

Designing Test Software for Pre-Learning Evaluation to Optimize the Differentiated Learning

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Abstract – Pre-learning evaluation helps map students' abilities and readiness to follow the learning of a subject. This shows the need for instruments of pre-learning evaluation that can be used for teachers. Software developed later can help teachers determine the best strategy for student learning. As a result, differentiated learning can be optimized. Differentiated learning is a starting point to meet diverse student learning needs but create equal learning opportunities. Based on these problems, this study aims to design test software for pre-learning evaluation that measures students' mastery of concepts and provides learning design recommendations to optimize differentiated learning. This research uses the research and development method with the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model. This research has produced test software for pre-learning evaluation.

The results of validation show that the test software for pre-learning evaluation that has been developed can be declared feasible with an outstanding category when viewed in terms of media and evaluation. The trial results also provide information that the developed test software for pre-learning is very well received by some teachers. The interview results showed that 91.57% of teachers were satisfied with the learning design recommendations that should be used for each student. Based on the research results and discussion, this study concludes that the test software for pre-learning evaluation has been successfully developed with outstanding criteria. Teachers will also receive recommendations for each student's learning design through this software test. So, through this software test, the implementation of differentiated learning is more optimal.

Keywords – Test software, pre-learning, evaluation, differentiated learning.

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1. Introduction

Assessment standards require teachers to conduct an initial evaluation of learning before students follow the learning process. This pre-learning evaluation helps map students' abilities and readiness to follow the teaching of a subject. Evaluation is carried out to collect data and then discussed to understand what students have learned and applied based on the knowledge gained in the previous learning process [1]. The evaluation results are used to measure student learning outcomes [2]. The evaluation results are also used to improve the quality of learning later [3]. Therefore, evaluation at the beginning of education becomes an important activity.

The results of observations in several schools in Indonesia show that the availability of instruments for pre-learning evaluation and their application still needs to be improved.

Only 12.5% of schools have implemented this initial evaluation of learning. The teachers stated they needed help compiling test instruments and conducting this pre-learning evaluation. This shows the need for instruments for pre-learning evaluation that can be used as examples for teachers to develop.

This research is necessary because the study's results can be used to assist teachers in carrying out initial evaluations of learning. The availability of test kits for pre-learning evaluation can motivate teachers to conduct assessments at the beginning of education. The availability of test kits increases teacher motivation in identifying the learning process [4]. The availability of these test kits can also encourage teachers to determine teaching strategies and motivate students to learn better [5].

Packaging instruments in software makes it easier for teachers and students to use and encourages technological literacy. The test kits available for pre-learning evaluation can also optimize the application of differentiated learning. Differentiated learning is a learning process that maximizes the learning process in the classroom because it considers the characteristics of each student. In addition, this research will also help the government in improving the quality of education.

Following up on this urgency, research is still needed to develop test software for pre-learning evaluation. Thus, the teacher no longer has difficulties in conducting preliminary diagnostics. Moreover, implementing this diagnostic assessment is vital in mapping students' mastery of basic concepts. It is not limited to mapping the knowledge of basic concepts of students, but the software to be developed can be an effort to support the implementation of differentiated learning. Software is formed into a tool to map the mastery of student concepts. Software developed later can help teachers determine the best strategy for student learning. As a result, differentiated learning can be realized.

Differentiated learning is effective in maximizing the learning process [6], learning outcomes [2], [3], addressing students' diverse abilities and potentials, and developing their skills [4], [5]. However, the existing conditions of teachers have yet to be able to design differentiated learning. Teachers still need to be ready to change [6], [7]. Lack of resources, time, support, teacher knowledge and competence, class size, and assessment of learning hinder the use of differentiated learning in the classroom [8], [9].

Differentiated learning is a starting point to meet the diverse learning needs of students, but it creates equal learning opportunities [10], [11], [12], [13], [14], [15].

Differentiated learning becomes an approach that recognizes and values student diversity and adapts instruction to engage each student [16], [17]. Therefore, it is necessary to evaluate at the beginning of learning to dig deeper into each student's information in order to realize differentiated learning.

In addition, teachers also need a thorough knowledge of content and a variety of pedagogical and didactic skills to plan and implement differentiated learning. In implementing differentiated learning in the classroom, the diversity of the student population and class size affect the interaction between teachers and students. In addition, support from schools can also influence the implementation of differentiated learning. Last, organizing such time and resources for professional development, learning environments, support from school boards, and a culture of professional collaboration can influence teaching.

Research on the development of tests for diagnostics has been carried out, among others, with the CRI method [23], [24], achievement tests [25], online-based [26], and tier tests [26], [27], [28], [29], [30], [31]. The results of the development of electronic-based diagnostic tests that have been carried out include using Adobe Flash applications on Business and Energy materials [32] and pictorial e-diagnostics [33], [33]. The development of the curriculum requires teachers to be able to provide diagnostic assessments before students start studying subjects. However, the product diagnostic instruments that have been carried out are not intended as a basis for the application of differentiated learning but to identify learning difficulties and misconceptions of students.

The novelty of this study lies in the type of diagnostic assessment software that has characteristics to determine students' initial ability so that teachers can apply differentiated learning. These characteristics are that the proportion of the material for each subject is 60% material 1 level below, 20% material two levels below, and 20% about the material at its level. Another novelty is the form of instruments packaged in software, so it is easy to use and fast in obtaining the results of assessment and mapping students' abilities.

Based on this background, this study will discuss how to design early learning evaluation test software that measures students' mastery of concepts and provides learning design recommendations. In the end of this study, test software for pre-learning evaluation will be developed so that differentiated learning can be realized.

2. Methodology

This research uses the Research and Development method with the ADDIE model. The research phase starts with (1) needs analysis, (2) evaluation test software design, (3) software development and product validation, (4) product implementation, and (5) product evaluation and finalization. The ADDIE model was chosen because of its simple stages [34].

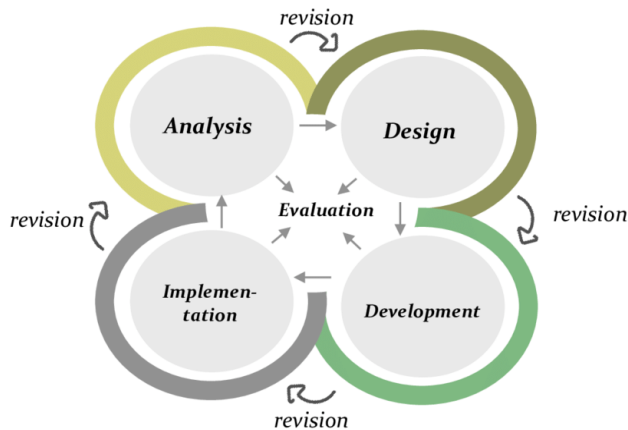


Figure 1. Research and development method with ADDIE Model

At the needs analysis stage, research is carried out with preliminary studies regarding the need for educational products. Initial research is also conducted with a literature study on differentiated learning.

At the stage of designing evaluation test software, blueprint test software is developed for pre-learning evaluation. Each question item produced is a multiple-choice question type. Each question item is arranged to measure students' readiness to learn the material to be discovered. In addition, the choice of the best learning design recommendations for each possible student is also made from the test results later. The determination of learning design recommendations is carried out through focus group discussions involving research teams and expert lecturers in the field of education.

At the stage of software development and product validation, the blueprint created is realized into complete software. The software developed at the end will provide learning design recommendations supporting the differentiated learning process. Software that has been developed will go through a validation process. Validation uses questionnaires, which are divided into media aspects and evaluation aspects. Therefore, the feasibility of the instruments that have been developed is reviewed from the media aspect and the evaluation aspect.

At the product implementation stage, software declared valid will be implemented for some students.

The trial was conducted by asking some students to answer each question item. The results of the problem are then given to the relevant teachers. The teachers then analyzed the classification from the software tests developed and the learning design recommendations provided. After that, the teachers will be interviewed and asked to complete a questionnaire. Interviews and questionnaires were conducted to determine teacher acceptance and satisfaction with the test software that had been developed.

At the evaluation stage, each of the previous steps will be evaluated. The final evaluation is carried out to produce conclusions from this study related to the finalization of products that have been developed.

3. Results

This study discusses how early learning evaluation test software design measures students' mastery of concepts and can provide learning design recommendations. So, this study aims to develop an initial learning evaluation test software design that can optimize the realization of differentiated learning. The results and discussion of each stage in this study are summarized in the following subsections.

3.1. Analysis

At the analysis stage, the research identifies the problems and needs of teachers in carrying out initial evaluations of learning in the classroom. This needs analysis was carried out to obtain further the availability of assessment tools that can be used for pre-learning evaluation to support the realization of differentiated learning.

This needs analysis was conducted by interviews with teachers at various levels of education units spread across several regions. In this activity, the study recorded the availability of assessment tools that can be used for pre-learning evaluation. The interview results, in general, can be shown as follows.

Availability of Assessment Tools for Evaluation of Pre-learning

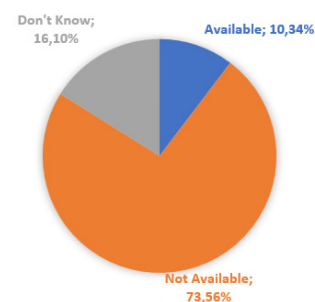


Figure 2. Graph for need analysis

Based on interviews, 73.56% of teachers stated that the need for pre-learning evaluation assessment tools was unavailable. Only 10.34% of teachers stated they had pre-learning evaluation assessment tools. While the rest (16.10%) said they did not know.

The analysis results identify that the need for assessment tools for evaluation at the beginning of learning is still urgently needed. The interview results are then re-analyzed based on the types of assessment tools available, namely CBT (Computer Based Test) and PBT (Paper Based Test). CBT-based assessment tools can be in software, websites, online forms, and others. Meanwhile, the PBT assessment tool still focuses on using paper and pencil. The results of the analysis are as follows.

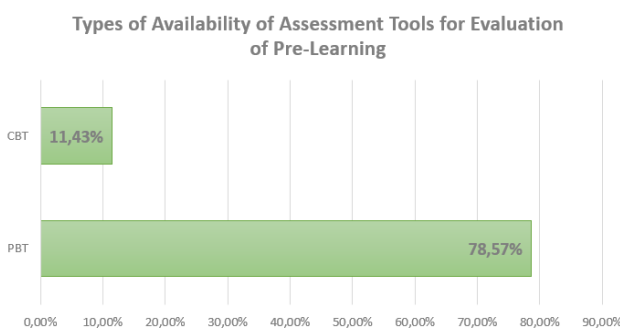


Figure 3. Types of availability of assessment tools

Based on interviews, 73.56% of teachers stated that the need for pre-learning evaluation assessment tools was unavailable. Only 10.34% of teachers stated they had pre-learning evaluation assessment tools. While the rest (16.10%) said they did not know.

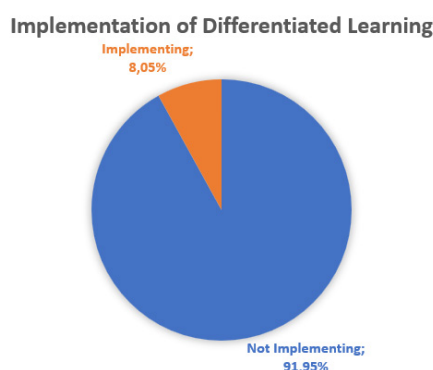


Figure 4. Implementation of differentiated learning

Most teachers (91.95%) revealed that they do not implement differentiated learning in the classroom. The results of the further analysis show that teachers need initial student data to implement differentiated learning.

This identifies that teachers also need tools to detect students' initial data before the learning process begins. So, at this stage, a more profound idea was obtained: develop assessment tools for initial evaluation in software that supports differentiated learning in the classroom.

3.2. Design

After conducting research at the analysis stage and completing a review of related literature and information, the next step is to plan. Planning is made to make it easier to make a series of straightforward steps in implementing development research in the field. There are several activities carried out at the design stage.

At this stage, research determines the picture of the final results of the research product to be developed. At this stage, researchers design assessment tools to be developed. Concepts and materials are created by compiling an outline of the material. The draft is prepared by looking for related literacy resources that can be used as material to conduct an initial evaluation of learning. In this section, the research also determines the product's appearance, the type and size of the font used, and the software used in product development. The software used MS Word, Adobe Flash Professional CS6, Adobe Photoshop CS6, and Adobe Illustrator CS6. Here is a storyboard view of the research product to be developed.

Introductory Screen	
Screen Title	Software Information
On-Screen Text	Welcome to Evaluation Test Software for Pre-Learning. In this software you will take a test to measure your readiness to take part in learning later. Please log in using your username and password. After that, enter the test token that was given to you by your teacher.
Pop-Up Text	No pop-ups
Additional Information	Audio narration Instruction for using the software
Graphics	Standard homepage of test
Filling Column	Username and Password
Button	Login Help Quit

(a)

Test Screen	
Screen Title	Test Title
On-Screen Text	Question (Multiple Choices)
Pop-Up Text	More detail about the question
Additional Information	Audio narration Image, Graph, Audio, and Video
Graphics	Standard test screen
Filling Column	-
Button	Next Question Previous Question Number of Question Submit Help Refresh

(b)

Figure 5. Storyboard samples

3.3. Development

At this stage, research products in the form of test software for pre-learning evaluation have been developed. The resulting research product has some components: the homepage, information on the test, test screen, and results screen (feedback to optimize differentiated learning). Here are some views of research products that have been produced.

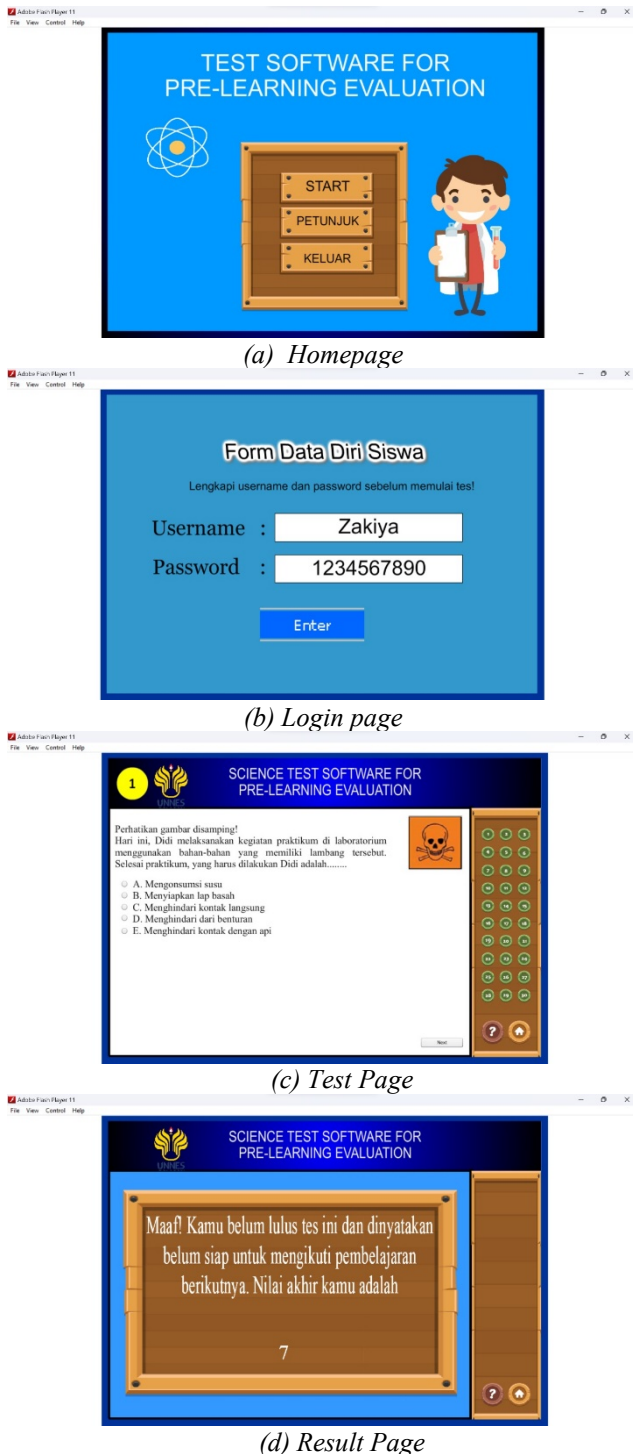


Figure 6. (a)-(d), Test software for pre-learning evaluation

Test software for pre-learning evaluation that has been developed is then reviewed by several experts. Several media and evaluation experts carried out the theoretical validation in this study.

Theoretical validation by media experts was given by seven lecturers who are experts in media development. Theoretical validation of media experts consists of 20 statements divided into three aspects: presentation, material, and language. The results of the theoretical validation of media experts gave an average score of 81.43% with very good criteria (outstanding). The test software designed for pre-learning assessment has exceptional media-related standards, as indicated by the score it achieved. Based on this information, the developed test software for pre-learning evaluation can be declared feasible with a very good category when viewed in terms of media. The scores for each aspect are shown in the following theoretical validation graph.

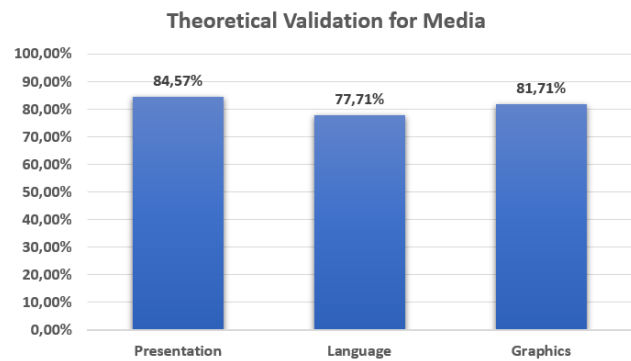


Figure 7. Theoretical validation for media

The graph above shows that from the aspect of "presentation," the test software for pre-learning evaluation that has been developed has excellent criteria with an average score of 84.57%. The same standards are also given to the test software for pre-learning evaluation, designed for the graphics aspect, with a score of 81.71%. The language aspect has a score of 77.71%, with good criteria.

Experts gave some inputs to improve the quality of test software for pre-learning evaluation that has been developed. Some revisions have been made based on expert information. The modifications made are minor because they only change some of the software. In the presentation aspect, modifications are made to display the question stimulus media to make it easier to read. In language, revisions are made to instruction sentences that still use negative words. Modifications are made to stimulus media that cannot function appropriately in graphics.

Seven lecturers, who are experts in evaluation, provided theoretical validation for the assessment.

This validation involves 20 statements covering three aspects: evaluation purposes, function, and principle. The results of the theoretical validation by evaluation experts indicate an average score of 80.86%, meeting the criteria for a very good rating.

The score reveals that the developed pre-learning evaluation test software meets the criteria in terms of evaluation. With this information, the test software can be deemed feasible, earning a very good categorization in evaluation. Detailed scores for each aspect are presented in the following theoretical validation graph.

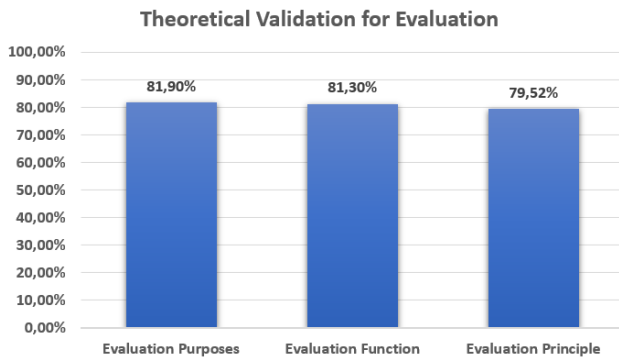


Figure 8. Theoretical validation for evaluation

The above chart illustrates that, concerning the "evaluation purposes" aspect, the developed pre-learning evaluation test software exhibits excellent criteria, achieving an average score of 81.90. Similarly, the evaluation function aspect of the pre-learning evaluation test software attains the same high standards with a score of 81.30%. As for the evaluation principle aspect, the software scores 79.52%, meeting the criteria for a good rating.

Experts provided feedback to enhance the quality of the developed pre-learning evaluation test software, leading to some revisions based on their insights. These modifications were minor and did not entail a complete overhaul of the software, similar to the adjustments made for media validation. In the evaluation function aspect, specific revisions were implemented to enable the presentation of student test results reports, facilitating teacher downloads.

3.4. Implementation

Research products that have gone through the media expert validation and evaluation stage will be revised according to expert input. Revisions to the research products carried out will produce software tests for pre-learning evaluation that are worth testing. At this stage, the test software for pre-learning evaluation that has been developed was tested on 83 teachers.

All teachers were given instructions on how to use the test software for pre-learning evaluation that had been developed. After that, they tried to use the test software for pre-learning evaluation that had been created. After operating the test software for pre-learning evaluation, all teachers were asked to fill out the test software for pre-learning evaluation trial questionnaire that had been developed.

The questionnaire distributed to teachers consisted of 20 statements divided into three aspects: evaluation, language, and presentation. The trial results gave an average score of 80.13% with very good criteria. The score provides information that the test software for pre-learning evaluation that has been developed is very well received by some teachers. Based on this information, the test software for pre-learning evaluation that has been developed can be declared suitable for use with a very good category. The scores for each aspect are shown in the following graph.

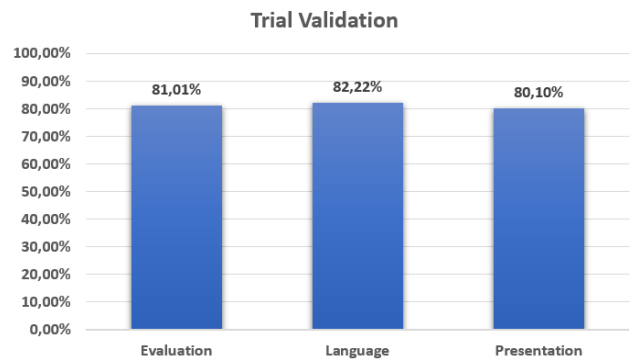


Figure 9. Trial validation

The graph above shows that all aspects have the same criteria, which is very good. The average score for the evaluation aspect was 81.01%, the language aspect was 82.22%, and the presentation aspect was 80.10%.

In addition, at this stage, interviews were also conducted with some teachers to determine the function of the software test for pre-learning evaluation in optimizing differentiated learning. The interview results showed that the learning design recommendations given at the end of the trial were beneficial for teachers in preparing the learning process in the classroom. The teacher's satisfaction with the learning design recommendations provided through the software test that has been developed is as follows.

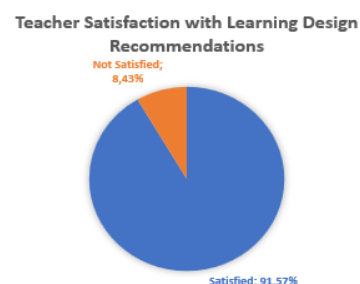


Figure 10. Teacher satisfaction with learning design

The interview results showed that 91.57% of teachers were satisfied with the learning design recommendations that should be used for each student. This is supported by their statement that each student's learning design recommendations will be able to optimize the learning process in the classroom. The remaining 8.43% were not dissatisfied but less satisfied. This is because new test software can recommend learning designs only. They stated that it is also necessary to recommend learning media for each student. This is input for further research.

The interview results also showed that teachers were better prepared for making lesson plans before starting the learning process. Additionally, test software for pre-learning evaluation also helps teachers categorize students with their respective abilities. This indicates that test software for pre-learning evaluation has supported optimizing differentiated learning in the classroom.

3.5. Evaluation

The evaluation process has been carried out at each previous stage. The evaluation results at each earlier step are considered in the next stage.

At the analysis stage, evaluation shows that assessment tools are needed for initial evaluation in software supporting differentiated learning achievement in the classroom. At the design stage, the evaluation shows that the blueprint and storyboard of the research product to be developed have been made. At the development stage, test software for pre-learning evaluation has been successfully produced with very good criteria in terms of media and evaluation. At the implementation stage, the software test for pre-learning evaluation showed acceptance by some teachers with very good criteria.

4. Discussion

The flexibility of test software in optimizing differentiated learning is a tangible manifestation of the flexibility of the technology used. Through the flexibility of this technology, users will become more likely to take advantage of the technology [35], [36], [37]. In addition, the more satisfying a technology developed, the more users will enjoy the learning process, undoubtedly affecting overall academic performance in a better direction [38], [39], [40].

Nowadays, teachers and students tend to try new things using technology. Thus, they will be more comfortable when using technology than using manual techniques [41]. However, some factors can discourage a person from using technology, including insecurity and discomfort [43], [44].

The more insecure and uncomfortable a technology is, the more likely users will avoid adopting or even avoiding it [45], [46]. Explorer-type users constitute the largest segment in terms of optimism to view a new technology positively [47].

Another influencing factor is the motivational factor, which significantly influences the contribution to technology [48]. Users with high motivators tend to be ready to use technology, especially for continuous use [49], [50], [18], [19]. Skeptical users generally have both positive and negative views of the presence of technology [20], [21].

However, research products in the form of test software for pre-learning evaluation tend to be preferred by its users. Most teachers respond positively through the implementation process carried out and discussed in the previous subsection.

The results of interviews and questionnaires discussed in the previous sub-section show that teachers have an excellent acceptance of the research products that have been developed. In addition, the teachers expressed satisfaction and were helped by the research products that had been designed. Through this technology, they can optimize the differentiated learning process. This is information that the developed research products are comfortable for use by its users.

Most students and teachers responded to using the research product test software for pre-learning evaluation, especially with the demands of the curriculum and the development of today's times. Higher technological readiness will enable users to use technology in everyday life [22], [42]. When the technology is good quality, users will always adopt it.

Based on the evaluation results at each previous stage, research products in the form of test software for pre-learning evaluation have been successfully developed. The test software for pre-learning evaluation has been produced and has excellent quality in media and evaluation. In addition, test software for pre-learning evaluation also has outstanding acceptance among teachers. Test software for pre-learning evaluation has also been proven to optimize differentiated learning in the classroom.

5. Conclusion

Differentiated learning is one of the successful learning processes in the classroom. Through this learning, each student can gain knowledge according to their characteristics. Through test software for pre-learning evaluation that has been developed, differentiated learning becomes more optimal.

This is because test software for pre-learning evaluation recommends appropriate learning designs for each student. As a result, differentiated learning can be more realized.

Based on the research results and discussion, this study concludes that the test software has been successfully developed with outstanding criteria. The test software is used for pre-learning evaluation. Teachers will also receive recommendations for each student's learning design through this software test. So, through this software test, the implementation of differentiated learning is more optimal.

Although this research has produced test software for pre-learning evaluation to optimize differentiated learning, the study can still be redeveloped. It is recommended to develop a question bank for pre-learning evaluation which can then be integrated with the test software. This integration would enable functionality like randomized question selection.

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