Development of Excel-Based Learning Media to Improve Understanding Statistical Concepts

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Article Info	Abstract
	This study is development research that aims to produce products in the form of Excel-based learning media that are valid, practical, and effective. The validation results of three experts indicate that the product is included in the valid and feasible category to be applied in learning. Furthermore, the results of a limited trial of several teachers and students stated that the product developed was efficient. Extensive tests followed them on research samples selected by purposive sampling with a pretest-posttest control group design. Descriptively it is known that the average final concept understanding ability of students who use Excel-based learning media is 12.95, which is greater than the average absolute concept understanding ability of students who do not use Excel-based media 9.95. Then, the inference test was carried out on the post-test results using the T-test. The value of Sig. (2-tailed) = 0.00 < 0.05, which means that H_0 is rejected and H_1 is accepted, namely, the average understanding of the population concept using Excel-based learning media is higher than the moderate understanding of the population concept that does not use Excel-based learning media. Judging from the results of the three tests, it can be concluded that the product developed is proven to be valid, practical, and effective for improving students' understanding of mathematical concepts in statistical material.

INTRODUCTION

In the current global era, humans will always be in touch with technology in every aspect of their daily lives at home, at work, and in education. This very rapidly developing technology, according to Alvin Toffler in Munir [1], is a revolution that takes place in three waves, namely, the first wave with the emergence of technology in agriculture, the second wave of the emergence of industrial technology, and the third wave of the emergence of information technology that encourages the growth of communication. The third development has succeeded dominate and influencing life humans in the world. So if we "STOP" technology, we could be left behind in getting an opportunity forward.

Development of such technology fast should too be quickly responded to quickly by the teachers as the front line in education [2]. In essence, technology is a tool to get added value in producing valuable products. Therefore lessons in the classroom should adopt technology as a medium or device to simplify and accelerate the learning process to achieve learning objectives optimally. Learning media is a tool help convey order and makes it easy to know something [3]. The teacher's role here is crucial in managing source existing power and various type of technology

developing around life daily for becoming a base in learning media development. As Intisari [4] put forward, the teacher should have the creativity to innovate in learning. Learning must be designed so that students feel happy and comfortable studying. Students need a tool or media to visualize the medium material studied. The learning process is more optimal, and required source learning is a learning medium that can make it easy for students to understand concepts learned. Learning media that utilizes technology computers could make learning mathematics easier and more enjoyable. Research by Apriandi [5] concludes that learning ICT-based media can make it easy for students to understand the material and improve positive attitude in the following learning. Cradler [6] states that computers could help convey Theory learning by demanding curriculum and changing learning-centered traditional from teacher to students. Furthermore, according to McCoy [7], learning helps computers have several advantages over others:

1. Could increase performance study student in the conceptual area so that they more steady in understanding something draft specific, including Skills manipulate and calculate.
2. It could increase learning effectiveness when Things are applied as part of a learning process. Learning help computer is something activity students to apply for the learning program. Learning process this could walk effectively if they work in group small.
3. Various vary accordingly to the characteristics of students in different groups students. Learning media mathematics based on computers like graphics and animation Wake up, wake up geometry could increase understanding of draft math.

Related to technology computer utilization in field education mathematics, [8] states that technology electronics, such as calculators and computers, something essential for helping learning and activities math. Computer media is beneficial to students in To do calculation routines fast and accurately, catching images of idea mathematics, and facilitating students in organizing and analyzing data. Besides that, [8] also states that the computer is one of the most potential media for increasing quality education in mathematics because, through a computer, the student can check representational formats that can be visually observed directly so that students with easy formulate and explore conjectures math. Dunham and Dick [9] state that using computer technology can help students study mathematics more meaningful and profound.

Several kinds of research concerning using technology computers in learning mathematics have produced several recommendations:

1. Computers as tools help learning media and have advantages in presenting graphics and pictures as form visualization that can observe students in actualizing mathematical concepts and models. Learning model this proven could increase quality learning [10]; [11]; [12].
2. Using math computers in Japan has proven to increase learning effectiveness because computers could help visualize geometry and operations numbers with fast and accurate accuracy in several problem mathematics [13]; [14].
3. Learning based on the computer has several advantages, including time to study more effectively. In general, score test students who learn to use tools help computers taller than students looking without a laptop. The student has an attitude positive toward learning based on a computer (James Kulik in Schacter [15]).

Studies show that learning mathematics with the help computer is already a lot done in some developed countries like America and Japan; however thing this is not yet many carried out in

Indonesia. by general, the usage of computers as tool help in the learning process in Indonesia such as application like Microsoft Word, Microsoft Excel is still rarely done. Anyone who has used it is still limited for word processing or numbers, even though learning mathematics moment this expected have power pull certain for students so that they no afraid to math.

Here the role of the teacher is very much needed for designing learning utilizing all types of existing technology media by characteristics of math theory. Roestiyah [16] says that a teacher must know the nature typical of each learning media, which is essential for mastery of every technique presentation so that teachers can learn, understand and be professional and use it accordingly. In learning mathematics, many technology media can be used. One is technology data processing in the form of Microsoft Excel itself. Applications like feature calculation and creating graphics make Microsoft Excel one of the popular computer programs used in computer micro [17].

Characteristics Microsoft Excel this, of course, very suitable with characteristics of the material statistics, which is one Theory tree in learning mathematics high school level. The one important thing to do is to give students at the start from middle school, high school, up to college high. Destination learning statistics emphasize understanding concept and reasoning statistics [18]; [19]; [20]; [21]. Understanding the good concept will make the student understand statistics with good. This thing by destination learning statistics that is students could understand statistics with good to get information from existing data, criticize and make a decision based on information the as well as develop skills for study [22]. In Theory, statistics, participants educated sued for could present statistical data in the form of tables or diagrams. Besides, participant students are also required to interpret tables or diagrams in everyday language. Following is the Theory of statistics studied by students in class XII SMA: a) the use of statistics in life every day; b) data collection; c) processing and presenting data in line chart shape, bar, or circle.

However, the facts on the ground obtained through a survey using Shared Google Forms to fellow mathematics teachers in several areas show that: First, material statistics this still significantly less liked and considered difficult for students because, in Theory, the majority of students are bored for the count, so a lot of data is presented, and often from they To make a calculation error. Second, most of the teachers carry out learning for material statistics. This still tends to be conventional, not yet technology to make it easy to understand, so teachers provide examples of data processing using manual methods that spend time.

Figure 1 Percentage of Tool Use in Statistics Learning

Third, completeness results learn on the material statistics this not yet, so max. It showed from the results survey that 58.8% of teachers stated that completeness in discovering statistics is still below 50%, and as many as 17% of teachers said they completed between 50%-75%, and only as much as 23% of the teachers stated complete above 75%.
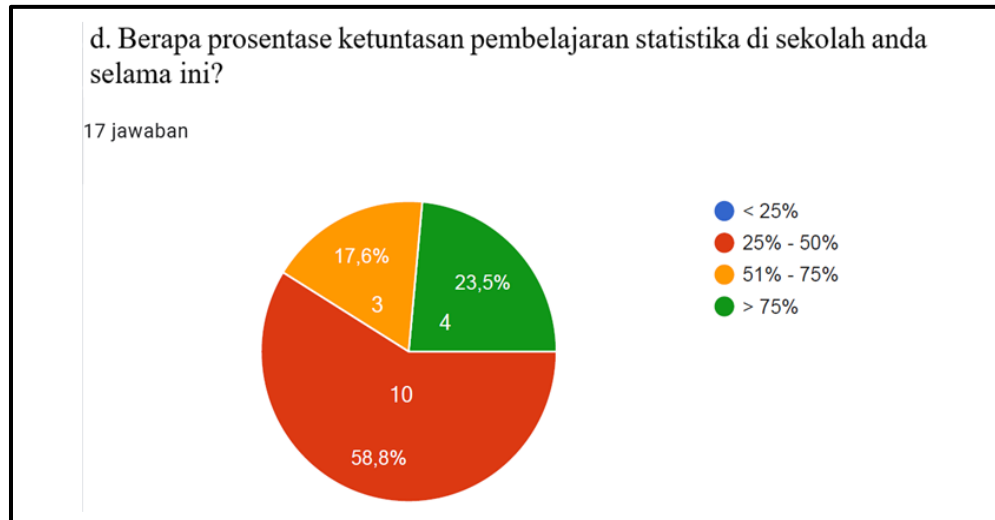

Figure 2 Percentage of Statistics Learning Completeness

Of the 17 respondents who teach statistics, only three have used the help or tool in learning statistics. Of the three teachers who use the device in statistics learning, it has not been seen that any teacher uses Microsoft Excel.
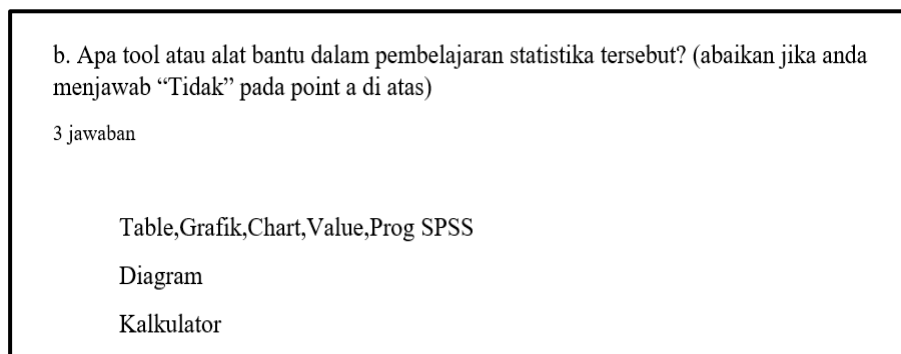

Figure 3 Statistical Learning Media used by Respondents

If we look at the efficiency of the learning carried out, it can be seen in the diagram in Figure 1.4 that the most significant percentage of learning time allocation is 4 × 4 lesson hours, which means the teacher uses 16 hours of lessons to study this statistical material.
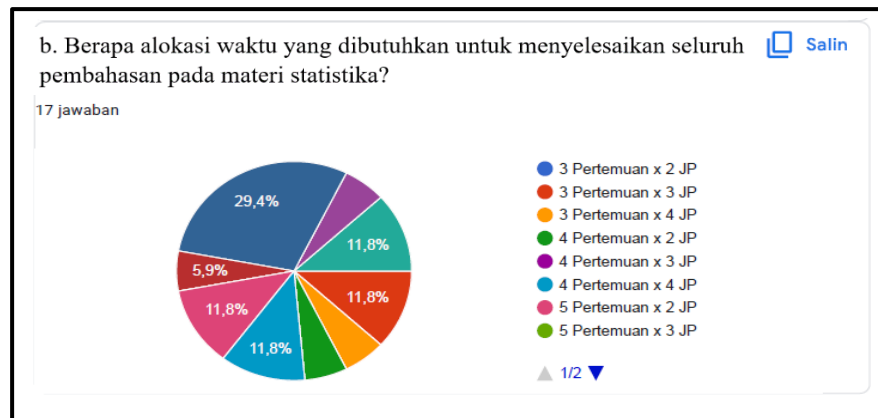
Figure 4 Time Allocation for Statistics Learning

Furthermore, the results of direct observations made at SMA Ma'arif 1 Central Lampung on September 29, 2021, showed that the learning was still using conventional media. The teacher explained the material in front of the class based on what was written in the mathematics textbook. The teacher conducts questions and answers with students, but the activity occurs passively. Students tend to be confused about what to ask even though they do not understand the delivered material. The interviews with mathematics teachers here also show that the learning carried out is still not optimal in terms of understanding students' concepts in statistical material. From the results of the interview, it was found that the biggest obstacle for teachers not being able to convey statistical ideas ultimately was the lack of time in learning because most of the lesson hours were used to perform arithmetic operations both in terms of giving examples by the teacher and in student training. Likewise, students' problem when studying statistics is the amount of data that must be calculated with very high accuracy and precision. Sometimes students are tired before they can complete the calculations, so the final result is not quite right. Here the teacher also admits that the statistics learning that has been carried out so far has never reached maximum completeness. Most students find it difficult when given statistical test questions because they do not understand the concept well while the time allocation for delivering this statistics lesson has been completed. The teacher must immediately enter the discussion of other materials so that the curriculum demands can be met.

The preliminary research results above show that conventional statistics learning has not achieved total mastery through surveys and direct observations. This fact is in line with the statement by Martiningsih [23] that the factor of low knowledge quality is that various learning resources have not been utilized optimally by teachers and students.

Microsoft Excel Technology is a tool in statistical learning so that students gain a good understanding of concepts and can apply them directly. With the utilization of Microsoft Excel in lesson stats, expected students can more readily accept Theory lesson statistics than the teacher can too easily convey existing material. The learning process will be more straightforward for achievement and is also expected to increase performance study. The utilization of Microsoft Excel is also an exciting attention student for examination. Information teacher explanations, descriptions that the teacher must deliver, and the knowledge that must be presented by the teacher collected in Microsoft Excel. Likewise, the teacher could also reduce activities, explain lessons, and have more time to guide students in their studies [24]. Because of that, see the above analysis, the

researcher tried to develop a tool to help to learn in the form of learning media based on Microsoft Excel. Hopefully, by using Microsoft Excel in lesson statistics, participants will more readily accept Theory lesson statistics so that the teacher can more easily convey existing material. The learning process will be more efficient and increase performance study because participants understand good concepts.

METHOD

Study this use method research and development or research and development (R&D) with the following procedure from Borg and Gall. According to [25], the steps carried out in study development are research, information collecting, planning, development design product initial, trial field, primary product revision, and main filed testing.

In the research process, this used design study Pretest-Posttest Control Group Design.

Table 1. Pretest-Posttest Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Information:
O_1, O_3 : Pretest Results of Students' Concept Understanding
X   : Learning with Excel-based Media
O_2, O_4 : Posttest Results of Students' Concept Understanding

Using this design, the experimental and control groups were given the same pretest to determine their initial ability to understand mathematical concepts in statistical material. Then the experimental group was assigned special treatment, namely learning using excel -based media, while the control class was given learning using conventional media. After being treated, both groups were given the same test again as a final test (post-test) to measure the absolute ability to understand mathematical concepts.

In the process of developing Excel-based learning media, validation was carried out by experts and learning practitioners, namely Dr. Sugeng Sutiarso, M.Pd, FKIP lecturer at the University of Lampung, Ms. Wiwin Rita Sari, M.Pd, a statistics lecturer at Nahdlatul Ulama University in Lampung, and Ms. Rosy Mavita Sari, M.Pd, a senior mathematics teacher at Ma'arif High School. 1 Central Lampung.

The subjects in this study consisted of the subject of preliminary research and product development trials. The topics in this preliminary study included respondents from a statistical learning survey by 21 teachers from several regions and the subject of class observations and interviews, namely a mathematics teacher, Mrs. Windi Anjani, S.Pd, and students of class XII IPA 1. At the same time, the issues of the research product trial were mathematics teachers and students of class XII IPA 1 and XII IPA 2 at SMA Ma'arif 1 Central Lampung.

RESULTS AND DISCUSSION
Results

At this stage, the results will be discussed development product reviewed from several aspects: aspect validity, aspect practicality, and aspects effectiveness.

1. Product Development Results

Developed Products in a study in the form of presentation media for teachers and LKPD media for participant education, built using Microsoft Excel. The process of programming and automation function in learning media use Visual Basic Excel features. Utilization This Visual Basic Excel feature aims that the application develop:

1. Has small size, so light for operated
2. Compatible with all Office Version
3. Safe from damage caused by error use

The image below this is part Macro VBA Excel script process view

```vba
Sub TblBuatTabelDistKelompok()
    If Sheets("Kelompok").Range("CD11").Value = 0 Then
        MsgBox "Silahkan dilengkapi dahulu data yang dibutuhkan...", vbCritical
    ElseIf Sheets("Kelompok").Range("CC11").Value = 0 Then
        MsgBox "Maaf, Frekuensi belum sesuai, silahkan perbaiki terlebih dahulu.
    ElseIf Sheets("Kelompok").Range("CC11").Value = 1 Then
        Call BuatTabelDistFrekuensi
    End If
End Sub
Sub BuatTabelDistFrekuensi()
'buat judul tabel
    Range("B11:AC11").Select
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = False
    End With
    Selection.Merge
    ActiveCell.FormulaR1C1 = "TABEL DISTRIBUSI FREKUENSI DATA BERKELOMPOK"
    Range("B11:AC11").Select
    Selection.Font.Bold = True
    Selection.Font.Size = 14

'copy dari sumbernya ke target tabel
    Range("AK12:BL24").Select
    Selection.Copy
    Range("B13").Select
    ActiveSheet.Paste
```

Figure 5 Display Excel VBA Macro Script on Learning Media

The image above shows that the run macro script will form a table creation process and calculations according to the data entered in the yellow cell.

After learning media, this was made following an assessment by experts to see the validity of teaching media.

Table 5. Validator Assessment Score on Excel-based Media

Assessment Aspect	Validator 1		Validator 2		Validator 3		Average	
	Score	Note:	Score	Note:	Score	Note:	Score	Note:
Content and purpose	16	Valid	18	Very Valid	15	Valid	16.3	Valid
Instructional	6	Valid	6	Valid	5	Less Valid	5.6	Valid
Technical	53	Very Valid	55	Very Valid	44	Valid	50.6	Valid

The data presented above shows the average expert's assessment of learning media included in valid category each evaluation aspect.

2. Limited Field Trial Results

After obtaining valid data from this excel-based learning media, the next test was limited to 2 math teachers and 6 participants in class XII SMA Ma'arif 1 Central Lampung, taken randomly. Data retrieval in trials defined this use sheet teacher and participant feedback with 8 grains question. The results from teacher responses are presented in the table following:

Table 6. Recapitulation Teacher's Response

Respondent	Score each Aspect								Total Score	Category
	1	2	3	4	5	6	7	8		
G.1	4	4	4	4	4	3	4	4	31	Very Practical
G.2	4	3	4	4	4	4	4	3	30	Very Practical
Average	4	3.5	4	4	4	3.5	4	3.5	30.5	Very Practical

Whereas results responses from participants educate presented in the table following:

Table 7. Recapitulation Response Learners

Respondent	Score each Aspect								Total Score	Category
	1	2	3	4	5	6	7	8		
S.1	3	4	4	4	4	3	4	4	30	Very Practical
S.2	4	4	4	3	3	4	4	3	29	Very Practical
S.3	3	4	4	4	4	4	4	4	31	Very Practical
S.4	4	4	4	4	4	4	4	4	32	Very Practical
S.5	3	4	4	3	3	3	4	4	28	Very Practical
S.6	4	4	4	4	4	4	4	3	31	Very Practical
Average	3.5	4	4	3.7	3.7	3.7	4	3.7	30,17	Very Practical

The data presented in Tables 6 and 7 show that teachers and students assess the learning media based on Excel. This is classified as very practical.

3. Extensive Field Trial Results

Trial field main held for knowing Effectiveness of Learning Media Excel based on understanding draft participant learn on the material statistics. There are three activities in the trial field: pretest activities for seeing the ability to understand draft beginning participant education, ongoing training learning for three meetings, and activities post-test for visiting ability end participant educate after learning with developed media.

The pretest results showed no significant difference between the average initial ability to understand the concepts of the experimental and control classes. This can be seen in the following table:

Table 7. Pretest Results

Class	Many Participants	Lowest Score	Highest Score	Average
Experiment	20	1	8	4.65
Control	20	1	7	4.4

The next stage in this broad field trial is learning, carried out in 3 meetings with the experimental class using excel-based learning media and the control class using conventional learning media. After that, a post-test was carried out to see the final ability of students' conceptual understanding, and the following results were obtained:

Table 8. Posttest Results

Class	Many Participants	Lowest Score	Highest Score	Average
Experiment	20	10	15	12.95
Control	20	7	12	9.95

The results of the post-test above indicate that descriptively it is known that the average understanding of students in the experimental class is higher than the intermediate understanding of the concepts of students in the control class. Furthermore, an inference test is carried out on

the post-test to see whether the high average concept understanding of students who use excel-based learning media is significant to the population. The post-test results showed that the data were normally distributed and homogeneous so that in testing the significance of the hypothesis, the average understanding of students' concepts used the t-test. From the t-test on the post-test results, a significance value of 0.00 <0.05 was obtained, which means that there is a significant difference between the average final ability of students' conceptual understanding using excel-based learning media and the average absolute ability of students' conceptual understanding—using conventional media.

Table 9. T-Test Results on Posttest Data

Learning	t_{count}	t_{table}	df	Sig.	description
Experiment					
Control	7, 505	2.024	38	0.0 00	Sig. <0.05

Discussion

Excel-based Learning Media Validity

Excel-based Learning Media is declared valid in terms of a series of processes related to one another, from the planning, and development, to expert assessment of this media. First is the planning stage for learning media development. Researchers have analyzed the learning objectives by referring to the essential competencies that have been prepared by the government according to the Minister of Education and Culture Number 27 of 2020 in the 2013 curriculum on statistics material so that the media developed is by the statistics learning needs at the Senior High School.

Second, at the development stage, the researcher pays attention to several aspects needed to get a valid learning media as proposed by Walker & Hess [26], namely elements of the quality of content and objectives, aspects of instructional quality, and aspects of technical quality. In the part of the quality of content and purposes. The researcher pays attention to the clarity of the material and the suitability of the questions with the material listed in the media. In the aspect of instructional quality, researchers made this Learning medium provide convenience in learning and motivate students who use it. And finally, on the technical quality aspect, the researcher tries to make this Learning Media application as easy as possible, design a simple and beautiful interface, and use language that is easy to understand for users.

Third, the researcher formulates the assessment instrument according to the media development aspect used to develop Excel-based Learning Media as described above. Then by using the tool, the validator states "good" or "very good" regarding the components of the Learning Media that have been prepared according to the indicators/descriptors. In terms of feasibility, the validators also gave an assessment that this Learning Media was suitable for use with revisions, comments, and suggestions from these validators, which researchers then used to refine this Learning Media further so that a Learning Media was obtained that was genuinely valid and feasible to use.

The Practicality of Excel-based Learning Media

Excel-based Learning Media is stated to be practical in terms of several factors. First, in general, the responses of teachers and students in the limited trial noted that the Learning Media was applicable/very practical for each question item in the response questionnaire.

Second, this Learning Media is made using Microsoft Excel and arranged according to the order of material and practical and complete learning needs, including the presentation of material features, examples, and exercises parts that can be generated data and are also equipped with a feature to verify the answers provided. Input into the application. As Arsyad [27] states, Microsoft Excel helps convey or deliver statistical learning messages to make them more effective and efficient.

Third, in terms of the efficiency of the teaching and learning process and the interaction between teachers and students, it shows that the learning process in the classroom occurs more interactively and actively, and teachers can more efficiently use their time to direct students to understand each concept in statistical material, and for students to learn to use statistics. This Excel-based Learning Media is more fun and interesting to learn more deeply. This is in line with the results of research [28], which states that knowing by using Microsoft Excel makes students more interested in learning, and the evaluation results at the end of the lesson also show good grades. The results of the study [29] also show that one of the advantages of the Microsoft Excel computer-assisted learning process is that it can make it easier for teachers to teach the material to their students in the classroom, besides that students can also be more enthusiastic about learning with Microsoft Excel as a media aid for learning. These Excel functions will help direct and maximize the teaching and learning process. Furthermore, [30] said that Microsoft Excel could convey and distribute messages from sources in a planned manner to create a conducive learning environment where the recipient can carry out the learning process efficiently and effectively.

Excel-based Learning Media

Excel-based Learning Media effectively increases conceptual understanding of statistical material regarding several factors. First, testing the inferential hypothesis in this study through a T-test on the final score of students' conceptual understanding shows that the average absolute ability to understand population concepts using Excel-based Learning Media on statistical material is higher than the average last ability to understand population concepts used. They are using conventional media. The conclusion of this hypothesis test means that this Excel-based Learning Media is proven to be statistically effective in increasing students' conceptual understanding of high school-level statistical material. The results of this study are also supported by research that has been carried out [31], which states that using Ms. Excel in learning can improve students' thinking patterns, help students solve mathematical problems, and improve student achievement.

Second, the characteristics of the software Microsoft Excel is by the features of the statistical material, so using Microsoft Excel in statistics learning will undoubtedly make it easier to convey messages and theories in the statistical material itself. Martiningsih (2015) states that Microsoft Excel in statistical learning is useful as a learning resource, reference, object, and material used for learning activities. This is also to research conducted Anggri [32], which states that Excel software-assisted learning is an effective alternative to improve learning outcomes in statistical material. Chaerani [33] says that Microsoft Excel in statistics has a critical position in learning, namely as a representation of the teacher's explanation in front of the class, the results of this study also show an increase in understanding and depth in problem-solving.

Third, the development of Microsoft Excel-based Learning Media is a manifestation of integrating information technology in learning mathematics. Several studies on the effectiveness of the use of information technology, especially Microsoft Excel, show a positive impact on learning

mathematics. As research Oktaviani [34] on the use of Excel VBA media in mathematics learning showed positive results, students' learning motivation was strong, and the use of Excel VBA media made it easier for students to understand math material. Previous research has also been conducted by [35], which stated that computer-based learning media with Microsoft Excel for class X SMA impacts students' achievement and motivation to learn mathematics. Furthermore, the research conducted by Suweken and Analyst (2008) [28] using Microsoft Excel as a Learning medium showed positive results, namely increasing students' motivation and understanding of mathematical concepts.

CONCLUSIONS AND SUGGESTIONS

It was concluded that the developed product in the Excel-based statistical learning media is a valid criterion in expert assessments. Practical measures in teacher and student responses resulted during limited trials. They proved effective for improving The ability to understand the concepts of students in statistical material at the high school level in terms of post-test results, which descriptively shows that the average power to understand concepts in statistical material for students who use excel-based learning media is much higher than understanding concepts of students who use excel-based learning media. Using conventional media, and in general, through the inferential test, showed that the difference was also significant to the population.

From the results of this study, the next researcher gave suggestions to teachers to be able to use Excel-based Statistics Learning Media products as an alternative to improve students' understanding of mathematical concepts for high school level statistics material. However, because the material contained in the Excel-based Learning Media that was developed is only statistical material for high school, it is recommended that readers or other researchers who want to develop further research on Excel-based Learning Media of Statistics should create a different scope of material, at the education unit level. Different skills or other abilities that students must have in learning mathematics.

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