



Development of Learning Cycle 7E-Based Teaching Materials on the Topics of Cartesian Coordinates

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Abstract: This research aims to develop and produce teaching materials. The teaching material in question is the Cartesian coordinates module for class VIII junior high school students. This Cartesian coordinate module is based on the 7e learning cycle model which meets valid and practical criteria. This research was carried out at SMP Negeri 5 Bajawa with the test subjects being class VIII students as potential product users. This development research uses the ADDIE development model which consists of five stages, namely Analysis, Design, Development, Implementation and Evaluation. The assessment instrument in this research uses expert test assessment sheets with the aim of measuring the level of validity of teaching materials as well as student and teacher response questionnaires with the aim of measuring the level of practicality of the teaching materials being developed. The research results show that the average validity score for teaching materials is 4.3 with the criteria "Very Good". Meanwhile, the average practicality score is 4.7 with the criteria "Very Good". Thus, the teaching material in the form of a Cartesian coordinate module based on the 7e learning cycle model for Class VIII middle school students is said to be valid and practical.

Keywords: development, modules, ADDIE, cartesian coordinates and learning cycle 7E

Abstrak: Penelitian ini bertujuan untuk mengembangkan dan menghasilkan bahan ajar. Bahan ajar yang dimaksud adalah Modul koordinat kartesius untuk Peserta didik SMP kelas VIII. Modul koordinat kartesius ini berbasis model learning cycle 7e yang memenuhi kriteria valid dan praktis. Penelitian ini dilaksanakan di SMP Negeri 5 Bajawa dengan subjek uji cobanya adalah peserta didik kelas VIII sebagai calon pengguna produk. Penelitian pengembangan ini menggunakan model pengembangan ADDIE yang terdiri dari lima tahapan yakni Analysis, Design, Development, Implementasi dan Evaluation. Instrumen penilaian dalam penelitian ini menggunakan lembar penilaian uji ahli dengan tujuan untuk mengukur tingkat kevalidan bahan ajar serta angket respon siswa dan guru dengan tujuan untuk mengukur tingkat kepraktisan bahan ajar yang dikembangkan. Hasil penelitian menunjukkan rata-rata skor kevalidan bahan ajar adalah 4,3 dengan kriteia "Sangat Baik". Sedangkan rata-rata skor kepraktisan adalah 4,7 dengan kriteria "Sangat Baik". Dengan demikian bahan ajar berupa modul koordinat kartesius berbasis model learning cycle 7e untuk siswa SMP Kelas VIII dikatakan valid dan praktis.

Kata kunci: pengembangan, modul, ADDIE, koordinat kartesius dan learning cycle 7E.

INTRODUCTION

Education is the key to the nation's future towards success. The Indonesian government has implemented a provision regarding an education system that can form reliable human resources, namely by issuing a legal basis in the form of a law regarding the National Education system. According to Law No. 20 of 2003, article 3, states that the aim of education is to develop the talents and interests of students, so that they become human beings who believe and are devoted to the one God, have noble character, are healthy, knowledgeable, creative, independent, and become democratic and responsible citizens (Pegi, 2021:26)

Mathematical education is one of the sciences taught in school that has conceptual characteristics and a deductive and consistent mindset. The target of mathematics learning is for students to be able to implement mathematics obtained at school in everyday life (Ngina, 2023:812). Mathematics is a science that plays a very important role in life and is the mother of all sciences. Many developments in other sciences are based on mathematics. So mathematics is one of the subjects taught from elementary education to tertiary level. The importance of mathematics can be seen from the benefits and uses of mathematics in everyday life, as well as the development of science (Wewe, 2017). According to (Piu, 2021:217), the aim of learning mathematics in the 2013 curriculum is that students are able to understand mathematical concepts, explain and apply concepts flexibly, accurately, efficiently and precisely in solving problems.

However, in fact, students' ability to solve mathematical problems is still very low. This fact is confirmed by reports from The International Mathematics and Science Study (TIMSS), in the last four years (namely 2015 which was only published in December 2016) the report stated that the mathematics and science scores of class VIII middle school students were not much different from the scores in the previous year, Indonesia was ranked 46th out of 51 country with a total score obtained of 397. This shows that mathematics is one of the subjects with a low index in Indonesia. Based on the results of interviews with students in class VIII and teachers at SMP Negeri 5 Bajawa, data was obtained that some students or 50% of students still had difficulty understanding Cartesian coordinates material. Where students' understanding of Cartesian coordinate material is still very low, and they also tend to memorize the material, and focus on example questions given by the teacher without understanding what is explained, causing students to become lazy in thinking. On the other hand, there are some students who easily do the practice questions given by the teacher, and there are also some students who experience difficulty in doing the practice questions given. This is because each student's understanding is different. The mathematics learning process at SMP Negeri 5 Bajawa, especially class VIII, still uses the lecture method, where learning activities are still centered on the educator, so that students tend to be passive when learning takes place and this causes students to be unable to build their own understanding and unable to solve mathematical problems. Educators also still use the 2013 curriculum mathematics package books prepared by the Education Department.

Based on the problems mentioned, it is a great opportunity for researchers to develop teaching materials in the form of modules that suit the needs and characteristics of students, so that the learning process becomes more active, creative and interesting. Development is a process used to develop and validate educational products (Rahmi, 2021:47). The development of teaching materials is all the materials needed by educators in planning and evaluating learning activities. The development of teaching materials really helps educators and students in achieving the goals of teaching and learning activities. The modules that will be developed are based on students' needs, equipped with various examples of questions related to daily life and supplemented with various interesting pictures with the aim of facilitating students' active independent learning in accordance with the characteristics of the 2013 curriculum which requires students to be active. can hone his own skills.

Kurikulum 2013 is a curriculum that demands independence, understanding, character and skills of students. The Ministry of Education and Culture (Kemendikbud)

stated that the 2013 curriculum encourages students to be able to carry out, observe, ask questions, reason and communicate what is known or obtained after receiving material during learning activities (Kemendikbud, 2013). In the 2013 curriculum, learning activities are centered on students (Student-Centered). On this occasion, researchers want to develop teaching materials in the form of module-based learning cycle 7E (Pegi, 2021:28).

The Learning Cycle 7e model is a learning model created with the aim of improving students' critical thinking skills and learning achievements and is in accordance with the 2013 curriculum. This learning model is also known as Student Center in the sense that the learning process is centered on students, Hidayah, et al, (Nango, 2021:292). According to Einskraf, (Pegi, 2021:28) Learning Cycle 7e includes seven learning stages consisting of: (a) ecilit, (b) engage, (c) explore, (d) explain, (It is) elaborate, (f) extended, (g) evaluation. Rawa, et al (2016:10) stated that the Learning Cycle 7e is an update of the Learning Cycle 5e by expanding the engagement with ecilit and add extended after elaborate stages.

Learning Cycle 7e has several advantages (Piu, 2021:220) which include: Stimulating students to recall previously learned topics, Stimulating enthusiasm and increasing students' curiosity, Training students to learn concepts through experimental activities, Training students to convey previously acquired concepts orally, Training students to think, search, find, and explain examples of the application of previously acquired concepts, Educators and students go through the learning stages complement each other, and educators can also use different methods in implementing this learning model.

▪ **METHOD**

The current research used the ADDIE model. Modules was developed using the ADDIE model development which consists of five development stages (Anglada, 2007), including Analyze. This analysis stage includes three important things, namely: Needs Analysis, Curriculum Analysis, and Student Characteristics Analysis Design: This stage the researcher begins to design the module that will be developed according to the results of the analysis carried out previously and prepares an assessment instrument. Development is the product realization stage. After that, the module developed will be validated by expert lecturers and teachers. Implementation (Implementation) This stage is carried out on a limited basis in the school which is used as a research site. Researchers apply teaching materials that have been developed in the learning process, Evaluation (Evaluation) This stage the researcher carries out final revisions to the modules developed based on input obtained from response questionnaires and observation sheets. The product based on the 7e learning cycle model that is being developed will be validated by several validators (material experts and design experts), then stage I revisions will be carried out. After that, the product will be tested on a limited basis with the aim of obtaining stage II revisions. The revised product will be tested in mathematics learning with Cartesian Coordinates material for Class VIII Middle School students. The test subjects in this research were mathematics teachers and 10 Class VIII students at SMP Negeri 5 Bajawa.

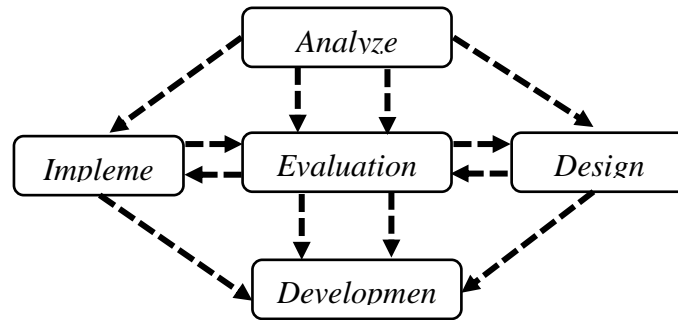


Figure 1. ADDIE model

The data collection methods used in this development research are Documentation, Interviews, Questionnaires. The instrument used in this research is a questionnaire that refers to the assessment of the National Education Standards Agency. Data to measure validity was obtained from mathematics teachers as material experts, while lecturers as design experts. Meanwhile, data to measure the practicality of teaching materials was obtained from teacher response questionnaires and student response questionnaires. Data regarding the quality of Cartesian coordinate teaching materials based on the 7e learning cycle model from product trial results were analyzed through conversion of scores obtained from the assessment instrument sheet. The change in research results from each expert is qualitative data which is then converted into quantitative data using a 1-5 Likert scale with the following criteria: Very Poorly, Poorly, Fair, Good, and Very Good (Sugiyono, 2016:135). The product being developed is said to be valid and practical if the minimum validity criteria achieved are good criteria.

▪ **RESULT AND DISSCUSSION**

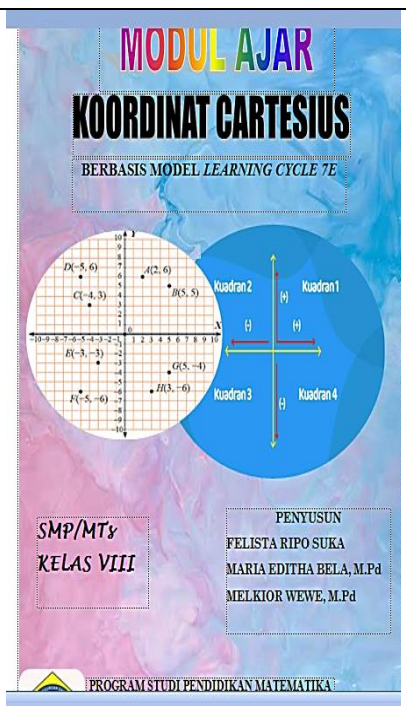
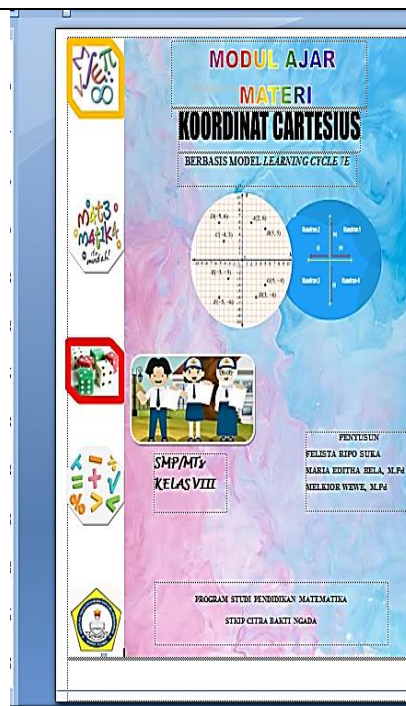
The development of the teaching material products developed uses the ADDIE development model which consists of 5 stages, namely: The Analyze stage is the first stage in this research, namely the analyze stage. At this stage what will be done is to carry out a needs analysis, curriculum analysis and analysis of student characteristics. The results obtained at this analysis stage are as follows: The first stage carried out by researchers in carrying out the analysis was analyzing student needs. This needs analysis stage aims to determine the extent of the mathematics learning process in class VIII. In the second stage, the researcher carried out a curriculum analysis in accordance with the applicable curriculum in the junior secondary education unit, the researcher analyzed the Basic Competencies (KD) and applicable Competency Achievement Indicators.

The Design Stage is the process of compiling this module, which requires the design stages of the elements of the module, such as Preparing a Draft Teaching Material, Collecting Images that Match the Cartesian Coordinate Material, Arranging the Design and Features of the Learning Module including the initial part, content and The final cover consists of: The cover of the Cartesian coordinate module based on the 7e learning cycle model consists of 2 types of covers, namely the front and back covers, The foreword is made to express gratitude to God and the people who helped write the module and apologies for the weaknesses of the module created, Components of the Learning Cycle 7 Model Based Module created by researchers in this development aims to explain each content of the stages of the 7e learning cycle model, Table of Contents aims to be a guide to the main content from the module and shows the locations of parts of the module,

Contents of the book, in the Cartesian coordinates module contains an introduction (description, instructions, basic competencies, keywords, achievement indicators and learning objectives), concept maps, recalling, observing and asking questions, explore, explain, let's practice 1, let's practice 2 and quiz.

Development Stage: In the development stage, researchers tested the product in the form of a Cartesian coordinate module based on the 7e learning cycle model which had been developed for material experts and design experts. Trials are carried out by providing the developed modules to experts for assessment. Trials were carried out with the aim of obtaining suggestions and comments from experts to improve the quality of the modules being developed. Implementation Stage, At this stage the researcher carried out implementation only limited to certain schools, namely SMP Negeri 5 Bajawa. This stage is carried out after the Cartesian coordinate module is declared valid by experts. Evaluation stage, After carrying out trials by giving questionnaire sheets to experts, the researcher revised the Cartesian coordinate module based on the revisions given by the experts which were used to determine the validity of the module developed. Product revisions are carried out in two ways, namely revisions by design experts and by material experts. The results of the revisions that have been carried out are presented in tables 1 and 2.

Table 1. Revisions by media design experts

Comments and Suggestions	Before	After
Make the cover design more attractive		

Sort module components

KOMPONEN MODUL (berbasis model learning cycle 7e)	7 (Tujuh) KOMPONEN MODUL Berbasis Model Learning Cycle 7e
 <p>Ingat Kembali adalah kegiatan siswa dalam mengingat kembali konsep dan prosedur yang telah dipelajarinya. Kegiatan yang dapat dilakukan adalah menjawab pertanyaan - pertanyaan terkait pengetahuan sebelumnya.</p>	<p>1. Elicit (Ingat Kembali) adalah kegiatan siswa dalam mengingat kembali konsep dan prosedur yang telah dipelajarinya. Kegiatan yang dapat dilakukan adalah menjawab pertanyaan terkait pengetahuan sebelumnya.</p>
 <p>Mengamati dan Menanya adalah kegiatan siswa memperhatikan suatu kejadian atau masalah kemudian memuliskan hal-hal yang ingin diketahuinya siswa berupa pertanyaan.</p>	<p>2. Engage (Mengamati dan Menanya) adalah kegiatan siswa memperhatikan suatu kejadian atau masalah kemudian memuliskan hal-hal yang ingin diketahuinya siswa berupa pertanyaan.</p>
 <p>Mengeksplorasi adalah kegiatan siswa menemukan informasi konsep dan prosedur untuk menambah keyakinan terhadap hal-hal yang ingin diketahuinya. Kegiatan yang dapat dilakukan adalah melakukan percobaan/eksperimen.</p>	<p>3. Explore (Mengeksplorasi) adalah kegiatan siswa menemukan informasi konsep dan prosedur untuk menambah keyakinan terhadap hal-hal yang diketahuinya. Kegiatan yang dilakukan adalah percobaan/eksperimen.</p>
 <p>Menjelaskan adalah kegiatan siswa untuk mendiskusikan materi yang telah disediakan dalam modul dengan diskusi kelompok. Kegiatan yang dapat dilakukan adalah memuliskan kesimpulan berupa rangkuman dari materi yang telah disediakan dalam modul.</p>	<p>4. Explain (Menjelaskan) adalah kegiatan siswa untuk mendiskusikan materi yang telah disediakan dalam modul dengan diskusi kelompok. Kegiatan yang dapat dilakukan adalah memuliskan kesimpulan berupa rangkuman dari materi yang telah disediakan dalam modul.</p>
 <p>Ayo Berlatih 1 adalah kegiatan siswa menerapkan pemahaman mereka pada masalah berdasarkan materi pembelajaran yang baru dipelajarinya dengan mengaitkan ide-ide matematis dalam topik yang sama. Kegiatan yang dilakukan adalah</p>	<p>5. Elaborate (Ayo Berlatih 1) adalah kegiatan siswa menerapkan pemahaman mereka pada masalah berdasarkan materi pembelajaran yang baru dipelajarinya dengan mengaitkan ide-ide matematis dalam topik yang sama. Kegiatan yang dilakukan adalah menyelesaikan masalah.</p>
 <p>Ayo Berlatih 2 adalah kegiatan siswa untuk memperluas pemahaman mereka pada masalah berdasarkan materi pembelajaran yang baru dipelajarinya. Kegiatan yang dapat dilakukan adalah menyelesaikan masalah.</p>	<p>6. Evaluate (Ayo Berlatih 2) adalah kegiatan siswa menyelesaikan masalah atau soal yang berkaitan dengan materi yang dipelajarinya sebelumnya.</p>
 <p>QUIZ adalah bentuk penilisan terhadap pencapaian belajar siswa dalam menjelaskan keterkaitan antara ide matematis yang diperoleh dari aktivitas pembelajaran dalam kehidupan sehari-hari.</p>	<p>7. Extended (Quiz) adalah bentuk penilisan terhadap pencapaian belajar siswa dalam menjelaskan keterkaitan antara ide matematis yang diperoleh dari aktivitas pembelajaran dalam kehidupan sehari-hari.</p>

Complete the steps in the module and make it more interesting

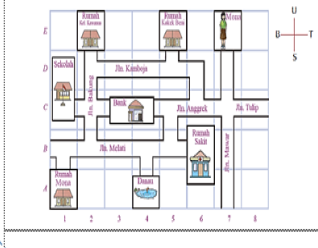
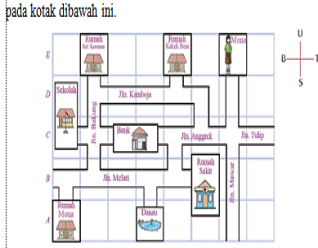
INGAT KEMBALI	ELICIT (INGAT KEMBALI)
<p>MASALAH 1</p> <p>Masih ingatkah kalian tentang koordinat? Koordinat adalah kedudukan suatu titik. Dalam kehidupan sehari-hari kalian pasti telah mengenal titik-titik pada bidang koordinat seperti yang terdapat pada peta. Untuk mengingat kembali, perhatikan gambar di bawah ini ! Setelah kalian mengamati gambar di bawah, apakah kalian ketahui tentang sumbu-x dan sumbu-y dan apakah kalian dapat menentukan posisi Danau terhadap sumbu-x dan sumbu-y ? Tulislah jawaban kalian pada kotak di bawah ini.</p>  <p>Jawab :</p>	<p>MASALAH 1</p> <p>Masih ingatkah kalian tentang koordinat? Koordinat adalah kedudukan suatu titik. Dalam kehidupan sehari-hari kalian pasti telah mengenal titik-titik pada bidang koordinat seperti yang terdapat pada peta. Untuk mengingat kembali, perhatikan gambar di bawah ini ! Setelah kalian mengamati gambar di bawah, apakah kalian ketahui tentang sumbu-x dan sumbu-y dan apakah kalian dapat menentukan posisi Danau terhadap sumbu-x dan sumbu-y ? Tulislah jawaban kalian pada kotak di bawah ini.</p> 

Table 2. Revision by content experts

Comments and Suggestions	Before	After
Adjust objectives to the learning indicators	<p>E. INDIKATOR PENCAPAIAN</p> <p>3.2.1 peserta didik dapat menentukan posisi titik terhadap sumbu-x dan sumbu-y</p> <p>3.2.2 peserta didik dapat menentukan posisi titik terhadap titik asal (0,0)</p> <p>3.2.2 peserta didik dapat menentukan posisi titik terhadap titik tertentu (a,b)</p> <p>3.2.4 peserta didik dapat menentukan posisi garis terhadap sumbu-x dan sumbu-y (sejajar, tegak lurus, berpotongan)</p> <p>4.2.1 peserta didik mampu menyelesaikan masalah yang berhubungan dengan titik dalam bidang koordinat cartesianus</p> <p>F. TUJUAN PEMBELAJARAN</p> <ol style="list-style-type: none"> 1. Peserta didik dapat menentukan posisi titik dan garis terhadap sumbu-x dan sumbu-y 2. Peserta didik dapat menentukan posisi titik terhadap titik asal (0,0) dan titik tertentu (a,b) 3. Peserta didik dapat menyelesaikan masalah yang berhubungan dengan titik dalam bidang koordinat cartesianus 	<p>E. INDIKATOR PENCAPAIAN</p> <p>3.2.1 Peserta didik dapat menentukan posisi titik terhadap sumbu-x dan sumbu-y</p> <p>3.2.2 Peserta didik dapat menentukan posisi titik terhadap titik asal (0,0)</p> <p>3.2.2 Peserta didik dapat menentukan posisi titik terhadap titik tertentu (a,b]</p> <p>3.2.4 Peserta didik dapat menentukan posisi garis terhadap sumbu-x dan sumbu-y (sejajar, tegak lurus, berpotongan)</p> <p>4.2.1 Peserta didik mampu menyelesaikan masalah yang berhubungan dengan koordinat cartesianus</p> <p>F. TUJUAN PEMBELAJARAN</p> <ol style="list-style-type: none"> 1. Peserta didik dapat menentukan posisi titik dan garis terhadap sumbu-x dan sumbu-y 2. Peserta didik dapat menentukan posisi titik terhadap titik asal (0,0) dan titik tertentu (a,b) 3. Peserta didik dapat menentukan posisi garis terhadap sumbu-x dan sumbu-y (sejajar, tegak lurus, berpotongan) 4. Peserta didik dapat menyelesaikan masalah yang berhubungan

Table 3. Expert validity results

No	Expert	Score	Average	Criteria
1	Content	60	5	Very good
2	Media design	40	3.6	Good

Based on the description of the research results above, the recapitulation table of product trial results from each expert to measure the validity of teaching materials is described in the following table:

The overall average score is 4.3, which indicates that the level of validity of teaching materials is of "Good" criteria. Based on the description of the research results above, the recapitulation table of product trial results from teachers and students to measure the practicality of teaching materials is described in the following table:

Table 4. Practicality results

No	Subject	Score	Average	Criteria
1	S1	67	4.7	Very good
2	S2	67	4.7	Very good
3	S3	67	4.7	Very good
4	S4	67	4.7	Very good
5	S5	68	4.8	Very good
6	S6	67	4.7	Very good
7	S7	67	4.7	Very good
8	S8	67	4.7	Very good
9	S9	67	4.7	Very good
10	S10	67	4.7	Very good

The overall average score is 4.7 which indicates the practicality of teaching materials with the criteria "Very Good". Based on data obtained from trials to measure the validity and practicality of the product developed above, it has answered the problem formulation in this research, namely that the researcher succeeded in developing teaching materials in the form of a Cartesian coordinate module based on the 7e learning cycle model that is valid and practical.

The results of this research are in line with the research results of Piu, et al (2021), in their research entitled "Development of a Spatial Geometry Module Based on the 7e Learning Cycle Model to Improve the Mathematical Connection Ability of Class VIII Middle School Students". This research produces a space geometry module based on the 7e learning cycle model that is valid, practical and effective. The results of the research show that the validity scores of content experts, design experts and media experts are respectively in the valid category, the module practicality scores are in the practical category, students' mathematical connection abilities are in the connection aspect between concepts or procedures in the same material there was an increase from 66 to 81 in the high category. Results of research by Pegi, et al (2021) with the research title "Development of Flat Geometry Teaching Materials Based on the 7e Learning Cycle Model for Middle School Students". This research produces a flat geometry module for class VII junior high school students. The research results show an average validity score of teaching materials of 4.2 in the "Good" category. Meanwhile, the average practicality score was 4.65 in the "Very Practical" category. The results of research by Wona, et al (2022) with the research title "Development of a Mathematics Module for Problem-Based Learning Settings on Cartesian Coordinate System Material". The results of this research are a mathematics module setting problem-based learning on Cartesian coordinate system material. Based on the research results, the overall average score of the module validity analysis results was 4.27 with good criteria and the overall average score of the module practicality analysis results was 4.48 with very good criteria.

Based on the relevant research results above, it can be concluded that research related to the Learning Cycle 7e based model has been carried out by previous researchers with results that meet valid and practical criteria. However, the research carried out by this researcher is research into the development of teaching materials using a Learning Cycle 7e based model, with good and attractive product designs in the form of images related to the material, using simple language, the material is arranged according to the module components so that students are more enthusiastic learning, students find it easier to understand the material. The average instrument assessment from material experts and design experts reached very good criteria, while the average teacher response questionnaire and student response questionnaire also reached very good criteria.

▪ **CONCLUSION**

Based on the results of research on the development of teaching materials in the form of a Cartesian Coordinate module based on the Learning Cycle 7e model for Class VIII Middle School students carried out by researchers, research data obtained shows that the average validity score for teaching materials is 4.3 with the criteria "Very Good". Meanwhile, the average practicality score is 4.7 with the criteria "Very Good". Thus, the teaching materials in the form of a Cartesian coordinate module based on the 7e learning

cycle model for Class VIII middle school students are said to be valid and practical and worthy of use by teachers and students.

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