment is a process to determine whether an activity program's process and results are following the goals and criteria set [9].

Based on observations, elementary school teacher candidates often complain about difficulty understanding science concepts. The cause of the difficulty in understanding scientific concepts is that science contains many abstract concepts and mathematical equations, and many images that are difficult to explain physically [10]. Mastery of concepts is a very important part that must be possessed by students, especially prospective teachers who will later teach these concepts to their students. This mastery is one of the main competencies that must be possessed by a teacher, namely professional competence [11].

Therefore, to give birth to prospective teachers with these competencies, educational institutions and education personnel need first to diagnose the level of achievement that these prospective teachers have achieved.

With the demands for increasing professional competence of prospective teachers, the world of education is faced with new normal conditions, where many learning activities are carried out online or blended learning. These conditions require educators to innovate in providing services or teaching to students so that the desired goals can be achieved [12]. On the one hand, changes in the way of learning require teachers to be innovative in providing evaluations and assessments of the learning activities that have been carried out [13]. One of the online applications that educators can use to assess learning activities that have been carried out online or blended is the Live Worksheets application. Live worksheets are spreadsheet worksheets that function as a place for user input of data through cells, processed and displayed in the workbook [14]. The live worksheet is a website that allows teacher educators, lecturers, and students to convert traditional printable worksheets (such as doc, pdf, jpg, and so on) into interactive worksheets [15].

Based on this, the researcher is interested in developing a diagnostic assessment instrument with the help of live worksheets to measure the level of understanding of science concepts for elementary school teacher candidates. According to the researcher, this instrument is important to be developed because we see and feel the learning conditions since the covid pandemic until now need special attention and evaluation to minimize the negative impact of this situation [16]. One example of the negative impact is that students need to understand the material they are studying. So researchers need to develop measuring tools to analyze how students or students have understood the level of understanding or what materials have not been and during learning in this situation.

RESEARCH METHODS

This research is a research development or Research and Development (R & D). Research and development is a research method that focuses more on producing certain products and testing the effectiveness of these products. The research and development design used in this study is a 4D model (Four D Model), which consists of define, design, development, and dissemination stages [17]. The data in this study are the results of expert validation questionnaires regarding the feasibility of diagnostic assessment instruments, live worksheets-assisted, and instrument practicality questionnaires to measure the level of understanding of science concepts for elementary school teacher candidates. Data were analyzed descriptively and quantitatively. The validity of the live worksheet-assisted diagnostic assessment instrument was determined by converting the average total score into a quality score using the criteria in Table 1.

Table 1 Criteria for the validity of live worksheet-assisted diagnostic assessment instruments

Score	Category
$3.5 < SR \leq 4.0$	Very valid
$2.5 < SR \leq 3.5$	Valid
$1.5 < SR \leq 2.5$	Invalid
$1.0 < SR \leq 1.5$	Very Invalid

Data on the practicality of the live-sheet-assisted diagnostic assessment instrument were obtained from student response questionnaires to use live-worksheet-assisted diagnostic assessment instruments to measure the level of understanding of science concepts for elementary school teacher candidates. The practical criteria are under the thickness of Table 2.

Table 2 Practical criteria for live worksheet-assisted diagnostic assessment instruments

Score	Category
$3.5 < SR \leq 4.0$	Very Practical
$2.5 < SR \leq 3.5$	Practical
$1.5 < SR \leq 2.5$	Impractical
$1.0 < SR \leq 1.5$	Very Impractical

RESULTS AND DISCUSSION

This research and development aim to produce a diagnostic assessment instrument with the help of a live worksheet to measure the level of understanding of science concepts for elementary school teacher candidates. The research and development stages refer to the 4-D Thiagarajan model consisting of the define, design, develop, and disseminate stages.

Define stage.

The analysis that has been carried out at this stage consists of several stages—reviewing and analyzing the Semester Lesson Plan, Student Assignment Design for elementary science education courses; analyzing the results of the previous semester's science education exams; as well as analyzing articles related to misconceptions that are often experienced in science subjects. Based on the analysis results, we determine the topics included in the developed instrument: temperature and heat, electricity, magnetic fields, and the Solar System.

Design Stage

At this stage, a diagnostic instrument is designed to measure the level of understanding of

science concepts for prospective elementary school teachers in the form of three-level multiple choice integrated into the live worksheet application. The components at the instrument's initial design stage include the instrument's title, student identity, item items containing questions, answer options, and columns to give reasons and options for confidence levels. An example of a designed instrument is shown in Figure 1

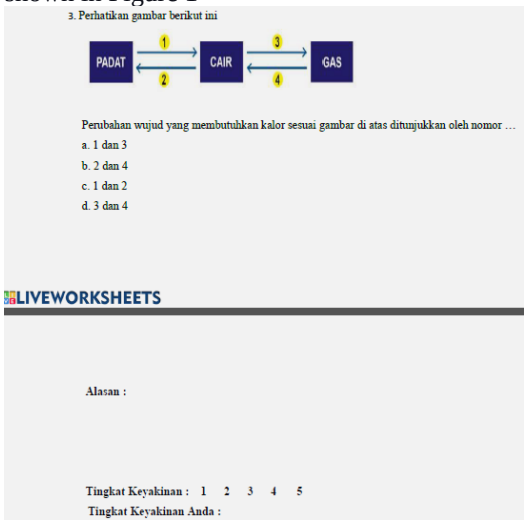

Figure 1. An example of a designed instrument.

Items of questions/questions are arranged based on the expected final competencies in science education courses, especially on temperature and heat, electricity, magnetic fields, and the Solar System. The expected final capabilities include the following:

1. Apply the concept of heat transfer in everyday life.
2. Analyze the effect of heat on changes in temperature and shape of objects in everyday life.
3. Understand the concept of electricity, the circuit's nature, and its application in everyday life.
4. Understand the concept of magnetism and the properties of magnetic fields, manufacture and maintain magnetic objects and solve magnetic field problems in everyday life.
5. Understand the solar system, the rotation and revolution of the earth, and the occurrence of lunar and solar eclipses.

Development Stage

The development stage aims to produce better diagnostic instruments after going through various validation processes by media and material experts. Diagnostic assessment instruments assisted by live worksheets that have gone through the validation process are then revised according to input from the validator—then tested on 35 students of the Elementary School Education Study Program, Faculty of Teacher Training and Education, Mataram University, to determine the practicality of the diagnostic assessment instrument.

The advantages of the resulting assessment instruments include that the instruments can be accessed using a laptop and a mobile phone. In addition, assessments assisted by live worksheets can provide feedback directly to students regarding the assessment results.

Validation Test Results

The validation process involves two validators: the material expert validator and the media expert validator. The validator validates the feasibility of the system, the feasibility of construction, content, and language. The technical assessment given by the validator is to fill out a questionnaire and ask for opinions, criticisms, and suggestions for improvement. The questionnaire is filled out by giving a checklist (√) in the column corresponding to the assessment given. The highest score is 4, and the lowest is 1 for each question or statement intended for experts. The total score given by the validator is then averaged and compared with a scale value of 4. The provisions and procedures for this assessment apply to all data from the validation results. The recapitulation of the validation results of the interactive Diagnostic Assessment Instrument to measure the understanding of science concepts for prospective Interactive Science Elementary teachers is presented in Table 3.

Table 3. The average score of the Diagnostic Assessment Instrument validation assessment results

Aspects of Assessment	Average	Criteria
System eligibility	4.00	Very Valid
Construct	3.75	Very Valid
Contents	3.75	Very Valid
Language	3.80	Very Valid
Whole	3.80	Very Valid

The results of the expert validation test as a whole show a very valid result with a final score of 3.8. Some of the notes given by the validator are 1). The appearance of the questions may be made more interesting, 2). Some questions may need to be added with pictures for a more comprehensive explanation. 3). The questions are varied, with multiple choice, matching, drop-down, and description. 4). To make it more interesting, it is necessary to add more use of images and example cases.

Practicality Test Results

The practicality data of the product trial consists of student response data. System feasibility, suitability of material content, structure, and language used in the diagnostic

assessment instrument for understanding Interactive Science on heat and its transfer material. Student responses to the readability test and attractiveness of the diagnostic instrument for understanding Interactive Science concepts after being tested in the field.

Data on the responses of educators and students to the use of interactive diagnostic assessment instruments to measure understanding of science concepts for elementary school teacher candidates on materials such as temperature and heat, electricity, magnetic fields, and the Solar System. Meanwhile, the number of respondents regarding the attractiveness and readability of the Interactive diagnostic assessment instrument that has been developed in 35 respondents/students of the study shows that the educator's response to the use of the diagnostic assessment instrument in measuring understanding of the science concept of Interactive Elementary School teacher candidates with the help of a live worksheet is included in the category of practical use. The average practicality analysis results obtained a score of 3.50, which means that the instrument developed is practical to use.

Disseminate Stage

The Dissemnimate stage focuses on disseminating the product as a result of development, namely the interactive diagnostic assessment instrument for scientific understanding. The instrument is accessible to certain grade students and all elementary school teacher education program students. The instrument can be accessed by accessing ttps://daring.unram.ac.id/, specifically for elementary science education classes and all elementary science lecturers.

Based on the results of the validation and dissemination tests, the diagnostic assessment instrument assisted by the lives worksheet that was developed showed that the instrument was suitable to be used to measure the mastery of science concepts for elementary school teacher candidates. The existence of these instruments can assist lecturers in measuring students' abilities related to understanding science concepts. Diagnostic instruments are important to implement because they can be used to identify learning difficulties experienced by students in science learning [18]. Diagnostic instruments, in addition to identifying learning difficulties, can also be used to measure students' ability to understand concepts [19-20]. Moreover, with the help of the lives worksheet application, diagnostic instruments are more practical, making it easier for lecturers to use instruments to measure students' ability to understand concepts.

CONCLUSION

Based on the results of research and discussion, it can be concluded that: 1). The diagnostic assessment instrument with the help of a live worksheet to measure the understanding of science concepts for elementary school teachers was declared to be very valid, with a mean score of 3.8. 2). The diagnostic assessment instrument, with the help of a live worksheet to measure the understanding of science concepts for elementary school teacher candidates, is stated to be practical with a mean score of 3.5. Based on these two things, the diagnostic assessment instrument with the help of a live worksheet to measure the understanding of science concepts for elementary school teacher candidates is valid and practical to be used in elementary school science education courses.

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