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DEVELOPMENT OF A DIFFERENTIATED LEARNING MEDIA MODEL BASED ON MICRO LEARNING IN MATHEMATICS SUBJECTS IN THE STUDY OF NUMBERS IN PRIMARY SCHOOLS

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Abstract
Mathematics learning media for elementary school level currently generally does not facilitate student diversity from various aspects of diversity, both content, process, product, and student learning environment by considering students' readiness, interests and learning profile to master certain competencies. Learning media is packaged monotonously without involving ICT, causing boredom for students, especially at the elementary school level, who are generally unable to endure long periods of learning using learning media that are not varied. Such mathematics learning media is not yet relevant to the principles of the current curriculum, namely the Kurikulum Merdeka which has a growth mindset. In the Kurikulum Merdeka, teachers are expected to be proactive figures (proactive teachers) who have a growth mindset by viewing that each student is unique and different, so it is necessary to provide services that accommodate students' various learning needs or differentiated learning based on the results of the initial assessment. Learning media also ideally strengthens quality learning experiences, including being developed and packaged digitally according to students' current learning needs with a micro learning approach so as not to bore students, containing various elements (text, audio, video, animation and infographics), containing only basic or important material, allows students to use it for a relatively short period of time, and allows students to use it anytime and anywhere. The research that has been carried out aims to develop a differentiated learning media model based on micro learning in Mathematics subjects in the field of Number studies in elementary school.
Keywords: *instructional media; differentiated; number; microlearning*

Abstrak
Media pembelajaran matematika untuk jenjang SD saat ini umumnya belum memfasilitasi keragaman siswa dari berbagai aspek keragaman, baik konten, proses, produk, maupun lingkungan belajar siswa dengan mempertimbangkan kesiapan (*readiness*), minat (*interest*), dan gaya belajar (*learning profile*) siswa untuk menguasai kompetensi tertentu. Media pembelajaran dikemas secara monoton tanpa melibatkan TIK sehingga menimbulkan kejemuan bagi siswa, khususnya pada jenjang SD yang pada umumnya tidak mampu bertahan lama untuk belajar menggunakan media pembelajaran yang tidak variatif. Media pembelajaran matematika yang demikian belum relevan dengan prinsip-prinsip pada kurikulum yang berlaku saat ini, yakni Kurikulum Merdeka yang berpola pikir bertumbuh (*growth mindset*). Pada Kurikulum Merdeka guru diharapkan menjadi sosok yang proaktif (*proactive teacher*) yang berpola pikir bertumbuh dengan memandang bahwa setiap siswa unik dan berbeda, sehingga perlu diberikan layanan yang mengakomodasi berbagai kebutuhan belajar siswa atau pembelajaran terdiferensiasi berdasarkan hasil asesmen awal. Media pembelajaran juga idealnya memperkuat pengalaman belajar yang berkualitas, di antaranya dikembangkan dan dikemas secara digital sesuai dengan kebutuhan belajar siswa saat ini dengan pendekatan *micro learning* agar tidak menjemukan siswa, memuat berbagai unsur (teks, audio, video, animasi, dan infografis), memuat materi yang pokok atau penting saja, memungkinkan digunakan siswa dalam durasi waktu yang relatif tidak terlalu lama, dan memungkinkan digunakan siswa kapan saja dan dimana saja. Penelitian yang telah dilakukan ini bertujuan untuk mengembangkan model media pembelajaran terdiferensiasi berbasis *micro learning* pada mata pelajaran Matematika bidang kajian Bilangan di SD.
Kata Kunci: media pembelajaran; terdiferensiasi; bilangan; *micro learning*

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Introduction

Mathematics is the science or knowledge about learning or logical thinking that humans really need for life, which underlies the development of modern technology. Mathematics has an important role in various scientific disciplines and advances human thinking. Studying Mathematics can improve students' ability to think logically, analytically, systematically, critically and creatively, as well as the ability to work together (Badjeber & Purwaningrum, 2018). These competencies are needed so that students have the ability to obtain, manage and utilize information to survive in conditions that are always changing, full of uncertainty and are competitive (Maryanto, et.al., 2023; Rofiqoh, 2020). Mathematics subjects equip students with how to think, reason and reason through mathematical mental objects in the form of facts, concepts, principles, relationships and operations as a tool to hone and train students' thinking skills needed to solve problems in life, so that students feel the meaning and the benefits of mathematics and learning mathematics as well as moral values in studying Mathematics subjects, including freedom, skill, assessment, accuracy, systematicity, rationality, patience, independence, discipline, perseverance, toughness, self-confidence, open-mindedness, and creativity (Rafianti, et.al., 2018; Putri, et.al., 2022).

Mathematics is one of the fields of study or subjects in Elementary School (SD) with an abstract field of study, generally the least liked by students, and is always a topic of conversation for many people involved in education such as students, teachers and parents. Concerns from all parties regarding low mathematics learning outcomes nationally and internationally are a concern and a serious concern for shareholders and education stakeholders. National test results through the Indonesian National Assessment Program (INAP) or also known as the 2016 Indonesian Student Competency Assessment (AKSI) which was carried out by the Education Assessment Center (Puspendik) in collaboration with the Ministry of Education and Culture (Kemdikbud) on 1,941 elementary schools in 232 districts/cities located in 34 provinces in Indonesia to measure students' abilities in three subjects, namely Indonesian, Mathematics and Natural Sciences, especially related to Higher Order Thinking, shows that the national average of students' mathematical abilities is still low, 2.29 % with Good criteria, 20.58% with Fair criteria, and 77.13% with Poor criteria (Dodeen, et.al., 2012; Döhrmann, et.al., 2012). Based on the results of the analysis by Puspendik, of the 85 questions used in INAP in 2016, only three questions were considered easy by students, more than 70% of students answered correctly, and only eleven questions could be answered correctly by more than 50% of students. . For the ten questions taken from the Trends in Mathematics and Science Studies (TIMSS) international test, in general Indonesia is far below the international average, with only one question item where Indonesian students scored above the international average (Utomo, 2021).

The 2016 INAP framework for elementary mathematics subjects is based on mathematics learning objectives, namely developing students' understanding of various mathematical concepts and developing students' abilities in reasoning and problem solving. In addition, the 2016 INAP framework for elementary mathematics subjects follows the TIMMS framework which uses two measurement domains, namely the content domain consisting of the study areas of Numbers, Geometry and Measurement, and Statistics and Data Processing and the cognitive domain consisting of the ability to understand concepts and high-level thinking skills, especially analytical and evaluation skills. This test aims to measure mastery of

mathematical concepts and get an overview of students' thinking processes through three areas of study in the content domain and high-level thinking abilities in the cognitive domain. The proportion of questions for the content domain is 50% for Numbers, 35% for Geometry and Measurement, and 15% for Statistics and Data Processing. The results of the analysis by Puspendik on students' answers to the Mathematics subject show that students have difficulties, especially in working on questions that require high-level thinking skills such as analytical and evaluation skills (Febriyandani & Kowiyah, 2021).

Mathematical mental objects in Mathematics subjects in elementary school are packaged through the fields of study of Numbers, Geometry and Measurement, and Data Analysis. Numbers are one of the areas of study in elementary mathematics subjects that are most widely studied at elementary school level and are a prerequisite for other areas of study such as Geometry and Measurement and Data Analysis. Moreover, the low competency of elementary school students in Mathematics subjects based on the results of INAP in 2016 and AKSI in 2018 is dominated by questions in the field of Number studies which have a maximum proportion of around 50% and is caused by the media and teaching materials in elementary school Mathematics which currently do not facilitate and accommodate The needs of each student are diverse. Thus, the field of Number studies at the elementary school level needs to be the focus of attention and study of teachers and researchers primarily related to the development of media and teaching materials, including LKPD that are relevant to the current curriculum (especially the Merdeka Curriculum), mathematics learning outcomes at each phase of student development , student learning difficulties both ontogenetically, epistemologically and didactically, and student learning trajectories (Awalia, et.al., 2019; Batubara, 2018).

The Merdeka Curriculum is a simplification and refinement of the 2013 curriculum by maintaining what has been successful in the Curriculum in Special Conditions, related to competencies and essential material (Katman & Akadira, 2023; Septiani, 2022). In the Independent Curriculum, each educational unit is given the opportunity to have the option of implementing the Independent Curriculum, namely Independent Learning (Option 1), Independent Change (Option 2), and Independent Sharing (Option 3) according to the readiness of each educational unit. The Merdeka Curriculum has a growth mindset which views that students will be able in their own time and achievements, so that the concept of learning outcomes and phases emerges which at the elementary school level consists of three phases, namely: (1) phase A (generally grade 1 and 2); (2) phase B (generally grades 3 and 4); and (3) phase C (generally grades 5 and 6). In the Independent Curriculum, teachers are expected to be proactive figures (proactive teachers) who have a growth mindset by viewing that each student is unique and different, so it is necessary to provide services that accommodate the needs of each student or what is known as differentiated learning and services that facilitate quality learning experiences of which are ICT based (Andrea Wullschleger, dkk., 2023; Katman & Akadira, 2023).

The implementation of differentiated learning begins with an initial assessment by the teacher as a basis and consideration for preparing learning plans, including learning media and ICT-based LKPD. Based on the results of the initial assessment, teachers can design ICT-based learning media that is differentiated in terms of content, processes, products and student learning environments based on students' readiness, interests and learning styles (learning profile). In other words, ideally ICT-based learning media developed and used by teachers in learning must facilitate student diversity. Learning media should ideally be developed and packaged digitally based on ICT so as not to bore students, contain various elements (text, audio, video, animation and infographics), contain only basic or important material, allow students to use it in a

relatively short time. (around 5 minutes at most), and allows students to use it anytime and anywhere (Purwanto & Gita, 2023).

Based on the explanation above, it is necessary to develop a differentiated learning media model for Mathematics subjects in the field of Number studies in elementary school that is interesting and does not bore students in accordance with the principles of the Independent Curriculum and based on the student's development phase, students' learning difficulties both ontogenetically, epistemologically and didactics, and student learning trajectories. The differentiated learning media model that is relevant to the above characteristics is the micro learning based differentiated learning media model which was studied in depth by the results of prospective analysis, metapedadidactical analysis and retrospective analysis to produce a micro learning based differentiated learning media model for elementary mathematics subjects that are relevant to various didactic situations that students are expected to go through in learning mathematics, including situations of action, formulation, validation, and institutionalization. This research aims to develop a differentiated learning media model based on micro learning for Mathematics subjects in the field of Number studies in elementary school.

Research methods

The research method that will be used in this research is the didactical design research method which includes the stages of prospective analysis, metapedadidactical analysis, and retrospective analysis (Suryadi, 2019; Aisah & Yulianti, 2016). Prospective analysis is an analysis before learning of didactic situations contained in the design of elementary mathematics learning media in the field of Number studies used by students in phase A (generally grades 1 and 2), phase B (generally grades 3 and 4), and phase C (generally grades 5 and 6). Prospective analysis was also carried out on students' learning difficulties (learning obstacles) both ontogenetically, epistemologically and didactically, when learning Mathematics in the field of Number studies using certain learning media.

The results of the prospective analysis are in the form of a hypothetical learning trajectory, pedagogical didactic anticipation, and a didactical design framework which is packaged in the form of a preliminary design for a differentiated learning media model based on micro learning that will be used in learning in accordance with the principles of the Merdeka Curriculum. The next analysis is metapedadidactical analysis during the learning process which is carried out through observations, interviews and documentation to record findings while students are learning Mathematics in the field of Number studies using the initial design of the micro learning based differentiated learning media model that has been developed. The findings during the learning took place were critically reflected through retrospective analysis after the learning took place to obtain the final design of a differentiated learning media model based on micro learning based on the findings from the metapedadidactical analysis.

Results and Discussion

Barriers to Student Learning in the Field of Number Studies

Student learning obstacles are student learning difficulties related to the use of didactic design, including ontogenic, epistemological and didactic learning difficulties (Ariansyah, et.al., 2021). The first step taken by researchers to find out students' learning difficulties in the field of Number studies was by interviewing elementary school teachers in class 1 (phase A) and class 4 (phase B) with the result being that the teacher stated that students still had difficulty learning in the field of Number studies with deep motivation. low learning, looks passive, bored and bored when learning takes place.The next step taken by the researcher was a study of several

learning media and teaching materials in the form of LKPD for Mathematics subjects in the field of Number studies used in schools where the teacher respondents served in the learning process., as well as learning observations of class 1 and class 4 teachers.

Based on a study of several learning media and teaching materials in the form of LKPD used in learning in class 1 and 4, researchers found that the learning media and teaching materials in the form of LKPD used during learning were in accordance with the basic competencies in that class, but the learning media and The teaching materials in the form of LKPD are packaged in written text only with a large number of pages and minimal illustrations without involving ICT. Apart from that, there is learning that is introduced to students in the form of mathematical symbols (abstract) without first introducing basic understanding such as the meaning of the mathematical subject material itself which students must understand before arriving at the symbolic stage using learning media and LKPD to mediate and guide learning.

Meanwhile, based on observations in the classroom, researchers found situations that caused students to experience ontogenetic learning difficulties, namely low learning motivation during learning which was dominantly controlled by the teacher or teacher-centered using learning media and LKPD that were not varied (not differentiated) according to the characteristics. and student learning needs in terms of content, process, product and student learning environment based on their readiness, interest and learning profile. Learning in the field of Number studies uses learning media and teaching materials in the form of LKPDThis is generally conveyed in a classical way. This results in passive learning and tends to be boring for students so that students experience learning obstacles that are dominantly ontogenetic.

To determine students' learning difficulties in the field of Number studies, researchers conducted a learning difficulty test for grade 1 and grade 4 students at SDN Cibodas III, Lembang District, West Bandung Regency, West Java as a research location followed by in-depth interviews. The results are indeed proven that students on average experience learning difficulties in the field of Number studies due to low learning motivation during learning. In addition, researchers found that students did not understand mathematical concepts and could only work on routine, mechanistic and procedural mathematics problems, and were unable to work on questions that tested conceptual understanding or reasoning.

Based on the explanation above, the researcher concluded that students had experienced learning obstacles which were dominant in the form of ontogenetic learning obstacles. This is related to students' mistakes who are still mistaken in working on questions related to conceptual understanding and have not mastered the prerequisite material completely, which is caused by boredom and boredom during learning using learning media and teaching materials in the form of LKPD which are monotonous, not varied, not differentiated and not multimode. Apart from that, learning media and teaching materials in the form of LKPD are developed with minimal illustrations and are not packaged in various forms that contain audio and visual elements (ppt, audio podcast, infographics, video explainer, and motion graphics) to strengthen students' understanding. Apart from that, another obstacle that occurs to students is didactic obstacles, namely learning obstacles that come from teachers when conveying certain concepts that have very little context. In general, teachers explain mathematics subject matter directly without starting with context, as well as the learning media and teaching materials in the form of LKPD that are used with very little context, whether personal, work, socio-cultural or scientific.

The results of the analysis show that students are completely passive and seem to feel bored and fed up during learning using learning media and teaching materials in the form of LKPD, giving rise to learning difficulties in understanding mathematical concepts in the field of Number studies. This is partly because the learning media and teaching materials in the form

of LKPD that are used only contain one form of written text (monomode) with minimal illustrations, are not packaged in multimode (PPT, audio podcast, infographics, video explainer, and motion graphics), do not show The sequence or stages of learning are correct according to the characteristics of elementary school students, and there is very little context for meaningful mathematics learning.

Judging from the students' learning barriers based on the findings above, it turns out that students not only experience epistemological and didactic learning barriers, but most importantly they also experience ontogenetic learning barriers. These learning obstacles can be overcome by making the learning carried out emphasize the cultivation of correct concepts, accompanied by relevant illustrations and context to strengthen students' understanding, as well as learning media and teaching materials in the form of LKPD that facilitate the diversity of students' characteristics and learning needs (differentiated). Apart from that, learning media and teaching materials in the form of LKPD are packaged as microlearning in various forms (written text, ppt, audio podcast, infographics, video explainer, and motion graphics) with a number of pages that are not multiple pages (maximum 10 pages) and duration not too long (between 3 to 5 minutes) to overcome ontogenetic learning obstacles in the form of student boredom and boredom during learning.

Presumptive Learning Trajectories in the Field of Number Studies

After knowing and analyzing students' difficulties or obstacles to learning mathematics in the field of Number studies, the researchers then developed a presumptive learning trajectory for elementary school mathematics learning in the field of Number studies. This presumptive learning trajectory helps answer several questions about what goals will be achieved, how to start and what teaching materials are relevant to the characteristics of elementary school students, what are the next steps for learning using teaching materials, how to learn using teaching materials so that learning goals are achieved. This is done so that mathematics learning is not mechanistic, not tedious, not tedious, and is carried out in stages according to students' stages of thinking by involving various forms of teaching materials, illustrations and contexts so that students can make sense of the mathematics subject material they are studying.

The preparation of this presumptive learning trajectory is carried out based on the learning achievements of Mathematics subjects in the Number element according to the phases that have been formulated by the Ministry of Education and Culture (Kemdikbud) in BSKAP Decree Number 033 of 2022, which for the elementary school level consists of three phases, namely phase A (generally class 1 and class 2), phase B (generally class 3 and class 4), and phase C (generally class 5 and class 6). Next, the researchers compiled a form of syllabus in the Merdeka Curriculum, namely the Learning Objectives Flow (ATP) which was detailed into indicators of learning objectives in accordance with the characteristics of the Merdeka Curriculum. Researchers then developed learning media and teaching materials in the form of differentiated LKPD packaged digitally based on microlearning to overcome previously identified ontogenetic and didactic learning barriers. The guess learning trajectory depicted in the development of the learning achievement phase in Mathematics subjects at elementary school level for the Number element according to BSKAP Decree Number 033 of 2022 is as follows.

Table 1. The Learning Achievement Phase In Mathematics Subjects At Elementary School Level

Phase A (Grade 1 and Grade 2)	**Phase B (Grade 3 and Grade 4)**	**Phase C (Grade 5 and Grade 6)**
At the end of phase A, students demonstrate understanding and having intuition about numbers (*number sense*) on whole numbers up to 100, they can reading, writing, determining place value, compare, sort, and perform composition (arranging) and decomposition (unraveling) number. Students can perform addition operations and reduction using concrete objects the number is up to 20. Students demonstrate understanding of fractions as part of a whole through context dividing an object or group of objects equally many, the fraction introduced is half and a quarter.	At the end of phase B, students demonstrate understanding and intuition of numbers (number sense) in whole numbers up to 10,000. They can read, writing, determining place value, comparing, ordering, using place value, doing composition and decomposition of the number. They can also solve problems related to money uses thousands as the unit.student can perform addition operations and Subtraction of whole numbers up to 1,000. They can perform multiplication and division operations whole numbers up to 100 using objects concrete, images and mathematical symbols. They do too can solve problems related to multiples and factors. Students can compare and order inter-fractions with a numerator of one and between fractions with the same denominator. They can recognize fractions worth using pictures and mathematical symbols. Students demonstrate understanding and intuition numbers (number sense) in decimal numbers. They can express decimal fractions tenths and hundredths, as well as connecting the decimal	At the end of phase C, students can demonstrate understanding and intuition of numbers (number sense) in whole numbers up to 1,000,000. They can reading, writing, determining place value, compare, sort, perform composition and decomposition of the number. They can too solve problems related to money. They can perform addition operations, subtraction, multiplication and division of whole numbers up to 100,000. They can also complete problems related to the KPK and FPB. Students can compare and order various fractions including mixed fractions, perform addition and subtraction operations fractions, as well as performing multiplication operations and division of fractions by natural numbers. They can converting fractions to decimals, as well as compare and order decimal numbers (one number after the comma)

	fraction of hundredths with the concept of percent.

Pedagogical Didactical Anticipation for Learning Numbers in Elementary Schools

Pedagogical didactic anticipation (ADP) was developed to predict student responses during learning using learning media and teaching materials in the form of differentiated microlearning-based LKPD that have been developed, then develop anticipatory learning intervention steps according to student responses when learning using learning media and teaching materials in the form of differentiated LKPD based on microlearning which has been developed and incorporated into the Learning Implementation Plan (RPP) and its completeness. The forms of student responses are categorized into three categories of learning difficulties, namely learning difficulties related to learning media and teaching materials in the form of LKPD which are unattractive or less aesthetic so they do not motivate students to learn (ontogenic learning difficulties), learning difficulties related to learning media and materials. teaching in the form of LKPD which does not teach students in stages (epistemological learning difficulties), and student learning difficulties due to a lack of diverse contexts in learning media and teaching materials in the form of LKPD (difficulty in didactic learning).

To overcome the various forms of student responses that have been categorized into the three categories above, the researcher formulated anticipated forms of teacher intervention based on these responses by describing the learning steps according to Harel's Triadic Cycle (2008) as follows.

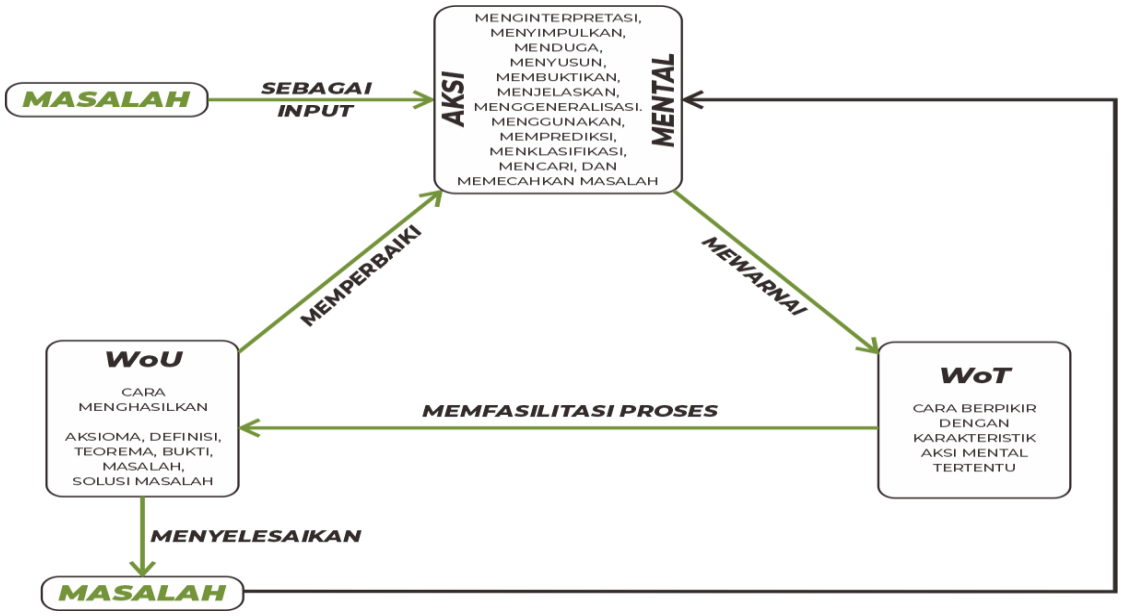


Figure 1. Learning Mathematics in the Triadic Cycle

Based on the Triadic cycle above, learning mathematics can only occur if students are faced with certain mathematical problems that trigger mental thinking actions that form a continuous flow of thinking that is subjective-individual in nature and culminates in the formation of a flow of understanding of mathematics learning material in the form of facts, concepts, certain mathematical principles, operations, relations, problems and solutions that are formal-universal in nature. This mental process occurs when there is a stimulus in the form of a mathematical problem which triggers random mental actions (mental acts) which progressively

form paths of thinking (ways of thinking/WoT) to construct and reconstruct certain mathematical mental objects and continue to form paths of understanding (ways). of understanding/WoU) towards certain mathematical mental objects. Certain mathematical mental objects that students learn will become more meaningful when used to solve mathematical problems that are relevant to those mathematical mental objects. Such mental processes can strengthen students' dispositions to experience the meaning and benefits of mathematics and learning mathematics as well as moral values in learning mathematics, including freedom, skill, assessment, accuracy, systematicity, rationality, patience, independence, discipline, perseverance, toughness, self-confidence. , open-mindedness, and creativity.

Students who have difficulty carrying out random mental actions to respond to a real or engineered mathematical problem as input will be anticipated by the teacher by raising other problems with different contexts and asking leading and exploratory questions so that students can carry out random mental actions safely and begin to be able to organize or organize their mental actions towards the correct train of thought (Haaq & Toheri, 2019). Students who have difficulty forming the correct train of thought will be anticipated by the teacher by carrying out metacognitive scaffolding through trigger, directing and probing questions so that students can organize their train of thought continuously to form a flow of understanding. Students who have difficulty forming a flow of understanding will be anticipated by sharing various work results so that intersubjectivity and explanation can be built by the teacher to validate the truth of students' thinking results based on scientific conceptions. So that the material that has been studied is meaningful for students, an institutionalization situation is carried out by providing contextual, real or engineered mathematical problems for students to work on. Students who have difficulty responding to problems as institutional situations will be anticipated by providing intervention in the form of explaining work steps or by raising problems in a context that is easy for students to understand. In other words, ADP was developed and put into learning media and teaching materials in the form of differentiated LKPD based on the following microlearning.

Table 2. Student Activities and Teacher Response Learning Media And Teaching Materials

Student Activities	Teacher Response
Students have difficulty understanding mathematical didactic situations that appear in learning media and teaching materials in the form of differentiated LKPD based on microlearning	• The teacher describes mathematical didactic situations that appear in learning media and teaching materials in the form of differentiated LKPD based on microlearning so that students can easily understand them. • The teacher displays other mathematical didactic situations that are easier for students to understand in various modes of learning media and teaching materials in the form of differentiated LKPD based on microlearning (PPT, infographics, audio podcasts, video explainers, and motion graphics).
Students find it difficult to perform apperception well	The teacher guides students with probing questions to make it easier for students to carry out good apperception which is expressed in learning media and teaching materials in the

	form of differentiated microlearning-based LKPD.
Students make mistakes or have difficulty relating the learning material that has been previously studied (prerequisites) with the mathematical didactic situations that arise in themlearning media and teaching materials in the form of differentiated LKPD based on microlearningand difficulty conveying the results of his apperception	• The teacher helps students by providing stimulus or assistance in the form of questions that lead students to be able to link the material that has been studied previously (prerequisites) with emerging mathematical didactic situations that have been outlined in thelearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher explains the relationship between the mathematical didactic situations that arise and the material that has been studied previously (prerequisites) • The teacher guides students when presenting the results of their apperception
Students have difficulty finding their weaknesses and strengths in studying mathematics learning material related to mathematical didactic situations that arise	The teacher provides probing questions that can guide students to discover their weaknesses and strengths in understanding the mathematics learning material that has been studied previously (prerequisites) related to emerging mathematical didactic situations that have been outlined inlearning media and teaching materials in the form of differentiated LKPD based on microlearning
Students do not understand or have difficulty understanding the prerequisite mathematics learning material	• The teacher provides many illustrations of prerequisite mathematics learning material, especially related to deep mathematical conceptslearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher provides many examples of the use of principles in mathematics such as formulas to solve deep mathematical problemslearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher demonstrates prerequisite mathematics learning materials, especially those related to deep mathematical procedureslearning media and teaching materials in the form of differentiated LKPD based on microlearning
Agreement on learning rules is difficult to achieve	• The teacher explains the importance of each learning rule item for students to obeylearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher firmly sets the learning rules even though there has not been an

	agreement with the students as stated in themlearning media and teaching materials in the form of differentiated LKPD based on microlearning
Students have difficulty understanding new mathematical didactic situations	• Teachers describe new mathematical didactic situations so that students can easily understand them in learning media and teaching materials in the form of microlearning-based differentiated LKPD • The teacher displays other new mathematical didactic situations that are easier for students to understand in learning media and teaching materials in the form of differentiated student worksheets based on microlearning
Students have difficulty or make mistakes in carrying out the mathematical repersonalization process regarding the main learning material to be studied in accordance with the new mathematical didactic situation	• Teachers provide motivation to students who have difficulty carrying out the mathematical repersonalization process to continue working referring tolearning media and teaching materials in the form of differentiated LKPD based on microlearning
Students are bored, bored, passive, and don't dare ask questions even though they don't seem to understand the learning material	The teacher asks questions to test students' understanding of the learning material outlined inlearning media and teaching materials in the form of differentiated LKPD based on microlearning
Students have difficulty or make mistakes in correcting the process and results of mathematical repersonalization even though they have been assisted by the teacher through metacognitive teasing	• Teachers provide motivation to students who have difficulty improving the process and results of mathematical repersonalization to continue working using itlearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher provides leading or digging questions that are easy for students to understand which are explained in detaillearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher assigns students to reflect (look back) on the mathematical repersonalization process
Students become dependent on teacher guidance so they are less independent in learning	Teachers provide individual independent guidance only to students who fail during the conditional pedagogical intervention steps who are still on the wrong path or endanger themselves physically or mentally such as misconceptions, etc. which is outlined in the formlearning media and teaching materials in the form of differentiated LKPD based on microlearning

Individual students are not motivated to learn	Teachers condition other forms of celebration that are varied and liked by students and teach students to use themlearning media and teaching materials in the form of differentiated LKPD based on multimode microlearning
Students are classically not motivated to learn	The teacher conditions other forms of celebration that are varied and liked by studentslearning media and teaching materials in the form of differentiated LKPD based on multimode microlearning
• Students do not understand the main mathematics learning material explained by the teacher to strengthen the process and results of mathematical repersonalization • Students have difficulty communicating with their friends to communicate the process and results of their mathematical repersonalization	• The teacher explains the main learning material again to strengthen the process and results of appropriate mathematical repersonalizationlearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher goes around guiding students and helps students communicate the process and results of mathematical repersonalization to their friends
• Students have difficulty understanding the teacher's explanation regarding the abstraction of the core learning material that has been studied	• The teacher explains the abstraction process sequentially starting from concrete, semi-concrete, semi-abstract mathematical objects to abstract useslearning media and teaching materials in the form of differentiated LKPD based on microlearning
• Students have difficulty understanding the teacher's explanation of the contextual benefits of the learning material they have studied for the teacher's life • Students have difficulty understanding mathematical didactic situations regarding the benefits of the learning material they have studied • Students have difficulty finding contextual benefits from the learning material they have studied for their lives	• The teacher provides illustrations to understand what is stated in the studentslearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher repeats the explanation of his experience several times • The teacher asks probing questions so that students can find contextual benefits from the learning material they have studied • The teacher gives students the opportunity to discuss with their friends the contextual benefits of the learning material they have studied • The teacher displays another mathematical didactic situation about the benefits of the learning material that has been studied which is poured into itlearning media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher describes or explains the mathematical didactic situation regarding the benefits of the learning material that has been studied accordinglylearning

	media and teaching materials in the form of differentiated LKPD based on microlearning • The teacher provides probing questions or key words to make it easier for students to find contextual benefits from the learning material they have studied for their lives.

Initial Design of Microlearning-based Differentiated Learning Media Model

Research on learning media and teaching materials in the form of differentiated LKPDbased on micro learning subjectsMathematics in the field of Number studies in elementary school has been carried out to produce nine sets of differentiated learning media modelsbased on micro learning (ppt, infographics, audio podcast, video explainer, and motion graphics) which is multimode and a set of MERDEKA LKPD modelsfor learning mathematics in elementary school class 1 and class 4 as follows:

1. Nine sets of differentiated learning media models based on micro learning in Mathematics subjects in the field of Number studies in elementary school.
2. Nine sets of teaching materials in ppt form
3. Nine sets of teaching materials in the form of infographics
4. Nine sets of teaching materials in the form of audio podcasts
5. Nine sets of teaching materials in the form of explanatory videos
6. Nine sets of teaching materials in the form of motion graphics or animated videos
7. A set of MERDEKA LKPD models

All learning media, teaching materials and differentiated microlearning-based worksheet that have been developed have been validated by mathematicians and mathematics education experts as well as language experts with the criteria of being suitable for use in elementary school learning according to grade level. Furthermore, in the context of metapedadidactical analysis, six sets of initial designs for differentiated learning media models equipped with teaching materials and microlearning-based LKPD MERDEKA were used in mathematics learning in class 1 and class 4 at SDN Cibodas III, Lembang District, West Bandung Regency, West Java. Six initial designs of microlearning-based differentiated learning media models equipped with teaching materials and MERDEKA LKPD were developed by accommodating Brosoeau's (2002) theory of didactic situations consisting of action situations, formulation situations, validation situations, and institutionalization situations and Harel (2008) related to the Triadic Cycle , includes contextual problems as input or stimulus, random mental actions, flow of thinking, flow of understanding, and institutional contextual problems as reinforcement.

Results of Implementation of Initial Design of Micro Learning-based Differentiated Learning Model

When learning, use the initial design of the modeldifferentiated learning media based on micro learningthat has been developed, the researcher conducted a metapedadidactical analysis through observations when students learned to use the initial design and interviews with students and teachers about what had been done and other student findings when using the initial designthe. In general, students do not seem enthusiastic about learning even though the initial design has been packaged to overcome ontogenetic, epistemological and didactic learning barriers. The results of interviews with students and teachers confirmed that the initial

design was packaged less attractively and less aesthetically according to the characteristics of elementary school students, so it did not motivate students to learn.

Furthermore, after the learning took place, the researcher carried out a retrospective analysis regarding the findings during the learning, especially the lack of student motivation to learn using the initial model designdifferentiated learning media based on micro learningwhich has been developed. The results of interviews with students and teachers indicate that the initial design must be improved, especially regarding the layout or packaging so that it is attractive, aesthetic and motivating for students to learn using model designs.differentiated learning media based on micro learningthe. This shows that the results of the implementation of learning using the initial design did not find epistemological and didactic barriers to student learning, but ontogenetic learning barriers still emerged. For that, initial designdifferentiated learning media based on micro learningrevised based on initial design recommendations involving the attractiveness and aesthetics of the design or design layoutdifferentiated learning media based on micro learningto motivate students to learn.

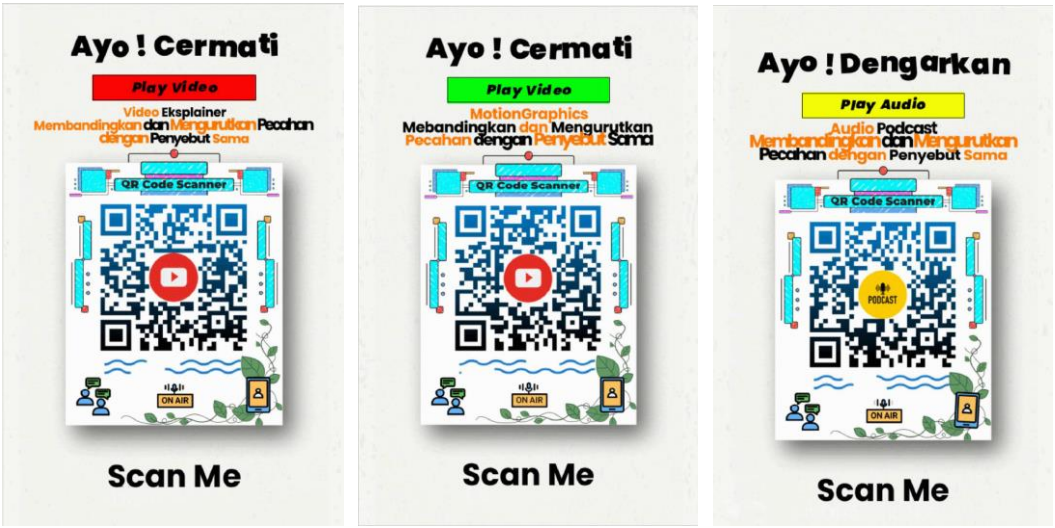
Final Design of Micro Learning-based Differentiated Learning Model

The initial design of a differentiated learning media model based on micro learning which has been analyzed retrospectively based on the findings when implementing learning is then revised with a focus on improvements or revisions on the attractiveness or aesthetics of the design to overcome ontogenic learning barriers to motivate students to learn mathematics using the learning media model design. micro learning-based differentiation that has been developed. Revisions were made to nine sets of initial designs for differentiated learning media based on micro learning which have been developed as follows.

1. Nine sets of differentiated learning media models based on micro learning in Mathematics subjects in the field of Number studies in elementary school.
2. Nine sets of teaching materials in ppt form
3. Nine sets of teaching materials in the form of infographics
4. Nine sets of teaching materials in the form of audio podcasts
5. Nine sets of teaching materials in the form of explanatory videos
6. Nine sets of teaching materials in the form of motion graphics or animated videos
7. A set of MERDEKA LKPD models

The nine sets of final designs for differentiated learning media models based on micro learning that have been developed do not experience changes in content, learning stages and context and still accommodate Brosoeau's (2002) theory of didactic situations consisting of action situations, formulation situations, validation situations and institutionalization situations. and Harel (2008) regarding the Triadic Cycle, including contextual problems as input or stimulus, random mental actions, flow of thinking, flow of understanding, and institutional contextual problems as reinforcement. Improvements are only made to the design or layout which is packaged more colorfully with images that are relevant to the characteristics of elementary school students who like to imagine. In addition, nine sets of final designs for differentiated learning media models based on micro learning are packaged in integration with the researcher's YouTube channel using a barcode system for print use and click on the link for digital use. This system makes learning differentiated at least based on auditory learning styles (using teaching materials in the form of audio podcasts), visual (using infographics and ppt), visual-auditory (using teaching materials in the form of explanatory videos and motion graphics), and kinesthetic (using MERDEKA LKPD). All modes of differentiated learning

media models based on micro learning are linked to the Researcher's YouTube link and packaged in the Learning Management System (LMS) that has been developed.



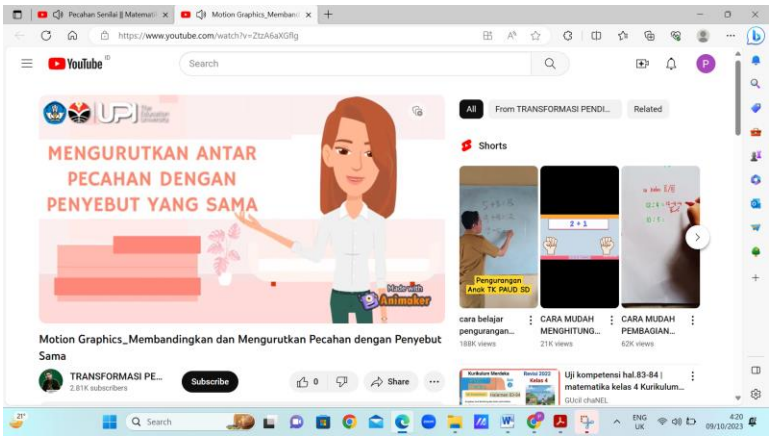


Figure 2. Differentiated Learning Media Model based on Micro Learning Integrated YouTube Channel
doc. Sandi Budi Iriawan

Conclusion

Based on the results and discussion above, several things can be concluded in accordance with the research problem that has been formulated as follows.

Students' learning difficulties in Mathematics subjects in the field of Number Studies generally have difficulties in understanding concepts, especially those related to Counting Operations and Fractional Numbers, which is caused by the design of learning media and teaching materials in the form of LKPD used in mathematics learning so far, which do not contain relevant contexts. and various, such as personal, work, socio-cultural, or scientific and packaged not involving ICT but in one form (monomode) in the form of text which has minimal illustrations, is boring and boring for students, so that it does not differentiate and creates obstacles to ontogenetic and didactic learning. Presumptive learning trajectories to overcome ontogenetic, epistemological and didactic learning barriers are formulated based on learning outcomes according to the phases in elementary school in BSKAP Decree Number 033 of 2022 which has been prepared by the Ministry of Education and Culture, including three phases, namely (a) phase A for grade 1 elementary school students and class 2; (b) phase B for grade 3

and grade 4 elementary school students; and (c) phase C for elementary school students in grade 5 and grade 6. The presumptive learning trajectory follows the mathematics learning flow according to Brosoeau (2002) which includes didactic situations of action, formulation, validation, and institutionalization as well as the mathematics learning flow according to Harel (2008) related to the Cycle Triadic, includes contextual problems as input or stimulus, random mental actions, flow of thinking, flow of understanding, and contextual problems of institutionalization as reinforcement. Pedagogical didactic anticipation is formulated based on the reaction principle in the Amora learning model which has been developed by Iriawan (2019) consisting of the syntax observe, momong and ngemong, ngrasake, and among. The ADP contains predictions of student responses and anticipation of teacher intervention to respond to student activities during learning using a differentiated learning media model design based on micro learning that has been developed.

The initial design of the differentiated learning media model based on micro learning that has been developed, consists of: (a) nine sets of differentiated learning media models based on micro learning for Mathematics subjects in the field of Number studies in elementary school (b) nine sets of teaching materials in ppt form; (c) nine sets of teaching materials in the form of infographics; (d) nine sets of teaching materials in the form of audio podcasts; (e) nine sets of teaching materials in the form of explanatory videos; (f) nine sets of teaching materials in the form of motion graphics or animated videos; and (g) a set of MERDEKA LKPD models.

The results of the learning implementation show that students no longer experience epistemological or didactic learning barriers, but rather show ontogenetic learning barriers related to low learning motivation in mathematics learning using the initial design of a differentiated learning media model based on micro learning which is caused by a design that does not involve ICT, is less attractive, less colorful, without pictures that are relevant to the characteristics of elementary school students, and packaged less aesthetically. The final design of the differentiated learning media model based on micro learning has been developed in nine sets based on recommendations for initial design improvements on design components or layouts packaged in multimode (infographics and ppt for visual students, explanatory videos and motion graphics for visual-auditory students, audio podcasts for auditory students, and MERDEKA LKPD for kinesthetic students) based on ICT with an integrated Researcher's YouTube channel and a Learning Management System (LMS) that has been developed, using a barcode system for print use and a click system linked to YouTube channels for digital use so that it is more aesthetic, attractive , colored, and accompanied by pictures that are relevant to the characteristics of elementary school students who like to imagine. The final design of the differentiated learning media model based on micro learning does not experience any changes to the content components, learning stages and context from the initial design. The final design of the differentiated learning media model based on micro learning that has been developed consists of (a) nine sets of differentiated learning media models based on micro learning for Mathematics subjects in the field of Number studies in elementary school (b) nine sets of teaching materials in ppt form; (c) nine sets of teaching materials in the form of infographics; (d) nine sets of teaching materials in the form of audio podcasts; (e) nine sets of teaching materials in the form of explanatory videos; (f) nine sets of teaching materials in the form of motion graphics or animated videos; and (g) a set of MERDEKA LKPD models.

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