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DEVELOPMENT OF THE PROPOSED MICROLEARNING-BASED DYNAMIC INTELLECTUAL LEARNING SYSTEM TO ACTUALIZE AN EFFECTIVE LEARNING PROCESS IN ONLINE ENVIRONMENT

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ABSTRAK

Era transformasi pendidikan pada abad 21 merupakan arus perubahan dimana guru dan siswa secara bersamaan memegang peranan penting dalam proses pembelajaran. Dalam hal ini perlu diterapkannya inovasi dan integrasi teknologi untuk mewujudkan proses pembelajaran yang efektif. Penelitian ini bertujuan untuk membangun sistem *dynamic intellectual learning* berbasis *microlearning* (sistem DIL-MicLearn) yang diakses melalui web. Penelitian ini menggunakan metode pengembangan teoritis-deskriptif yang menggunakan kajian teori, proses pengembangan perangkat lunak, dan evaluasi oleh ahli. Tahap penelitian yang digunakan adalah dua tahap pertama dari model penelitian desain Plomp, yaitu tahap penelitian pendahuluan, dan tahap pengembangan. DIL-MicLearn merupakan sistem pembelajaran yang dipersonalisasi yang memungkinkan siswa mencapai ketuntasan belajar di setiap unit pembelajaran sesuai dengan kemampuan kognitif dan kecepatan belajarnya, dapat mengakses konten pembelajaran sesuai gaya belajar, serta dapat mengurangi beban kognitif siswa dalam proses pembelajaran. Sistem *DIL-MicLearn* diterapkan dalam lingkungan pembelajaran online, dengan mempertimbangkan karakteristik sistem ini. Kelebihan dan kekurangan sistem ini dijelaskan secara rinci. Tingkat validitas sistem DIL-MicLearn mencapai 99,57% dan sistem ini valid untuk digunakan dalam proses pembelajaran.

Kata kunci: microlearning, mastery learning, sistem DIL-MicLearn, proses pembelajaran yang efektif

ABSTRACT

The era of educational transformation in the 21st century is a stream of change where teachers and students simultaneously hold an important role in the learning process. In this matter, it is necessary to apply innovation and technology integration to realize an effective learning process. This study aims to build a dynamic intellectual learning system based on microlearning (DIL-MicLearn system) which is accessed via the web. This research uses a theoretical-descriptive-development method that uses theoretical studies, software development proses, and expert evaluation. The research phase used is the first two stages of the Plomp design research model, namely the Prelimentary Research stage, and the Development or Prototyping phase. The DIL-MicLearn system is a personalized learning system that allows students to achieve learning mastery in each learning unit according to their cognitive abilities and learning speed, can access learning content according to learning styles, and can reduce students' cognitive load in the learning process. The DIL-MicLearn system is implemented in a online learning environment, considering the characteristics of this system. The advantages and disadvantages of this system are described in detail. The validity level of the DIL-MicLearn system reaches 99.57% and this system is valid for use in the learning process.

Keywords : *microlearning, mastery learning, DIL-MicLearn system, effective learning process*

1. INTRUDUCTION

The era of educational transformation in the 21st century is a stream of change where teachers and students simultaneously hold an important role in the learning process. The important role of the teacher in 21st-century learning will be more optimal if assisted by technology and information [1]. By utilizing technology, the learning atmosphere will become more active, creative, innovative, and entertaining [2] so as to create good multi-interactions between teachers and students [3], teachers and students with learning media/resources, as well as among students. On the other hand, the role of this technology can effectively change the way students learn toward personalized learning [4] in a self-paced environment [5]. Efficient personalized learning can increase student motivation, engagement, and understanding [6], improve learning achievement [7], maximize learner satisfaction, learning efficiency, and learning effectiveness [8]. Keep in mind that in learning, the choice of learning methods and strategies is very important [9]. The success of learning is due to the application of appropriate learning methods, not the media or learning technology itself [10]. The learning method is the main variable in determining student achievement [11]. Therefore, teachers must be able to choose and apply appropriate learning methods for that purpose.

Mastery Learning is one of the most effective learning models [12]. The application of Mastery Learning begins with giving students an understanding of the material. Then, students understanding of the material is assessed through formative assessment. The teacher can provide feedback and exercises to increase students' understanding in the remedial form if there are fuzzy concepts. Students who are able to master the content from the knowledge side can continue or move on to the following material. It suggests that students will move through the learning sequence at their own pace. After the students master all the material, it is continued by conducting a summative test. The summative test is intended to obtain the grades of the courses to be reported. In Mastery Learning, it is necessary to set a value to measure learning completeness called the minimum passing criteria (MPC).

The Mastery Learning approach has been widely applied in conventional learning [11], [13], [14] and has been proven to be effective and capable to improve student learning achievement with different levels of intelligence, namely high, medium, and weak [13]. The drawback of applying Mastery Learning in conventional classes is that it can cause boredom for students with high cognitive abilities [14]. It happens because they have to wait for friends with lesser cognitive abilities, so they are also slow in completing learning units. Under these conditions, the teacher's workload will increase to deal with heterogeneous student learning steps [15].

On the other hand, with current technological developments, adaptive learning systems are able to identify student learning styles, give different treatments to participants according to their intelligence, and the ability to monitor student academic achievement has begun to be developed [16], [17]. Dynamic Intellectual Learning (DIL) is a learning model that provides opportunities for students to explore learning content according to their characteristics, level of knowledge, and learning style and is conducted in an online learning environment [18]. DIL has almost the same characteristics as Mastery Learning. Students can carry out the learning process well and have fast progress if they can complete each test session in each course unit according to predetermined conditions. Students who do not pass the test session will be directed to participate in the remedial stage. If students still cannot pass the test session in the final remedial stage following the conditions, DIL will lock the course unit so that students cannot take the course unit [18].

Along with the development of technology in education, the methods of presenting learning content are also advancing. Microlearning is one of the innovations in handling the form of presentation of online learning content [19]. In microlearning, learning content is fragmented into short learning units, with discussions focused on one topic, in a simple format, and can be consumed quickly [20]. Learning content presented in the form of small units will reduce the cognitive load students feel in the learning process [21]–[23]. Based on the assumption of cognitive load theory that excessive cognitive load will hinder learning due to limited working memory capacity [21]. In its application, the microlearning approach requires a form of modality. Video content is a form of microlearning modality students like [24].

From the description above, it is necessary to develop a personalization system that can provide different treatment to students according to their learning style, intelligence, and learning speed, and is able to handle problems in learning mastery so that the learning process becomes more

effective whether implemented online learning environment. In this study, the authors propose a learning system that is dynamic intellectual learning based on microlearning (DIL-MicLearn system). The validity of this system will also be tested by learning experts. The proposed system is accessed via the web and is an embodiment of a combination of the advantages of mastery learning and dynamic intellectual learning which is bridged with a microlearning approach to handle the presentation of learning content.

2. METHODS

This research uses a theoretical-descriptive-development method that uses theoretical studies, focus group discussions, and agile software development. There are three research stages, which consist of 1) Prelimentary Research, 2) Development or Prototyping phase, and 3) Assessment phase [25], [26]. This article, focus on the first two stages.

2.1 Prelimentary Research Phase

At the Prelimentary Research stage, a requirements analysis process is performed. The process looks at literature studies regarding the use of mastery learning as an effective learning method, as well as the criteria for an effective learning system. The system proposed is called dynamic intellectual learning based on microlearning (DIL-MicLearn system). There were 22 articles that studies mastery learning methods and effective learning processes, which were successfully collected and studied.

2.2 Development or Prototyping Phase

At this stage, an effective learning system is designed based on the results of the study in the Prelimentary Research Phase. The learning system that is created is web-based, which is different from e-learning in general. Next, a path plan of the DIL-MicLearn system is created. This DIL-MicLearn system focuses on student learning process activities. This learning system is not a “one size fits all” [27].

3. RESULTS

The discussion is focused on establishing mastery learning as an effective learning method that forms the basis for the development of learning systems, the elements that must exist to achieve effective learning, and the design of learning systems.

3.1 Choosing Mastery Learning Method

The learning process can be conducted successfully because of the influence of applying suitable learning methods, instead of because of the use of learning media [10]. The learning method is the main variable in determining student achievement [11]. Therefore, teachers must be able to choose and apply suitable learning methods for this purpose.

In this study, the mastery learning method was chosen as the basis for developing the DIL-MicLearn system because it has several advantages, namely 1) mastery learning is a learning model that is classified as very effective in the learning process [5], [12], [14], [28]; 2) mastery learning is able to increase learning achievement [11], [13] and is successful in providing learning experiences to all students with different intelligence levels, such as high, medium, and weak [13]; 3) mastery learning can be used to ensure that almost all students have learned and are competent in learning material that is adjusted to the passing criteria before proceeding to the next material [11]. Mastery learning also has the weaknesses previously described. To overcome the weakness of mastery learning, the DIL model is applied. Whereas the DIL model is an adaptive learning model and has almost the same characteristics as mastery learning.

3.2 Criteria for an Effective Learning System

At this stage, a review was carried out on several articles that discussed effective learning processes. From these articles, a summary was made, as shown in Table 1.

Table 1. Studies on Effective Learning Processes

No	Source	Result of studies
1	[29]	- Collaborative methods can be used as a guide for students to share knowledge and cultivate ideas to

No	Source	Result of studies
		ensure the learning process runs effectively. - Learning styles can be used as a way to acquire knowledge
2	[2]	- The implementation of technology in learning has a positive impact where the learning process becomes more active, creative, and can increase student effort and interest in learning. - The utilization of technology in learning causes the learning process to be more efficient, effective and can be used as a medium for interaction between teachers and students.
3	[31]	- The implementation of online learning is a form of using technology in learning. - Online learning has proven to be effective because it can increase students' knowledge and skills in the learning process. - The implementation of online learning makes the learning process more interesting and can increase student involvement in learning.
4	[4], [32]	- E-learning with a personalized learning environment is a factor that contributes significantly to an effective learning process that can increase learning satisfaction, learning speed, quality, and efficiency of the learning process. The main goal of personalization in e-learning is to provide appropriate education and adjust environmental conditions for each learner according to the special characteristics of students. - Personalization in the e-learning environment based on learning style has a significant effect on students' academic success and satisfaction.
5	[16]	- An adaptive learning system with instructions tailored to the needs and learning abilities of individual students has a positive impact on learning. - Adaptive learning system is one of the effective learning systems to be applied in learning
6	[3]	- An ideal and effective learning process can occur because of the interactions that occur between teachers and students. - This type of interaction can affect the quality of students and student motivation. - Other factors for creating an effective learning process are emotional support, class management, applying appropriate learning strategies, and good learning organization.
7	[21], [23]	- Microlearning is practically able to reduce cognitive load which is an obstacle to learning. - Can increase student satisfaction, and performance in learning. - Can increase student engagement in online learning
8	[33]	- Microlearning can improve students' retention skills and learning experiences. - Can be used in blended learning
9	[34]	- Innovation in learning is one of the factors that can encourage a better and more effective learning process. - One of them is using a digital learning platform. - Student-centered learning methods can also encourage learning effectiveness
10	[22], [35]–[37]	- The microlearning approach in learning can significantly increase motivation, interest in learning, and student achievement. - Microlearning is also very effective in increasing student participation in learning.

From the results of study above, the authors designed a personalized learning system called the DIL-MicLearn system. Furthermore, the DIL-MicLearn system is designed to meet the criteria for an effective learning system.

3.3 Development of DIL-MicLearn System

At this stage, the process of developing the DIL-MicLearn system was carried out based on the results of theoretical studies conducted in the Prelimentary Research Phase.

A) Path of Learning Process in DIL-MicLearn System

At this stage, the researcher designed a DIL-MicLearn system with several features to fulfil an effective learning process. The DIL-MicLearn system is a personalized learning system that allows students to achieve learning mastery in each learning unit according to their cognitive ability and learning speed, can access learning content according to learning style, and can reduce students' cognitive load in the learning process. The DIL-MicLearn system is implemented in a blended learning environment. This system discusses more about the learning process that fulfills learning mastery. The path of learning process in DIL-MicLearn system according to Figure 1 is as follows:

a) Students perform login into the DIL-MicLearn system.
b) Students select the course.
c) The lowest learning unit is opened.
   At this stage, students can start carrying out the learning process in open learning units. In each learning unit, learning content is presented in learning module and microvideo content. The learning module is presented in one file with an exposition of material for all learning indicators

in the unit. A minimal learning indicator is discussed in a microvideo. Microvideo content in one learning unit is presented sequentially from the exposition of material on the first learning indicator to the exposition of material on the last learning indicator.

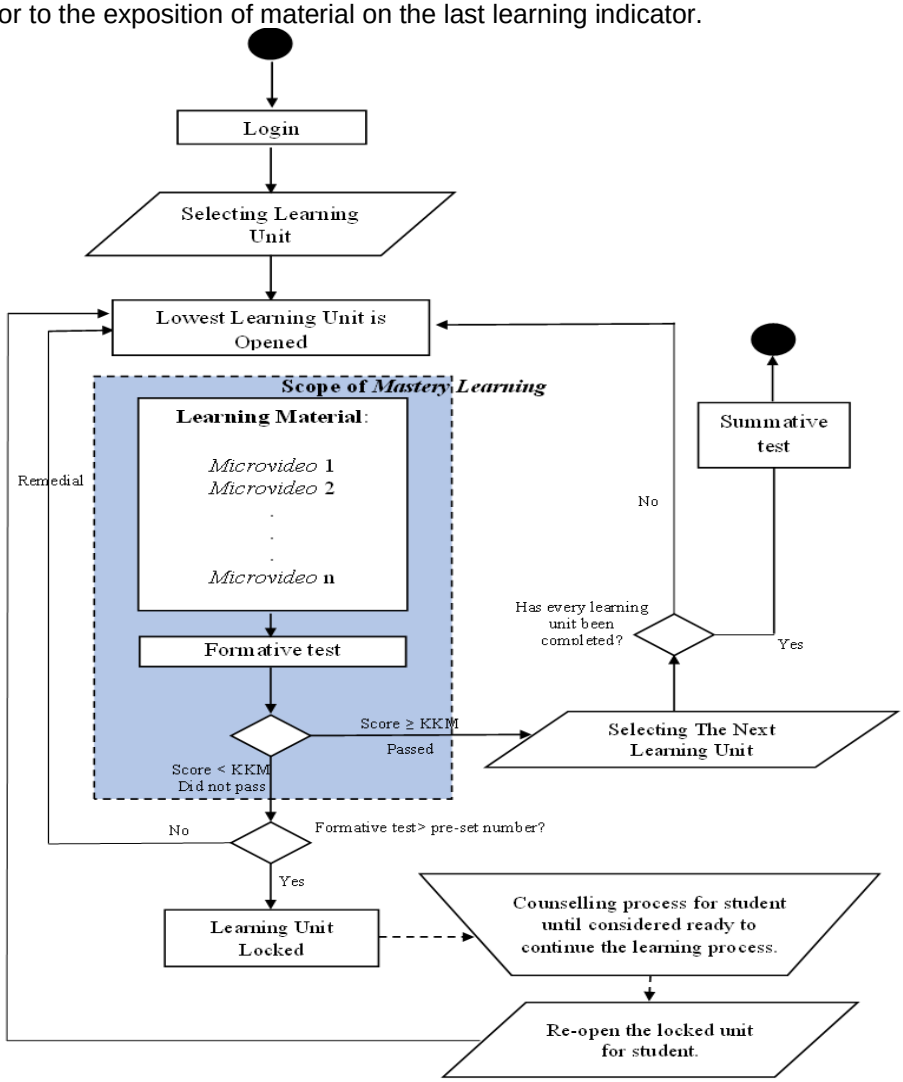

Figure 1. DIL-MicLearn System Design.

d) Formative Test.
A Formative Test will be opened when students have finished studying the learning material/microvideo content. Students can take the test process to determine their mastery of the material in that unit. The questions are displayed in the form of multiple-choice tests and represent each existing learning indicator. The questions are displayed through a random process from the question bank. After students complete the formative test process, they will be given feedback in the form of a result score by the system.
- If the score is greater than MPC that have been set, then the student is declared complete and can carry out the enrichment stage in the form of continuing to the next learning unit (stage 3 is repeated)
- If the score is less than the MPC, then the student is declared not to have met the minimum completeness and must follow the remedial stage.

e) Remedial
Students must review learning unit material that has not been completed through remedial activities. In this condition, the formative test link is locked and cannot be accessed by students. Furthermore, the DIL-MicLearn system encourages students who are in the remedial stage to carry out the collaborative learning process using the peer tutor method. The DIL-MicLearn system will provide recommendations for names of students who have completed with the highest scores and the shortest completion time on formative exams in related learning units to

become peer tutors. The learning process with the peer tutor method can be carried out offline or online by utilizing the current public facilities. The learning process with the peer tutor method is carried out outside the system. The process of repeating formative tests can be carried out by students according to a predetermined time. Remedial opportunities are given to students, according to existing provisions. If the student has not been able to get a score that meets the MPC on the last reformative test, then the learning unit will be automatically locked by the system. The student in question is asked to immediately contact the course teacher to get the assistance process for understanding the material. This is a form of teacher-student interaction that is needed for certain students.

f) The learning unit is locked
This locking status occurs when students continue to get formative test scores less than the MPC, up to a predetermined amount of remedial. The part that is locked is only the formative test questions, while the learning material remains open so that students can still access existing learning material. At this locking stage, the teacher will carry out the counseling process for students outside the system. The counsel process can be carried out both offline and online by utilizing existing facilities, such as zoom, Google meets, or other video conferencing facilities. After the counselling process is considered sufficient, the teacher will open the locking status of the formative test questions in the learning unit. Finally, students can take formative tests on learning units that have not been completed.

g) Summative Test
The summative test phase can be completed if all learning units are completed. The summative test is carried out simultaneously according to a predetermined schedule. The summative test is carried out to fulfil the obligation to get the course's final grade, which can be reported to the manager.

B) Usecase Diagram Design

The DIL-MicLearn system can be accessed by three tier of users which consist of admin, teachers and students. Each user must login to access the features provided by the DIL-MicLearn system. The admin has the authority to manage users, course data, class data, and reset user accounts. Teacher have the authority to manage learning data which includes data on sub-learning objective of the courses, learning indicators, learning content, and management of the question bank. Teacher can also organize and manage lecture class data. Finally, students as the main users of the DIL-MicLearn system can perform the registration process for course classes and carry out the learning process. Activities in the learning process include accessing learning content, taking formative tests and summative tests.

C) Database Design

In the development process, the DIL-MicLearn system uses 18 tables in the database design. All tables are related according to the requirements. Database design can be seen in Figure 2.

D) Interface Design

The interface design serves to facilitate interaction between the user and the DIL-MicLearn system. When accessing the DIL-MicLearn system for the first time, the user must go through the login page. The user must input their account to be able to access the features of the DIL-MicLearn system.

If the user is an admin, after the login page the admin main page will be displayed. On the left side of the display, there are menus for managing users and managing course classes.

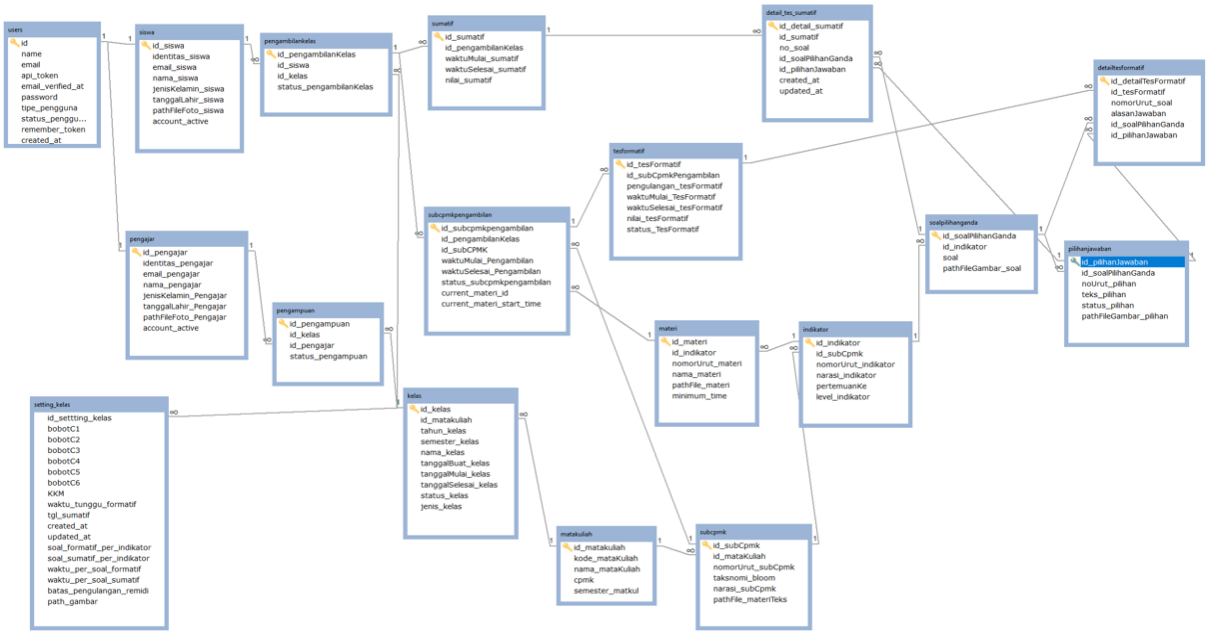

Figure 2. Database Design of DIL-MicLearn System

If the user is a teacher, after the login page a welcome page will be displayed as shown in Figure 3.

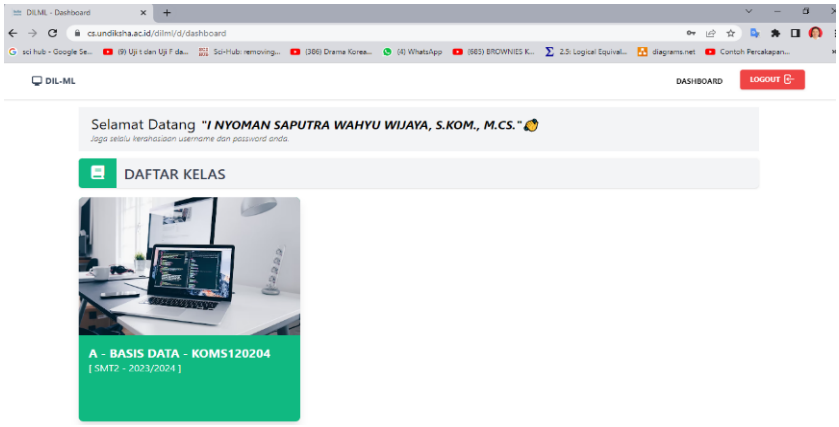

Figure 3. Welcome Page for Teacher

In Figure 3, the teacher chooses the lecture class that they taught. The DIL-MicLearn system can be used to manage the learning process for more than one class in the same study program. After the teacher selects a lecture class, the teacher's main page will be displayed as shown in Figure 4.

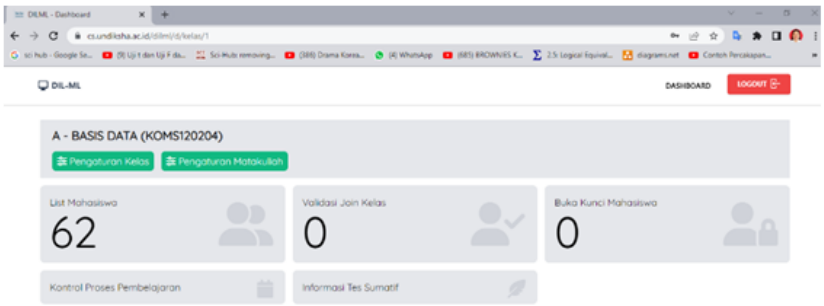

Figure 4. Main Page for Teacher

On the teacher's main page, several menus are displayed for setting lecture classes, setting course data, displaying a list of students taking course classes, unlocking formative test locked

status for certain students, controlling the learning process, and displaying information on summative test implementation.

For users as students, after the login page a welcome page will be displayed with almost the same appearance as Figure 3. On this page, students can choose a lecture class to take part in the learning process (Figure 5).

On the learning process page, learning material is displayed in the form of a microvideo with a maximum duration of 6 minutes according to recommendations from [38]. Microvideo is grouped into a learning unit. Each learning unit consists of several learning indicators to be achieved. So microvideos are presented sequentially according to the order of learning indicators to be achieved in one learning unit. If all the microvideos have been studied, students can take formative tests on the learning unit. For the next stage, the same as described in the DIL-MicLearn system design section above.

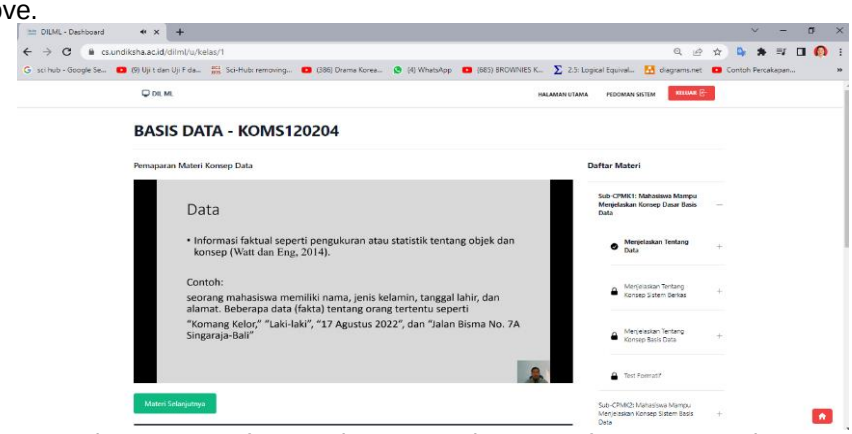

Figure 5. Page for Learning Process in Scope of Mastery Learning

E) Source Code Development

The web-based DIL-MicLearn system was developed using several software and hardware as supports. The software used for the development process are laravel 9, and MySQL 10 for database management system.

G. Validation Process of DIL-MicLearn System by Learning Experts

The process of validity of the DIL-MicLearn system is carried out by two learning experts using valid instruments. The aspects assessed are learning design, software engineering, media displays, learning videos (microvideo), and DIL-MicLearn system functionality. The results of testing the validity of the DIL-MicLearn system are presented in Table 2.

Table 2. DIL-MicLearn system validation results as a development product

No	Aspect	Expert 1	Expert 2	Average	Category
1	Learning Design	100%	98%	99%	Very Valid
2	Software Engineering	100%	100%	100%	Very Valid
3	Media View	100%	100%	100%	Very Valid
4	Microlearning Video	100%	100%	100%	Very Valid
5	DIL-MicLearn System Functional	100%	100%	100%	Very Valid

Based on the results of the assessment by experts, the DIL-MicLearn system was stated to be very valid for each value aspect. Overall, the validity level of this system reaches 99.57%. The DIL-MicLearn system is valid for use in the learning process.

4. DISCUSSION

In this research, a DIL-MicLearn system is designed to overcome challenges in implementing Mastery Learning in conventional classes. There are several advantages that the DIL-MicLearn system has. First, in terms of learning content, the forms of modality used to present learning content are video and text. Students can choose their preferred form of learning content to study. In this case,

students can learn according to their learning style. The presentation of video content uses a micro-learning approach. The learning video content is packaged in small pieces, with discussions focused on topics, short video duration, and in a simple format called microvideo. The maximum duration of a microvideo is 6 minutes [38]. With the form of fragmented video content, it will be able to reduce students' cognitive load in the learning process [21]–[23]. By presenting learning content in the form of small pieces, the learning process can be carried out by students anytime, anywhere, and the content also can be accessed easily due to its simple format [21], [22].

Second, students can learn dynamically according to their cognitive abilities and keep up according to each student's learning speed. Students with weak abilities and who cannot complete a learning unit must participate in remedial activities through collaborative learning with peer tutoring techniques. The tutors are their friends who have been able to achieve mastery of learning content in learning units with the highest scores and the shortest use of time in formative tests. Peer-Assisted Learning is a teaching and learning strategy that can improve learning effectiveness and student academic performance [39]. On the other hand, it is possible that collaborative learning can improve students' working memory so that they can increase test scores produced later [14]. The Mastery Learning approach combined with group/collaborative learning has been successfully applied by Bizimana, Mutangana & Mwesigye [40]. Research results show that it increases the motivation, involvement, and active participation of students in the learning process [5].

Third, the DIL-MicLearn system can provide direct feedback to students in the form of achievement scores after conducting evaluations in the form of formative tests and summative tests. This feedback is given after students complete formative tests and summative tests. The questions used for formative tests and summative tests are in the form of multiple-choice questions. According to Roessger, the type of direct feedback resulting from the form of multiple-choice questions is classified as the most effective feedback [28]. The questions on the formative test and the summative test were taken from the question bank using a random technique to minimize the possibility of cheating by students when working on the questions. The impact of the random technique is that each student is likely to face different types of questions but is still at the same level of learning indicators.

Finally, the DIL-MicLearn system provides regulatory and control features that can be performed by lecturers. The teacher can measure the level of the questions according to the taxonomic bloom level of predetermined default learning indicators. Teachers can also set a MPC score which is used as a reference for assessing formative tests. In the control section, teachers can monitor students' progress in the learning process as well as monitor to find out which students have attained a level of mastery according to the predetermined MPC. In the DIL-MicLearn system, the teacher's role remains for students who need it, especially for students who cannot complete the learning unit according to the predetermined number of remedial limits.

From the several advantages possessed by the DIL-MicLearn system that is successfully created, there are still potential problems in the learning process that can be examined further in their implementation. There are several potential problems that need to be discussed, including 1) monitoring student learning activities in the Mastery Learning block, 2) enrichment process, 3) remedial implementation challenges, and 4) challenges in working on formative tests and summative tests.

4.1 Student Learning Activity and *Involvement Monitoring in Scope of Mastery Learning*

In the learning process, most students want to achieve better academic results. Yokoyama (2019) states that the longer students are involved in learning activities, certainly, the student's academic performance will be better [41], [42]. Monitoring learning activities and student involvement in online learning is very important [42] and is a challenge in itself, especially in this DIL-MicLearn system. In the Mastery Learning block section where students study learning content both in the form of microvideo and text content, the teacher cannot properly monitor student activity and involvement in learning. A question arises, "Do students really watch micro-videos or read text content properly?". This section is the dark side of the DIL-MicLearn system. Even though the learning design offered has a decent quality learning, monitoring of learning activities and student involvement is still a challenge because the design of the DIL-MicLearn system has not addressed this problem. Meanwhile, student activity and involvement in learning in the DIL-MicLearn system can only be monitored regarding the implementation of formative and summative tests by students.

4.2 Enrichment Process

After the initial learning process is completed, students are directed to complete a formative assessment based on predetermined learning outcomes. If students can achieve the mastery level determined in one learning unit, they can carry out enrichment activities. However, students who cannot reach the predetermined level of mastery will enter the remedial stage.
In enrichment activities, students are directed to take the next learning unit automatically. However, according to the author, this is not enough to provide further understanding and strengthen the mastery of learning objectives for students with more abilities. According to [12], at this enrichment stage, it is necessary to be better designed to motivate students to build competence. Basically, Mastery Learning has the goal of building competence.

4.3 Remidial Challenge

In the conventional Mastery Learning flow, information related to remedial is not clearly discussed. The remedial process must be followed by students who do not reach the mastery level set in one learning unit. Under these conditions, students must participate in corrective activities by repeating the learning process to gain a better understanding. In the current DIL-MicLearn system, students participate in corrective activities through collaborative learning with peer tutoring techniques. With this form of collaborative learning, students can interact and conduct a discussion with friends to produce a better understanding of themselves [12]. In the implementation of collaborative learning, remedial students are directed to form small groups and friends who are recommended as peer tutors. Studying in small groups can provide more significant benefits to student learning activities, and also such a learning process can be carried out at home in a learning environment that does not have time pressure [14].

Currently, the DIL-MicLearn system does not directly facilitate collaborative learning activities with peer tutoring techniques. Meanwhile, this collaborative learning process can be carried out both online and offline. The collaborative learning process with online peer tutoring techniques can be carried out using the currently available online meeting facilities. While the collaborative learning process with offline peer tutoring techniques can be carried out where students can meet face-to-face with other remedial students and also peer tutors. In the future, the DIL-MicLearn system can be developed by facilitating special discussion forums for remedial students so that the collaborative learning process with peer tutors becomes more effective. Therefore, it is indeed important to integrate discussion forum facilities into the DIL-MicLearn system so that students can interact with their friends or tutors. It will significantly support an effective collaborative learning process [43].

4.4 Challenge in Taking Formative and Summative Tests

In the proposed DIL-MicLearn system, students independently complete formative and summative tests. The challenge in completing formative and summative tests is the tendency towards cheating by students. Many questions may arise, for example, “Is it true that students take evaluation tests honestly without the help of others?”. It is a big challenge in the form of evaluation implementation in an online learning environment. The most likely thing to do to avoid cheating is to require students to agree to a statement regarding honesty in completing the evaluation process. This statement can be the basis for judgment when cheating occurs.

5. CONCLUSION

In this study, the proposed DIL-MicLearn system was successfully developed for an effective learning process. This DIL-MicLearn system is implemented in a online learning environment. Some of the advantages of this system are 1) learning content is presented in the form of small units with a short duration so that it is able to reduce students’ cognitive load in the learning process, 2) students can learn dynamically according to their cognitive abilities and able to keep up with the learning process according to their learning speed, 3) the DIL-MicLearn system can provide direct feedback to students in the form of achievement scores after conducting evaluations in the form of formative tests and summative tests, and 4) the DIL-MicLearn system provides regulatory and control features that can be carried out by the teacher. On the other hand, the DIL-MicLearn system also has some drawbacks. From the results of the assessment by learning experts, the proposed DIL-MicLearn system can be said to be valid with a score of 99.57%. The DIL-MicLearn system is valid for use in the learning process. The form of further research carried out is testing and implementing the DIL-MicLearn system to see the effectiveness of the system.

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