



## DYNAMIC SOFTWARE BASED MATHEMATICS REVIEW LESSON DESIGN: TAKE A BASIC THEOREM OF VECTOR PLANE AS AN EXAMPLE

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### ABSTRACT

Reviewing lessons as a very important form of learning and very important role to impress students. The research method was adopted the ADDIE model design. This research was done at Balihan Senior High School, China. The population of this research are 43 students and using random sampling to selected a representative 5 students. The student statement result show that, a using Hawgent dynamic in the review lesson can improve student learning performance, very useful in the learning process and etc with statement average is 80.4% or good category. Based on validation results of the 3 aspects obtained an average percentage of 81.33% in a good category. Therefore, the review lesson of basic theorem vector plane using Hawgent dynamic mathematics software can be applied to the teaching process and can using this dynamic software to the review lesson another mathematics topics.

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## DESAIN PENGAJARAN REVIEW MATEMATIKA BERBASIS DYNAMIC SOFTWARE: CONTOH PADA TEOREMA DASAR BIDANG VEKTOR

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### Kata Kunci:

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### ABSTRAK

Mengulas pelajaran sebagai bentuk pembelajaran yang sangat penting, merupakan peranan yang sangat penting untuk memberikan kesan kepada siswa. Metode penelitian yang digunakan dalam penelitian ini mengadopsi model ADDIE. Penelitian ini dilakukan di Balihan *Senior High School*, China. Populasi penelitian ini adalah 43 siswa yang kemudian diseleksi perwakilan 5 siswa dengan random sampling. Hasil pernyataan siswa menunjukkan bahwa, penggunaan Hawgent dynamic dalam pembelajaran review dapat meningkatkan prestasi belajar siswa, sangat berguna dalam proses pembelajaran dan lain-lain dengan rata-rata pernyataan 80,4% atau kategori baik. Berdasarkan hasil validasi dari beberapa aspek diperoleh persentase rata-rata sebesar 81,33% dalam kategori baik. Oleh karena itu, review pelajaran matematika dengan menggunakan Hawgent Dynamic mathematics software dapat diterapkan pada proses pembelajaran dan juga dapat digunakan untuk mereview pelajaran matematika pokok bahasan lainnya.

## 1. INTRODUCTION

With the continuous advancement of “Internet Plus” information technology, education has also undergone a series of educational reforms. How to use the innovative achievements of “Internet Plus” to help education is a question worthy of in-depth study. One of the basic teaching concepts proposed by “General High School Mathematics Curriculum Standards (2017 Edition)” [1], [2] is to “optimize the curriculum structure, highlight the main line, and select content”, and attach importance to the deep integration of information technology and mathematics curriculum teaching to improve The effectiveness of teaching cultivates students’ core literacy in mathematics[3], [4].

Reviewing lessons as a very important form of learning[5]–[7], is a very important role to impress students, to use knowledge in solving problems, and to review learning patterns so that they are respected and developed. Based on the above-mentioned context, the authors initiated an in-depth study of the third level review. [8]–[10]A mathematics review lesson and a grunt are two different concepts, which are mainly demonstrated in the review of lessons related to specific mathematics content, which strengthens and clears further knowledge, and by providing explanations of the questions studied as a guide, deepens students’ understanding and mastery of the subject. Points of knowledge that have been learned, as well as reaching methods for consolidating knowledge and developing capacities. The lesson learned is the main goal, usually without any specific material limitations. Therefore, the mathematics review lesson in the grade 12 should be designed as a whole and carried out in stages to make the class more effective, based on specific features.

The current review lessons for senior high school grade 12 students[6], [7], [11], [12] mainly have the following problems: first, the teaching mode is single. The current review lessons for grade 12 students mainly focus on intensive teaching and more practice. Teachers do not have effective teaching strategies and teaching tools to guide them, and monotonous method repetition leads to high intensity but low efficiency review results. Second, there is a lack of evaluation system. Under the pressure of college entrance examination system and admission, school education usually adopts summative evaluation, which inspects students’ review degree through their homework and chapter tests, which is biased to the development of students’ core literacy[13]–[15]. This method is essential for the development of students’ core literacy. Therefore, this research takes the first lesson of the basic theorem of vectors plane as an example, introduces review lesson using Hawgent dynamic mathematics technology, enriches the teaching model, perfects the evaluation system, and improves the learning motivation of the grade 12 students in the mathematics review lesson[16].

Hawgent dynamic teaching software, as an emerging technology teaching media, it has the following functions such as to create geometric dynamic mapping, drawing the corresponding point, line, plane and other common mathematical models by drawing tools[17], [18]; Dynamic measurement and calculation, can automatically measure Angle, length, radian; Intelligent formula text, you can set up tables, graphics and text, to achieve the effect of combination of numbers and shapes[19]–[22]. Presenting static mathematical knowledge in dynamic form can effectively improve the efficiency of teachers’ “teaching” and help teachers develop comprehensively under the background of educational reform. At the same time, it can also promote students’ understanding of knowledge, and cultivate students’ mathematical abstract quality and intuitive imagination quality[23]–[25].

Based on the results of the previous research above, conclude that the review of mathematics lessons is very important for elementary student, middle and high school students. Because lesson reviews can help and improve student understanding and student achievement, but the majority teachers still only use traditional methods which often bored students in the teaching and learning process. Related to this, many previous research results show that dynamic mathematics software can help students' understanding, students' interest in learning and also improve student achievement. Thus, in this study, researchers were motivated to try to design integrable ware[26]–[28] as a new learning model with the aim of integrate into mathematics learning in order to assist teachers in reviewing mathematics lessons on basic theorem vector plane and other mathematics sub-topic. The difference between this study and previous research is that there have been no previous researchers who have integrated Hawgent dynamic mathematics software into the review of mathematics lessons. Thus, the problem in this research is, are a lesson review of the basic theorem vector plane using Hawgent dynamic mathematics software can help students understanding and improve student achievement?

**2. METHOD**

This research adopted the ADDIE model design[29]–[31]. ADDIE model is a training model developed by the Teaching Technology Research Center of Florida State University. It includes three aspects: what to learn (the formulation of learning objectives), how to learn (the application of learning strategies) and how to judge the learning effect that learners have achieved (the implementation of learning evaluation). ADDIE model mainly includes five stages: analysis, design, development, implementation and evaluation. Since its development and design, ADDIE model has been used by many scholars and played a good role in curriculum teaching reform. In this paper, the author in view of the practical problems existing in the three recitation, use of ADDIE teaching design model to explore the review class curriculum teaching reform train of thought, to “the basic theorem of plane vector” lesson, as an example. Figure 1 shows the research design of ADDIE model that authors used in this paper.

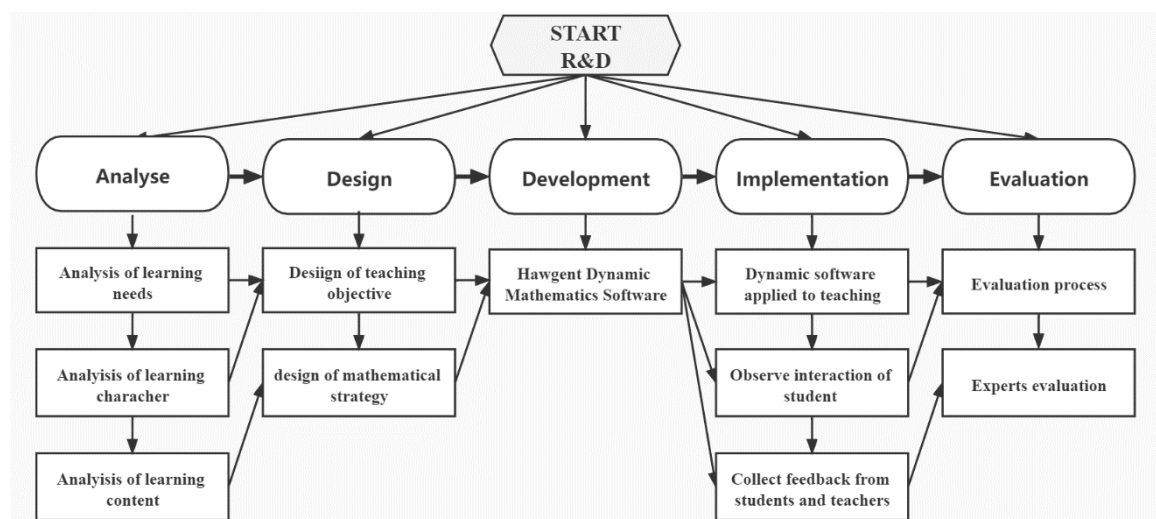


Figure 1. ADDIE Research and Development Framework [31], [32]

**2.1 Analyse**

Analysis of the teaching content is the first step of research review lesson. Analysis is the basis of clear teaching goal, is the precondition of teaching design. First of all, teachers should start from the three aspects of learning needs, characteristics of learners

and learning content, understand learning situation and analyze teaching content on the whole, and truly achieve macro control. Secondly, it is necessary to analyze the previous review micro-class research in order to achieve the purpose of improvement and innovation.

**2.2 Design**

In the design steps, first of all, based on the teacher’s combing, analysis, arrangement and layout of the curriculum, the teaching objectives and teaching strategies are determined. The teaching strategies include determining the teaching sequence, selecting the teaching method, and determining the learning method. Then, the framework of the review lesson of the “Basic Theorem of Plane Vectors” is initially constructed, and in the actual teaching process, the teaching steps are continuously considered, and the teaching process is improved and adjusted in time.

**2.3 Development**

The “re-construction of learning materials and rebirth of learning methods” proposed by li Yu-nan, a special-grade teacher, points out the direction of how to develop teaching design. Because it is a review course, it is more necessary to do a good job in the teaching design of each link, so that the review course has the consolidation, innovation and value, rather than method, boring repetition. In the development of this link, the author designs the dynamic mathematics integrals and micro lessons of plane vector in Hawgent dynamic mathematics software to assist students to review and consolidate the knowledge of plane vector.

**2.4 Implementation**

In the implementation stage, the researchers applied lesson review about a basic theorem of vector plane using Hawgent dynamic mathematics and observed the interaction of students and collected the feedback from students and teachers.

**2.5 Evaluation**

In the evaluation stage, the formative evaluation or summative evaluation is carried out on the teaching media and implementation process to verify whether the design and implementation of the curriculum meet expectations, and corresponding modifications, adjustments and improvements are made according to the analysis of the evaluation results. The evaluation criteria show in table 1.

**Table 1.** Evaluation Criteria

Interval	Category
89%-100%	Very good
60%-88%	Good
41%-59%	Average
12%-40%	Poor
<12%	Very poor

**3. RESULTS AND DISCUSSION**

**3.1 Analyse**

Firstly, it analyzes the learning needs, learners’ characteristics and learning contents. First of all, the study needs analysis, the research object is senior three students, in order to consolidate the basic knowledge, make up for the missing knowledge for the purpose of research; The characteristics of learners are that senior three students enter the general

review stage and have learned all the high school mathematics content, but because of the long learning time, learners generally forget the phenomenon. The learning content is the basic theorem of plane vector. Plane vector plays a very important role in students' learning of two-dimensional space knowledge. Plane vector is not only applied to mathematics, but also plays a great role in physics learning.

Second, analyze the previous lesson review class micro research, beginning in 2011, with the continuous reform of education, for the requirement of increasing the teachers' teaching, more and more domestic experts and scholars devoted to the study of micro class, based on the CNKI Chinese Journal periodical database collection of literature, to document review lesson "micro" as the theme, It is found that there are a total of 23230 related literatures, and 674 related literatures are retrieved on the theme of "Mathematics micro-lesson". Then, there are only 28 related literatures when retrieved on the theme of "Mathematics micro-lesson". It can be seen that there are relatively few researches on mathematics micro-lesson. The use of micro-lesson as an auxiliary means in the traditional review class has not been well promoted. At the same time, the literature retrieval with "Hawgent" as the subject, only 21 relevant literature, so it can be seen that Hawgent application in mathematics teaching is relatively less, the use of Hawgent assisted mathematics review micro-class teaching research is relatively lacking.

### 3.2 Design

First, determine the teaching objective, the teaching objective of this course is to review and consolidate the basic theorem of plane vectors, solid basic knowledge. Second, determine the teaching strategy, teaching sequence is situational introduction, review old knowledge; Show examples, analysis of minimum knowledge points; Teachers explain and form diagrams; Summarize and summarize systematically. Teaching method Hawgent dynamic mathematics software was selected to make the moving product of plane vector and make a mathematics integrable ware, which was combined with the teacher's explanation. The learning method is mainly independent learning, supplemented by teacher's explanation, to stimulate students' cognitive motivation.

### 3.3 Development

Hawgent dynamic mathematics software basic theorem of plane vectors by prototype displayed in figure 2.

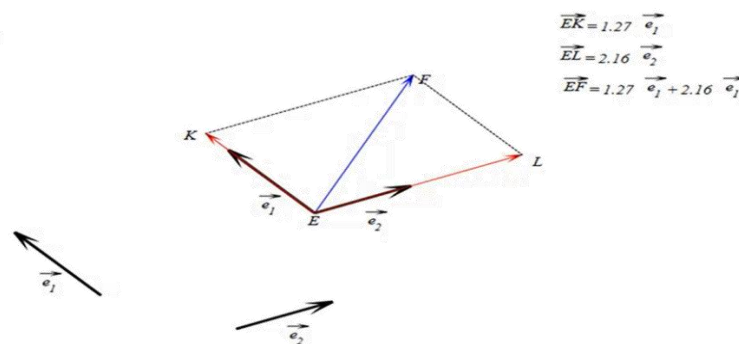


Figure 2. Integral ware Effect of Plane Vector Fundamental Theorem

#### 3.3.1 Creating of Basis Vectors

Choose "drawing tools" in the appropriate position on the page in turn constructed six points, A, B, C, D and E, F, then switch to A "selection tool", hold down the Ctrl key, and in turn the option A and B two points, click on the "drawing" | "drawing" | "vector"

constructed vector  $(\overrightarrow{AB})$ , and constructs the vector  $(\overrightarrow{CD})$  and any vector in turn. a good job in the teaching design of each link, so that the review course has the consolidation, innovation and value, rather than mechanical, boring repetition. In the development of this link, the author designs the dynamic mathematics integrals and micro lessons of plane vector in Hawgent dynamic mathematics software to assist students to review and consolidate the knowledge of plane vector.

### 3.3.2 Make the Basis Vectors $(\overrightarrow{AB})$ and $(\overrightarrow{CD})$ Starting Point with any Vector

Constructing vector  $(\overrightarrow{AB})$   $(\overrightarrow{CD})$  the translation vector: hold down the Ctrl key, and in turn the option A, E by “drawing” | “segment” connected, connect the CE with the same method; Click on the “structure” | “variable length variable t is constructed, click” ok “, hold down the Ctrl key, and in turn the option A, E by “drawing” | “parameters” constructed on the parameters of the variable t G points; Similarly, the parameter point H about variable t is constructed on line segment CE. Hold down the Ctrl key, in turn, the option B and AG direction, through the “structural” | “translation” times as the input translation number is 1, click ok to get an I point, hold down the Ctrl key, in turn, the option G, I through the “drawing” | “drawing” | “vector” connected, vector is a vector  $(\overrightarrow{GI})$   $(\overrightarrow{AB})$  on the AG direction translation vector. Similarly, construct the translation vector  $(\overrightarrow{CD})$  of vector  $(\overrightarrow{HJ})$  in the direction of CH.

### 3.3.3 Decompose any Vector $(\overrightarrow{EF})$ in the Basis Direction

First, draw auxiliary parallel lines. Hold down the Ctrl key and select point F and vector  $(\overrightarrow{GI})$ , click on the “drawing” | “drawing” | “parallel” represented by point F and the parallel lines parallel to the GI, hold down the Ctrl key, and in turn the option I and lead point F parallel lines, click on the “drawing” | “drawing” | “parallel” drawing I had point about G parallel lines, by the same token, the parallel to the vector drawing abroad point F  $(\overrightarrow{HJ})$  and the parallel line of the crossing point J with respect to G; Click and drag the variable ruler so that points G, H, and E coincide, thus commencing with any vector  $(\overrightarrow{EF})$ .

Next, draw the decomposition vectors of any vector  $(\overrightarrow{EF})$  in both basis directions. Hold down the Ctrl key, select a o F the parallel lines parallel to the HJ and vector GI parallel lines, click on the “drawing” | “intersection” point K. Get the decomposition vector of any vector  $(\overrightarrow{EF})$  in the direction of basis  $(\overrightarrow{AB})$ , and similarly get the decomposition vector of any vector in the direction of basis  $(\overrightarrow{CD})$ .

### 3.3.4 Beautifying a Interface

First of all, hide the guides, hold down the Ctrl key, select step 3 draw out four parallel lines and line AE, CE, click on the “design” | “hide” to hide. Second, change the line, hold down the Ctrl key, select point E and K, click on the “drawing” | “drawing” | “vector” connect the two, by the same token, the connection vector  $(\overrightarrow{EL})$ ; Hold down the Ctrl key, select the K, F two points, click on the “drawing” | “line connecting two points, the same will L, F two connected into line; Hold down the Ctrl key, select line KF, LF, click on the “design” | “linear” | “dotted line” will be selected two line segments linear to the dotted line.

Next, change the line width. Hold down the Ctrl key, select base vector  $(\overrightarrow{AB})$ ,  $(\overrightarrow{CD})$  and the translation into the opposite  $(\overrightarrow{GI})$ ,  $(\overrightarrow{HJ})$  click on the “design” | “line width” in “line is on the” text box input “1”, “increase of line width” instead of “2”. Finally, design colors.

Select any vector ( $\overrightarrow{EF}$ ), click on the “design” | “color” “blue” in the “set type” choice only check the “line drawing”, arbitrary vector ( $\overrightarrow{EF}$ ) color to blue, by the same token, the will ( $\overrightarrow{EK}, \overrightarrow{EL}$ ) the decomposition of vector color changed to red.

**3.3.5 Make Display Animations**

The effect of this step is when you’re starting point when base vector and arbitrary vector page shows any vector decomposition of vector, hold down the Ctrl key, select decomposition vector ( $\overrightarrow{EK}, \overrightarrow{EL}$ ), line KF, LF and two points K and L, click on the “design” | “dynamic transparency”, the “transparency” of the text box input signEx (t, 1).

**3.3.6 Measuring Correlation Length**

First of all, measure the length of the associated vector selected vector ( $\overrightarrow{AB}$ ), click on the “structure” | “length”, measured its length; similarly, measure the length of the vector ( $\overrightarrow{CD}, \overrightarrow{EK}, \overrightarrow{EL}, \overrightarrow{EF}$ )

**3.3.7 Structural Correspondence**

First of all, To obtain the corresponding length ratio, switch to “Editing Tool”, right-click the length of AB, double-click “01- General” in the pop-up property dialog box, and check that the corresponding variable is “u000”. Similarly, check that the corresponding variable is “u001” for CD, “u002” for EK, and “u003” for EL. And EF correspond to variable u004. Mouse the left key click on the “structure” | “expression”, in the algebraic expressions box input “u002 / u000”, as shown in figure 1-1, click ok to get expression; Similarly, input as shown in Figure 3a,b to obtain the expression “u003 / u001”.



Figure 3. (a) and (b) Expression Design

Second, change the base vector ( $\overrightarrow{AB}$ ) and ( $\overrightarrow{CD}$ ) to vector ( $\vec{e}_1$ ) and ( $\vec{e}_2$ ), select point A to switch to “Editing Tools”, right-click the mouse, double-click “02- Display” in the pop-up property dialog box, change the “Annotation content”, select the text type to “vector” in the “Text Editing dialog box”, change “A” to vector, as shown in Figure 2-1; Similarly, change the basis vector ( $\overrightarrow{CD}$ ) to vector ( $\vec{e}_2$ ) by entering the text box as shown in Figure 4a,b.



Figure 4. (a) Text Editing Page  $\vec{e}_1$  and (b) Text Editing Page  $\vec{e}_2$

Then, any vector  $(\vec{EF})$  is represented by  $(\vec{e}_1)$  and  $(\vec{e}_2)$ , and the decomposition vector  $(\vec{EF})$  is represented by  $(\vec{EF})$  and  $(\vec{e}_1)$  is represented by (). According to the method of Step 7, the variable of expression “u003 / u001” is “u005”, and the variable of expression “u002 /u000” is “u006”. Switch to “Editing Tool”, select the length of line segment EK and right click, double-click “01- General” in the pop-up properties dialog box to open “Text”, enter the content as shown in Figure 5a in “Text Editing Dialog Box”, and click OK; Similarly, change the text of EL length to as shown in Figure 5b. Change the text length of  $(\vec{EF})$  to figure 5c.

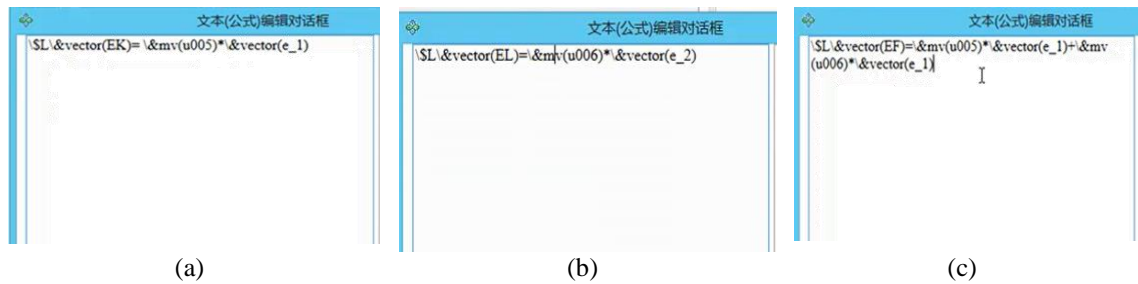


Figure 5. (a), (b), and (c) Editing Tool

### 3.3.8 Optimization of Product Parts

First of all, set animation button, click on the “structure” | “animation” | “button”, “label variables or objects for the variable” t “, “maximum” 1, “minimum value” for the 2, “frequency” changed to 150, click ok, and to make the button text notes, switch “editing tools”, right click on the button, double-click on the properties dialog “02 - show “, enter “Decomposition of any vector” in “annotation Content”, adjust the display annotation to “True”, and click OK.

Secondly, according to Step 4, hide the variable ruler and the length expression of the measured correlation vector. In the end, will change the size of the all points, hold down the Ctrl key, select all the points, click on the “design” | the size of the “point”, will be the size of the “point” changed to 0.1; Select point B, right-click in Edit mode, and set Show Annotations to False. According to Step 7, change G, H to  $(\vec{e}_1)$  and  $(\vec{e}_2)$  respectively.

### 3.4 Implementation

The dynamic plane vector product based on Hawgent dynamic mathematics software is applied in teaching, and short and exquisite micro lessons are made to improve the efficiency of review lessons. In the actual teaching process, let students practice, strengthen students’ participation and initiative. Teachers observe students’ participation, ask questions in time and make process evaluation. After the lecture, the opinions and feedbacks of students and educational experts on the application of dynamic integrals made by Hawgent dynamic mathematics software to review lesson were collected.

### 3.5 Evaluation

In the evaluation process, the learners’ learning of plane vector is firstly evaluated by asking questions and testing to test the learning effect of the students. 5 students were randomly interviewed to collect students’ feedback on micro-lesson learning, and questionnaire survey was conducted among education experts to test the effectiveness of micro-lesson teaching for review lesson. Students’ feedback is shown in the Table 2.



**Table 2.** Student’s Statement

Students	Statement	Percentage	Category
S01	Students enjoy using dynamic software in lesson reviews	82%	Good
S02	review lessons with dynamic software can improve student learning performance	76%	Good
S03	Using dynamic software to review lessons is very useful in the learning process	79%	Good
S04	Using dynamic software review lessons allows for understanding and completing assignments faster	80%	Good
S05	integrating dynamic software into review lessons are very clear and easy to understand	85%	Good
Average		80.4%	

Based on Table 2, the results of the student statement result show that, a using Hawgent dynamic in the review lesson can improve student learning performance, very useful in the learning process and etc. the student statement average is 80.4% or good category.

**Table 3.** Validation Result by Validator

Component	Score Validation	Percentage	Criteria
Presentation theory	2.3	79%	Good
Presentation concept	2.5	81%	Good
Explanation steps	2.7	84%	Good
Average		81.33%	

Based on Table 3, the validation results of the 3 aspects obtained an average percentage of 81.33%. This result said that the using Hawgent dynamic mathematics software in a review lesson of basic theorem of vector plane are in the good category and need to be revised a little to found the maximum learning material standards to be able to use on other mathematics subjects.

Based on the results of students’ perceptions about the use of integrable ware designs for lesson reviews for mathematics learning in the basic theorem of the vector plane lesson and the results of the evaluation of media and materials experts, we can conclude that, lesson reviews for mathematics lessons using integrable ware designs can be used by teachers to review a lessons because very important to help students’ understanding and students’ learning motivation, so that in the future researchers and all mathematics teachers in elementary , middle and senior high school can use integrable ware to reviewing a lesson of mathematics education and other sub-topics in particular.

#### 4. CONCLUSION

The results of the study above show that the average statement of several students on the review of mathematics lessons on the basic theorem of the vector plane is 80.4%, and based on the validity of the results, it is 81.33%. from the research result show that the use of dynamic software to review mathematics lessons, the subject of the basic theorem of vector plane can improve student learning performance, useful in the learning process, allows for understanding and completing assignments quickly and very clear and easy to understand a review lesson. Therefore, the review lesson of basic theorem vector plane using Hawgent dynamic mathematics software can be applied to the teaching process and can using this dynamic software to the review lesson another mathematics topics.

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