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THE DEVELOPMENT OF ASSISTED WORKSHEETS DIFFERENTIATION LEARNING BASED ON LEARNING STYLE: HOW GREAT IT CAN HELP STUDENTS' MATHEMATICAL UNDERSTANDING ABILITY?

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Abstract
The purpose of this study is to develop mathematics differentiation learning worksheets based on learning style and to know the impact for mathematics understanding ability in 4th grade. The method we used was R&D including 10 steps. The instruments were a validation test, questionnaire for teachers and students, and an understanding concept test. Validation and questionnaire data analyzed by descriptive quantitative. Although, mathematics understanding ability data analyzed by difference test and N-Gain test. The results of this study show that the differentiation learning worksheets fit with the criteria. Eligibility validation from experts gets an average of 91%. Practically based on teachers and students' responses get an average 86%. It means that the learning materials are very valid. The learning materials in experiment class can increase the understanding concept with N-Gain 0,74. We can conclude that with mathematics differentiation learning worksheets can increase mathematics understanding ability.
Keywords: *worksheet; differentiation; conceptual understanding.*

Abstrak
Penelitian ini bertujuan untuk mengembangkan LKPD Matematika Berdiferensiasi Gaya Belajar dan mengetahui pengaruhnya terhadap kemampuan pemahaman matematis siswa di kelas IV SD. Metode yang digunakan adalah penelitian dan pengembangan (RnD) yang terdiri atas 10 langkah. Instrumen pengumpul data meliputi lembar validasi, angket respon guru dan siswa, dan tes pemahaman konsep. Data validasi dan kepraktisan dianalisis secara kuantitatif deskriptif, sedangkan data kemampuan pemahaman matematis dianalisis dengan uji beda dan n-gain. Hasil penelitian menunjukkan bahwa LKPD berdiferensiasi yang dikembangkan memenuhi kriteria kelayakan, kepraktisan, dan keefektifan. Validasi kelayakan oleh ahli memperoleh rata-rata skor 91% (sangat layak). Kepraktisan mengacu pada respon guru dan siswa memperoleh rata-rata skor 86% (sangat baik). LKPD berdiferensiasi di kelas eksperimen mampu meningkatkan kemampuan pemahaman matematis secara efektif dibanding kelas kontrol dengan n-gain 0,74. Berdasarkan hasil tersebut, dapat disimpulkan bahwa peningkatan kemampuan pemahaman matematis siswa sesuai gaya belajarnya dapat dipengaruhi oleh LKPD berdiferensiasi.
Kata Kunci: LKPD; diferensiasi; pemahaman matematis.

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Introduction

Every student is unique and have different characteristics (Defitriani, 2019), it's creating the diversity in classroom. Students' diversity become one of challenges for primary school teachers (Frerejean et al., 2021) that demands them to must be able to respond to these diversity needs (Dack & Triplett, 2020) to ensure that students can get the same maximum learning opportunity (Anthony, Hunter, & Hunter, 2019) through learning adaptation (Ekstam et. al, 2017).

Differentiation learning is a systematic approach to planning the curriculum and teaching for diversity students (Ekstam et. al, 2017). At the implementation level, differentiation learning refers to the practice of applying various instructional and learning adaptations to meet all of students' diversity learning needs in the classroom, so they can construct knowledge in their own ways (Eller, Polka, & Mete, 2019). Differentiation learning is also interpreted as a collection of actions that interact with differences between students by covering various alternative strategies (Anthony et al., 2019).

The application of differentiation learning makes a positive contribution to learning. Differentiation learning helps teachers reach each student and help them progress effectively because it is based on awareness of individual differences in learning and recognition of differences (Eller et al., 2019). Various student abilities can be optimally developed through differentiation such as learning achievement (Godor, 2021), higher order thinking (Dack & Triplett, 2020), attitude (Ekstam et. al, 2017), and involvement in learning (Anthony et al., 2019).

Mathematics is one of knowledge that have essential foundation for people thinking. Through mathematics, people can develop systematic, critical, creative, and logical thinking skills (Bernard, 2015). One of the students' learning abilities in mathematics that needs attention is mathematics understanding ability. It is defined as the process of capturing transferred ideas, which can facilitate students to apply what is learned in class across all domains (Macanas & Rogayan, 2019). Mathematics understanding ability involves mastery of content where knowledge can be generated and constructed through many relationships between existing and prior knowledge and transferred through procedure reconstruction (Mutambara, Tendere, & Chagwiza, 2020). Students are said to have high mathematics understanding ability if they can correctly define, utilize, apply, and exemplify each part of theoretical knowledge (Saglam-arslan & Devecioglu, 2010).

However, many students meet their difficulties to mastery some mathematics materials. Based on (Bernard & Senjayawati, 2019), one of student's difficulty is not yet understand the basic mathematics such as how to do addition, substraction, etc. Moreover, they still can't solve problems to the next stage because they are not aware that basic mathematics will be needed to solve the next stage problems (Astuti, Kartono, & Wardono, 2018). Another student's difficulties are conveying real life problems into mathematics symbols, solve problem using another mathematics forms, make an mathematics symbols analogy to real life problems, etc (Batubara, 2017).

Given the benefits, differentiation learning is very important to implement. Recognition of the need for differentiation was also put forward by NCTM, especially in mathematics (Ekstam et. al, 2017). In mathematics class, students are at different points in their development and bring various experiences to learning (Anthony et al., 2019) while learning mathematics requires achieving high cognitive standards, in terms of creativity, rationality, control of multiple semiotic registers, metacognition, etc. (Demo et al., 2021). For this reason, teachers

need to distinguish learning tempo, depth of content, assignments, frequency of using aids, time allocation, use of different manipulative tools, or flexible grouping (Ekstam et. al, 2017). Thus, the teacher must prepare teaching materials according to demands (Abdurrahman et al., 2019).

Teaching materials are a set of substances that are arranged systematically, showing a complete picture of the competencies that students will master. One form of visual teaching material is worksheets (Abdurrahman et al., 2019). Worksheets are needed as learning instructions that guide student activities so that they run correctly (Bakri et al., 2020). In it the teacher must be able to find, select, modify, and provide assignments adequately (Bardy, Holzäpfel, & Leuders, 2021) according to student needs.

In contrast to the facts on the ground, there are many challenges faced by teachers when designing and implementing differentiation such as teacher perceptions of differentiation, the need for collaboration, school and community support, time constraints and workload, and a narrow understanding of differentiation (Leballo, Griffiths, & Bekker, 2021).This has implications for the provision of student learning services and their abilities. The diversity of students is served by learning that is dominantly uniform, including in mathematics. The impact is very predictable, students' learning abilities are not optimal.

One of the students' learning abilities in mathematics that needs attention is conceptual understanding. Conceptual understanding is defined as the process of capturing transferred ideas, which can facilitate students to apply what is learned in class across all domains (Macanas & Rogayan, 2019). Conceptual understanding involves mastery of content where knowledge can be generated and constructed through many relationships between existing and prior knowledge and transferred through procedure reconstruction (Mutambara et al., 2020). Students are said to understand a concept if they can correctly define, utilize, apply and exemplify each part of theoretical knowledge (Saglam-arslan & Devecioglu, 2010).

The explanation above shows the urgency of developing differentiation based LKPD in learning mathematics as an effort to increase conceptual understanding. Studies related to differentiation previously explored more about differentiation strategies in learning mathematics which were still very limited (Hubbard & Livy, 2021), minimally leading specifically to worksheets. Likewise with the development of LKPD, it focuses more on efforts to improve students' abilities by not considering the differences that students have, both readiness, interests, and even learning styles. The development of LKPD is expected to contribute to both teachers and students in facilitating teaching at the right level so that students can understand the material.

Research Methods

This study is to developed differentiation learning worksheets based on learning style and measured its effectiveness on students' mathematics understanding ability. Therefore, the method of this study is Research and Development (R&D). In the field of education, R&D is a process used to develop and validate educational products (Gall et al., 2003). The stages used refer to ten stages, namely: 1) Research and information collecting 2) Planning, 3) Develop preliminary form of product, 4) Preliminary field testing, 5) Main product revision, 6) Main field testing, 7) Operational product revision, 8) Operational field testing, 9) Final product revision, and 10) Dissemination and implementation (Borg & Gall, 2007).

The research begins with a review and data collection related to the needs of differentiation in the field. Referring to these data, the researchers focused on developing LKPD based on learning style differentiation on KPK and FPB material to improve students'

understanding of concepts. The differentiation based LKPD design was realized in the initial printed form of Draft 1 and then validated by three experts. After the revision, draft 1 became Draft 2 which can be used for small-scale testing. The small-scale test was carried out in one class with 30 students in 2 meetings. After that, questionnaires were given to teachers and students to find out their responses regarding the practicality of the developed LKPD. Referring to the practicality analysis results, draft 2 was revised to Draft 3 and can be used for large-scale tests. The wide-scale test was carried out in two classes with 62 students in 2 meetings. After the broad test, draft 3 was revised into Draft 4 and was ready to be used in the effectiveness test which was carried out involving the experimental class (32 students) and the control class (32 students).

The development of differentiation based LKPD is carried out in the Cimahi City area. The area was selected using a convenience sampling technique (Gall, Gall, & Borg, 2010). The subjects involved in the small-scale test were 1 class, the large-scale test was 2 classes, and the effectiveness test was 2 classes in three different schools. Thus, as a whole, this study involved fourth grade students in three schools and five classes.

In the data collection process, the instruments used were 1) a semi-structured questionnaire to collect needs study data, 2) validation sheets to determine the feasibility of LKPD, 3) teacher and student response questionnaires to find out the practicality of LKPD, and 4) concept understanding test to determine effectiveness LKPD. Feasibility and practicality data were analyzed with descriptive quantitative. The effectiveness data was analyzed by comparing the pretest and posttest averages in the experimental class and control class with the t test. Next, calculate the n-gain to obtain the level of effectiveness.

Results and Discussion

The development of LKPD is based on the results of preliminary studies and preliminary data collection. The results of the analysis reveal the need to develop LKPD based on learning style differentiation on KPK and FPB material to improve students' understanding of concepts. Furthermore, the differentiation based LKPD design is realized in the initial printed form of Draft 1 as presented in the following figure.

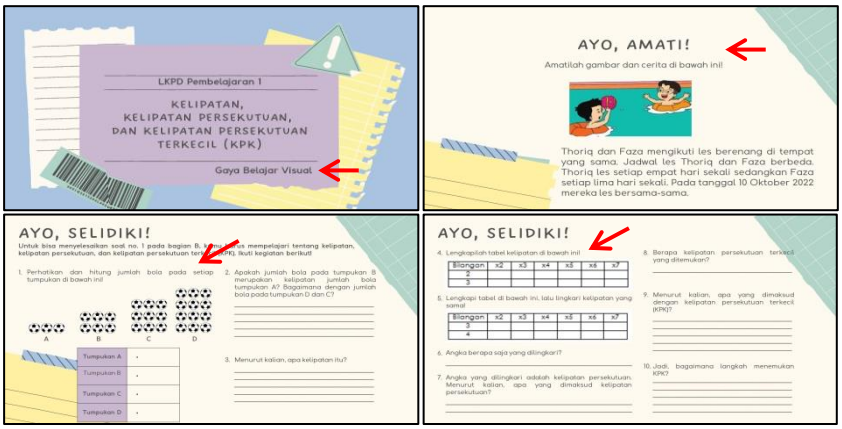

Figure 1. Differentiation Worksheet – KPK (Visual)

Jurnal Cakrawala Pendas Vol. 9, No. 2, April 2023, pp. 205-214

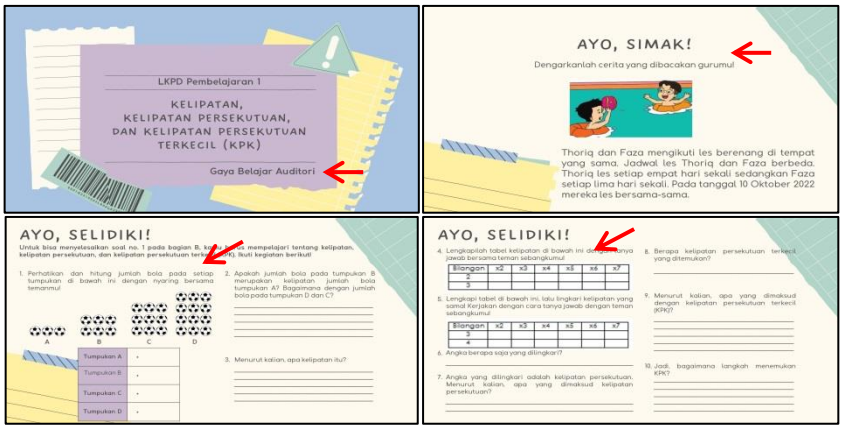

Figure 2. Differentiation Worksheet – KPK (Auditory)

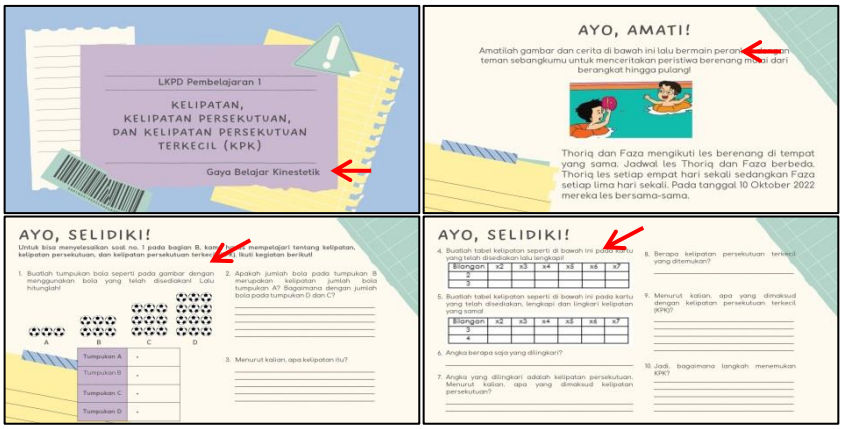

Figure 3. Differentiation Worksheet – KPK (Kinestetik)

Figure 4. Differentiation Worksheet – FPB (Visual)

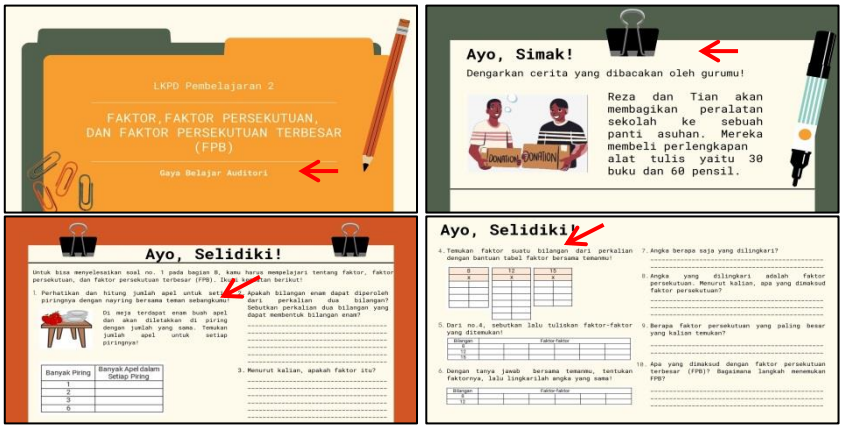

Figure 5. Differentiation Worksheet – FPB (Auditory)

Figure 6. Differentiation Worksheet – FPB (Kinestetik)

The developed LKPD was assessed and validated by experts consisting of material experts, language experts, and graphics experts. The assessment of these experts is to obtain judgment regarding the feasibility of the developed LKPD. Validation includes aspects of content, language, and presentation. The three experts who validated the LKPD were two mathematics lecturers and one class IV teacher. The aspects of content validation that are assessed include the suitability of the material with competencies and goals, the suitability of activities with objectives, the suitability of activities with indicators of conceptual understanding, and the suitability of learning style differentiation. The language aspects include the use of language and spelling, the directness of meaning, the consistency of writing scientific names. Finally, the presentation aspects include clarity of purpose, systematic, image suitability, curiosity stimulus, and involving student activity. The results of the three experts' validation are presented in the following table.

Table 1. Results of Appropriateness Test

No	Component	Average	Criteria
1	Content	88%	Very Appropriate
2	Language	90%	Very Appropriate
3	Presentation	94%	Very Appropriate
Average		91%	Very Appropriate

Based on Table 1 the developed LKPD is declared feasible with very good criteria, in terms of content, language and presentation aspects. Obtaining an assessment in this very good category is because the LKPD prepared refers to the LKPD eligibility guidelines (Abdurrahman et al., 2019). Nonetheless, there are suggestions from the validator for revision by researchers as presented in the table below.

Table 2. Suggestion Revised from Validator

No	Component	Comments	Suggestion
1	Content	The number of activities to teach the same concept is seen as too much	Reduce the number choose the one that represents
2	Language	It is feared that the use of English is less understood by students	Translated into Indonesian
3	Presentation	The font size on the cover is too big	Reduced font size

After the revision, draft 1 became Draft 2 which can be used for small-scale testing. The small-scale test was carried out in one class with 30 students in 2 meetings. After that, questionnaires were given to teachers and students to find out their responses regarding the practicality of the developed LKPD. Referring to the practicality analysis results, draft 2 was revised to Draft 3 and can be used for large-scale tests. The wide-scale test was carried out in two classes with 62 students in 2 meetings. Following are the results of the practical analysis of the developed LKPD.

Table 3. Results of Practicalness Test

No	Component	Average	Criteria
1	Teachers	84%	Very Practical
2	Students	88%	Very Practical
Average		86%	Very Practical

Based on Table 3 the developed LKPD was declared practical by the teacher and very practical by the students. The use of LKPD in learning makes it easier for teachers to understand students on KPK and FPB material. Likewise, the opinion of students that by using this LKPD they find it easier to understand the material being studied.

After the broad test, draft 3 was revised into Draft 4 and was ready to be used in the effectiveness test which was carried out involving the experimental class (32 students) and the control class (33 students). The effectiveness of LKPD was obtained by comparing the test results (pretest and posttest) in the experimental class and the control class. The results of the effectiveness test are presented in the following table.

Table 4. Results of Effectiveness Test

Test	Experiment	Control	t test
Pretest	37,6	34,5	0,104
Posttest	83,2	60,0	0,000
n-gain	0,74	0,40	0,000

Based on Table 4 there is a significant difference in increasing students' understanding of mathematical concepts in the KPK and FPB material. The experimental class that applied differentiation-based worksheets experienced a higher increase than the control class. Judging from the amount of n-gain obtained, the experimental class obtained a gain of 60 in the effective category. Thus, differentiation based LKPD is able to increase understanding of the concepts of KPK and FPB effectively. This proves that differentiation learning has a positive influence on learning (Ekstam et. al, 2017), because besides being able to overcome the challenges of student differences (Demo et al., 2021) it is also able to increase student achievement (Beck & Beasley, 2021; Dack & Triplett, 2020; Godor, 2021), one of which is understanding the concept.

Furthermore, students' understanding of concepts with different learning styles in the experimental class is presented in the following table.

Table 5. One-Way ANOVA of Understanding Concept

Learning Style	Pretest	Posttest	n-gain	Sig.
Visual	40	84	0,76	
Auditory	37	83	0,73	0,897
kinesthetic	34	82	0,74	

Table 5 shows that the increase in conceptual understanding for each learning style in the experimental class experienced a relatively similar increase. sig. value 0.897> 0.05 reveals that there is no significant difference in increasing students' understanding of concepts in each learning style. These findings prove that differentiation learning can accommodate students by (a) overcoming student diversity; (b) adopting certain teaching strategies; (c) implementing variations in learning activities; (d) monitor individual student needs, and (e) pursue optimal learning outcomes (Roiha, 2021). Considering the differences in student learning styles, the differentiation worksheet modifies the learning elements related to the learning process. This is in line with the study of Bakri et al. (2020) where the LKPD is compiled as a guide for students to be able to find learning concepts.

Conclusion

Differentiated mathematics worksheets developed using research and development methods meet the valid, practical, and effective criteria in increasing elementary school fourth grade students' conceptual understanding of KPK and FPB material. Surprisingly, with differentiated worksheets on math, KPK and FPB were able to increase students' conceptual understanding in each learning style with relatively the same average. The research findings provide recommendations for the importance of developing LKPD for other materials and even other subjects. Additionally, the number of subjects can be expanded to take account of urban, transitional, or rural locations.

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