JURNAL ABSIS
Jurnal Pendidikan Matematika dan Matematika
Vol. 7 No. 2, December 2024

DEVELOPMENT OF A CONTEXTUAL STUDENT WORKSHEET ON RELATIONS AND FUNCTIONS TO FACILITATE STUDENTS' MATHEMATICAL CONCEPTUAL UNDERSTANDING

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ABSTRACT This research was motivated by the low ability of students to understand mathematical concepts. One of the efforts made to facilitate the ability to understand mathematical concepts is by developing Contextual Teaching and Learning LKPD. This research aims to produce valid and practical LKPD products to facilitate the ability to understand mathematical concepts. The form of this research is development research using the 4-D model (definition, design, development and distribution). The research subjects were class VIII of SMPN 32 Pekanbaru. Research instruments include interviews, observations, validation sheets, student response questionnaires. The data analysis technique is carried out by analyzing validation data and student response data. The results of data analysis showed that the LKPD developed had met valid standards with a percentage of 89.06% in the very valid category. The student response questionnaire met practical standards with a percentage of 89.62% in the very practical category. Based on the results of data analysis, it can be concluded that the LKPD developed meets the valid and practical criteria, so it can be used in the mathematics learning process.

Keywords: student worksheet, contextual learning, mathematical conceptual understanding, relations and functions

ABSTRAK Penelitian ini dilatarbelakangi oleh rendahnya kemampuan pemahaman konsep matematis siswa. Salah satu upaya yang dilakukan untuk memfasilitasi kemampuan pemahaman konsep matematis yaitu dengan mengembangkan LKPD Contextual Teaching And Learning. Penelitian ini bertujuan untuk menghasilkan produk LKPD yang valid dan praktis untuk memfasilitasi kemampuan pemahaman konsep matematis. Bentuk penelitian ini adalah penelitian pengembangan dengan menggunakan model 4-D(pendefenisian, perancangan, pengembangan, dan penyebaran). Subjek penelitian yaitu kelas VIII SMPN 32 Pekanbaru. Instrumen penelitian berupa wawancara, observasi, lembar validasi, angket respon siswa. Teknik analisis data dilakukan dengan cara menganalisis data hasil validasi dan data respon siswa. Hasil analisis data diperoleh bahwa LKPD yang dikembangkan telah memenuhi standar valid dengan persentase 89,06% dengan kategori sangat valid. Angket respon siswa memenuhi standar praktis dengan persentase 89,62% dengan kategori sangat

praktis. Berdasarkan hasil analisis data, dapat disimpulkan bahwa LKPD yang dikembangkan telah memenuhi kriteria valid dan praktis, sehingga dapat digunakan dalam proses pembelajaran matematika.

Keywords: LKPD, pembelajaran kontekstual, pemahaman konsep matematika, relasi dan fungsi

INTRODUCTION

The ability to understand mathematical concepts is fundamental in mathematics learning. Without a strong foundation in conceptual understanding, students are unlikely to grasp the ideas being taught (Ompusunggu, 2014). Students should be given the opportunity to rediscover mathematical concepts through contextual problems that are relevant to their real-life experiences and close to their way of thinking, thereby promoting more humanistic values in mathematics education (Hendriana & Soemarmo, 2014).

Effective mathematics learning is characterized by a high level of conceptual understanding among students. When students comprehend the underlying concepts, they are better equipped to solve mathematical problems (Zein & Darto, 2012). Conceptual understanding forms the basis of learning, enabling students to identify cause and effect relationships and the origins of mathematical problems. In this way, teachers can assess whether students have truly mastered the content (Sardiman, 2010).

However, students' mathematical conceptual understanding in Indonesia remains below expectations, particularly in relation to the 2013 Curriculum, which emphasizes conceptual mastery, active discussion, presentation, and disciplined behavior (Rulviana, 2017). Field observations show that students still encounter major difficulties in learning mathematics, as reflected by low test scores and a poor grasp of fundamental concepts.

Interviews with a mathematics teacher at SMPN 32 Pekanbaru revealed that classroom instruction was still teacher-centered and lacked opportunities for students to construct their own understanding. This limits students' ability to engage with mathematical processes and concepts meaningfully. Moreover, student participation in class was limited; many students were hesitant to ask questions due to fear or embarrassment. During group discussions, only a few students were actively involved, while others remained passive. Some even failed to pay attention during lessons, indicating low engagement overall.

These findings align with prior research. Aida, Kusaeri, and Hamdani (2017) found that students' conceptual understanding remains low, with only 4.76% able to represent concepts using various forms, and just 1.19% able to apply specific procedures and operations. Kartika (2018) similarly reported that students struggle to explain and represent learned concepts. Yani (2019) noted that students tend to memorize formulas from textbooks without truly understanding them.

https://doi.org/10.30606/absis.v7i2.2645

Consequently, they fail to solve unfamiliar problems or connect new material to previous knowledge.

Yufentya, Irwandani, and Simatupang (2019) found that while high-performing students demonstrated conceptual mastery in over 50% of the indicators, students with average or low abilities scored significantly lower. Istiqomah (2019) reported that 60% of students relied on rote memorization and failed to apply their knowledge when presented with new problems or link it to prior concepts.

This lack of conceptual understanding ultimately impacts learning outcomes. Zulkardi (2003) emphasized that mathematics learning should focus on concept acquisition. Therefore, teaching materials should support students in constructing and internalizing key concepts. One such tool is the student worksheet.

According to Sagita (2016), student worksheets are essential tools for guiding students in discovering concepts through individual or group activities. These materials enhance student engagement and support the development of scientific thinking, contributing to improved academic performance.

However, the worksheets currently used at SMPN 32 Pekanbaru are insufficient. They are not based on the Contextual Teaching and Learning (CTL) approach and have not been developed specifically for the topic of relations and functions. Ideally, worksheets should help students construct their own knowledge, promote collaboration, and foster deeper understanding.

CTL is a teaching approach that actively engages students in discovering and connecting learning materials to real-life situations, whether in the context of family, society, or nation. This helps students find personal meaning in their learning (Harudin & Saputra, 2018). In the development of student worksheets based on CTL, the topic of relations and functions was chosen due to its relevance to students' daily experiences. By drawing on familiar contexts, students are better positioned to build and internalize new mathematical concepts.

METHODS

This study employed a research and development (R&D) approach aimed at producing a student worksheet based on the Contextual Teaching and Learning (CTL) approach for the topic of relations and functions. The development model used in this study was the 4-D model, which consists of four phases: Define, Design, Develop, and Disseminate. This model was introduced by Thiagarajan, Semmel, and Semmel, as cited in Mulyatiningsih (2014).

The participants in this study were 12 students from SMPN 32 Pekanbaru, and the research was conducted in August 2023. The trial implementation aimed to obtain direct feedback on the student worksheet developed using the CTL approach. Data collection was conducted using a student response questionnaire to assess the practicality of the worksheet.

This study collected both qualitative and quantitative data. Qualitative data were obtained from the expert review of the student worksheet by three university lecturers. The feedback, suggestions, and comments were compiled and used to improve the worksheet. Quantitative data were gathered through the scoring of validation sheets and student response questionnaires.

The instruments used in this study included validation and practicality questionnaires. Additional techniques for data collection included interviews, student response questionnaires, and observations.

The data analysis techniques included both qualitative and quantitative methods. The goal of the analysis was to produce a student worksheet that meets the criteria of being valid and practical. The assessment criteria for validity were based on a Likert scale, as presented in Table 1.

Table 1. Validity Assessment Criteria

Score Range	Category
81% – 100%	Very valid
61% – 80%	Valid
41% – 60%	Fairly valid
21% – 40%	Less valid
≤ 20%	Not valid

To assess the practicality of the student worksheet, a Likert scale was also used. The practical scores were calculated based on the average responses, and the criteria are listed in Table 2.

Table 2. Practicality Assessment Criteria

Score Range	Category
90% – 100%	Very practical
80% – 89%	Practical
65% – 79%	Fairly practical
55% – 64%	Less practical
< 55%	Not practical

FINDING AND DISCUSSION

This study aimed to develop or produce a product in the form of a student worksheet based on the Contextual Teaching and Learning (CTL) approach for the topic of relations and functions. The student worksheet that was developed and produced in this research fulfilled the criteria of validity and practicality. The development

https://doi.org/10.30606/absis.v7i2.2645

followed the 4D model, which consists of four stages: define, design, develop, and disseminate.

The initial stage of this research began with the define phase. The results of this phase indicated that the student worksheet previously used in the teaching and learning process was based on CTL, but it had not been effective in sharpening students' ability to understand mathematical concepts. This was evident from students' low levels of conceptual understanding, which did not meet the expectations intended by the researcher. One of the contributing factors was the students' unfamiliarity with problems related to their daily lives and their lack of experience in making connections between mathematical concepts. In other words, students were not used to being confronted with problems that required them to exercise their conceptual understanding of mathematics.

The student worksheet that was developed and produced also included practice exercises that were constructed based on the indicators of mathematical conceptual understanding. These exercises were designed so that students could become accustomed to working on problems that specifically targeted those indicators and could gradually achieve the learning objectives intended for each lesson. Additionally, the researcher applied a CTL-based learning process by developing a student worksheet that integrated the CTL approach. The purpose of developing the CTL-based student worksheet was to shift the learning process away from merely memorizing formulas and instead encourage students to engage in activities that would help them understand the material through connections to real-life problems relevant to their experiences. Consequently, the researcher developed a student worksheet based on CTL principles in the topic of relations and functions to facilitate the development of students' conceptual understanding in mathematics. This development effort proved to be effective in the learning process, especially when the process was oriented toward enabling students to solve problems presented in the worksheet (Sulastri, 2017).

In the design phase, the researcher undertook the preparation of assessment standards, selected the appropriate media, determined the format, and developed the initial draft of the student worksheet. This stage resulted in an initial draft design of the student worksheet. The draft consisted of several elements commonly found in worksheets, such as the title, learning objectives, instructions for use, and practice exercises. In addition, it included numbering for each session, student identification sections, and supporting images. The worksheet was printed in a format similar to those commonly used in schools, but the content was designed with reference to the seven CTL components. Each CTL component was incorporated with the aim of facilitating the development of students' conceptual understanding. At the end of each worksheet session, students were provided with tasks that contained problems aligned with the indicators of mathematical conceptual understanding. As facilitators of learning, teachers must be able to select instructional strategies that

suit their students' abilities in the classroom and participate in developing teaching materials that support the overall learning process (Gazali, 2016). In this case, the chosen instructional material was the student worksheet, with the initial version referred to as Draft I.

The next stage was development. In this stage, the researcher carried out self-evaluation, expert review, one-to-one testing, and small group testing. The first draft went through a self-evaluation process and was then assessed through an expert review by three validators to determine its validity and feasibility. The researcher did not merely request scores or assessments but also solicited constructive feedback and suggestions from the validators, which were considered in the further refinement of the worksheet. After that, the one-to-one test was conducted, where the first draft was distributed to three students. The purpose of this one-to-one testing was to identify any errors in writing, as well as issues related to clarity and language usage. This is crucial because appropriate language use can significantly help students understand the information or instructions provided in the worksheet (Saftina et al., 2021). During this phase, students also gave feedback and suggestions. Some of the inputs received included unclear diagrams and graphs, small font size, and the need for more supportive visuals for the exercises. Based on these inputs, revisions were made to Draft I, resulting in the production of Draft II.

The researcher then proceeded with the small group test to assess the practicality of the student worksheet. This test focused on several aspects, including ease of use, content presentation, readability, and time efficiency. A practicality questionnaire was distributed to 12 students to gather their responses regarding Draft II. Based on the results, further revisions were made to improve the worksheet, resulting in Draft III, which was considered the final version.

The validation test, conducted by three expert validators, involved the assessment of three key aspects: face validity, content validity, and construct validity. Face validity included indicators such as presentation quality, graphic design, and language clarity. Content validity focused on the relevance and accuracy of the content, while construct validity evaluated the alignment with the Contextual Teaching and Learning (CTL) approach and the worksheet's ability to facilitate students' conceptual understanding.

The results of the validation of the student worksheet on the topic of relations and functions using the CTL approach are presented in the following table.

Table 1. Validation Results of the Student Worksheet on Relations and Functions

Aspect	Indicator	Average of 6 Validators (%)	Average per Aspect (%)
Face Validity	Presentation Feasibility	88.12	87.77
	Graphic Feasibility	83.70	
	Language Clarity	91.47	

https://doi.org/10.30606/absis.v7i2.2645

Aspect	Indicator	Average of 6 Validators (%)	Average per Aspect (%)
Content Validity	Content	89.62	89.62
Construct Validity	Alignment with CTL-Based Learning	89.25	89.80
	Supporting Conceptual Understanding	90.36	
Overall Average			89,06%

Table 2. Student Practicality Response for the CTL-Based Student Worksheet on Relations and Functions

Aspect	Average	Category
Ease of Use	89.21	Very Practical
Presentation Quality	90.30	Very Practical
Readability	89.62	Very Practical
Time Efficiency	90.60	Very Practical

The data in the table indicate that the student worksheet scored an overall average of 89.93% across all aspects, placing it in the Very Practical category. This demonstrates that the worksheet was well-received by students, who found it easy to use, clearly presented, readable, and appropriately paced for use in the classroom.

CONCLUSIONS AND RECOMMENDATIONS

This development research resulted in a learning material product in the form of a student worksheet based on the Contextual Teaching and Learning (CTL) approach for the topic of relations and functions. The worksheet was specifically designed to facilitate students' mathematical conceptual understanding. The validation results from three expert reviewers indicated that the worksheet met the criteria of very valid, with an average score of 89.06%. Additionally, the practicality test involving student responses yielded an average score of 89.62%, placing it in the very practical category.

These findings demonstrate that the developed student worksheet is both theoretically and practically feasible for use in the mathematics learning process at the junior high school level. The design incorporates real-world contexts, clear instructions, and structured tasks that support students in building meaningful conceptual understanding in mathematics.

However, it is important to note that this study was limited to a small-group trial phase aimed at testing the practicality of the worksheet. Therefore, the researchers

recommend that further studies be conducted to evaluate the effectiveness of the worksheet on a larger scale, involving full classroom trials or experimental designs. Future research should also examine the impact of this worksheet on learning outcomes, student motivation, and long-term retention of mathematical concepts across diverse student populations.

By expanding the implementation and evaluation phases, the worksheet has the potential to become a widely applicable instructional tool that supports contextualized mathematics education in various learning environments.

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