

**DEVELOPMENT OF PHYSICS E-MODUL FOR THE
INDEPENDENT LEARNING CURRICULUM TO ENCHANCE
LEARNING INDEPENDENCE ON GLOBAL WARMING AND
ENVIRONMENTAL POLLUTION FOR GRADE X HIGH
SCHOOL**

THESIS

Submitted as one of the requirements of obtaining a degree Bachelor of Education



By
NAJMI ASFIYA
19033114/2019

**PHYSICS EDUCATION STUDY PROGRAM
DEPARTMENT OF PHYSICS
FACULTY OF MATHEMATICS OF NATURAL SCIENCES
UNIVERSITAS NEGERI PADANG
2024**

UNDERGRADUATE THESIS APPROVAL

Title : Development of oPhysics E-Modul for the Independent Learning Curriculum to Enchance Learning Independence on Global Warming and Environmental Pollution for Grade X High School

Name : Najimi Asfiya

Student ID : 19033114

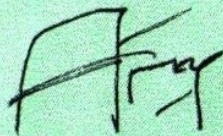
Study Program : Physics Education

Department : Physics

Faculty : Mathematics and Natural Science

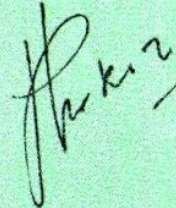
Padang, 4 January 2024

Knowing:
Head of Physics Department



Prof. Dr. Asrizal, M.Si
NIP. 19660603 199203 1 001

Approved by:
Advisor



Prof. Pakhrur Razi, S.Pd, M.Si, Ph.D
NIP. 19790812 200604 1 003

VALIDATION OF UNDERGRADUATE THESIS EXAMINATION

Name : Najmi Asfiya
Student ID : 19033114
Study Program : Physics Education
Department : Physics
Faculty : Mathematics and Natural Science

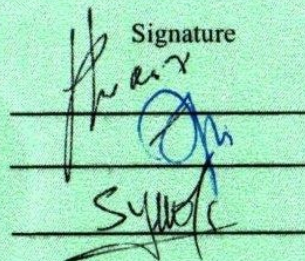
**DEVELOPMENT OF OPYHSICS E-MODUL FOR THE INDEPENDENT
LEARNING CURRICULUM TO ENCHANCE LEARNING
INDEPENDENCE ON GLOBAL WARMING AND ENVIRONMENTAL
POLLUTION FOR GRADE X HIGH SCHOOL**

It was declare that she had passed after being defended in front of the
undergraduate thesis examiner team for Department of Physics Education,
Faculty of Mathematics and Natural Science, Universitas Negeri Padang

Padang, 4 January 2024

The Undergraduate Thesis Examiner Team

Name
Chairman: Prof. Pakhrur Razi, S.Pd, M.Si, Ph.D
Member : Dra. Hidayati, M.Si
Member : Silvi Yulia Sari, S.Pd, M.Pd

Signature


STATEMENT LETTER

I hereby declare:

1. My paper, the final project in the form of a thesis entitled "Development Of Physics E-Modul for the Independent Learning Curriculum to Enchance Learning Independence on Global Warming and Environmental Pollution for Grade X High School", is my own work.
2. This paper is purely my own ideas, formulations and research, without the help of other parties, except from the supervisor.
3. In writing this paper, there are no works or opinions that have been written or published by others, unless clearly stated in writing in the literature.
4. I make this statement in fact and if there are any deviations in this statement, I am willing to accept academic sanctions in the form of revocation of the degree. I have obtained because of this writing, as well as other sanctions in accordance with applicable norms and regulations.

Padang, December 20th 2022

Who makes statement



Najmi Asfiya

NIM. 19033114

ABSTRAK

Najmi Asfiya : Pengembangan E-modul Fisika Kurikulum Merdeka untuk Meningkatkan Kemandirian Belajar pada Materi Pemanasan Global dan Pencemaran Lingkungan Kelas X SMA/MA

Kurikulum merdeka diterapkan untuk mengatasi *learning loss* yang timbul sebagai dampak dari pembelajaran pada saat pandemi. *Learning loss* dapat ditanggulangi dengan kemandirian belajar peserta didik. Kurikulum merdeka terfokus pada pembelajaran yang mandiri bagi peserta didik. Faktanya, kemandirian belajar peserta didik rendah serta bahan ajar fisika kurikulum merdeka belum dapat memaparkan materi fisika dengan baik. Penelitian pengembangan ini bertujuan untuk mengembangkan e-modul yang dapat menjadi bahan ajar fisika serta dapat meningkatkan kemandirian belajar peserta didik dalam upaya menanggulangi *learning loss*.

Penelitian ini merupakan *Education Design Research* menggunakan model pengembangan Plom. yang terdiri dari dua tahap yaitu tahap pendahuluan (*preliminary research*) dan tahap pengembangan (*prototyping phase*). E-modul diuji kelayakannya melalui tahap evaluasi formatif yang terdiri dari *self-evaluation*, *expert review*, uji praktikalitas *one-to-one* yang dilakukan kepada peserta didik di SMAN 2 Padang, SMAN 10 Padang dan SMA Pembangunan Laboratorium UNP dan *small group* yang dilakukan peserta didik di SMAN 10 Padang dan SMA Pembangunan Laboratorium UNP. Teknik analisis data yakni dengan statistik deskriptif kualitatif dan kuantitatif.

Berdasarkan data yang telah dianalisis didapatkan hasil penelitian yakni pada tahap *self-evaluation* diketahui bahwa e-modul yang dikembangkan valid dengan nilai rata-rata 98,88%. Pada tahap *expert review* diketahui bahwa e-modul sudah valid dengan nilai 0,89 berdasarkan skala Aiken's V. Jadi dapat disimpulkan bahwa e-modul yang dikembangkan valid dan praktis serta dapat dijadikan bahan pertimbangan oleh guru dan peserta didik sebagai bahan ajar kurikulum merdeka.

Kata Kunci : E-modul, Kurikulum Merdeka, Kemandirian Belajar, Pemanasan Global, Pencemaran Lingkungan.

ABSTRACT

Najmi Asfiya : Development Of Physics E-Modul for the Independent Learning Curriculum to Enhance Learning Independence on Global Warming and Environmental Pollution for Grade X High School

The independent curriculum is applied to overcome learning loss that arises as a result of learning during a pandemic. Learning loss can be overcome by the independence of student learning. The independent curriculum focuses on independent learning for students. In fact, the learning independence of low students and independent curriculum physics teaching materials have not been able to explain physics material properly. This development research aims to develop e-modules that can be physics teaching materials and can increase student learning independence in an effort to overcome learning loss.

This research is an Education Design Research using the Plom development model which consists of two stages, namely the preliminary research and the development stage (prototyping phase). The e-module is tested for feasibility through a formative evaluation stage consisting of self-evaluation, expert review, one-to-one practicality test conducted on students at SMAN 2 Padang, SMAN 10 Padang and SMA Pembangunan Laboratorium UNP and small groups carried out by students at SMAN 10 Padang and SMA Pembangunan Laboratorium UNP. Data analysis techniques are qualitative and quantitative descriptive statistics.

Based on the data that has been analyzed, the results of the study were obtained at the self-evaluation stage, it was found that the e-module developed was valid with an average value of 98.88%. At the expert review stage, it is known that the e-module is valid with a value of 0.89 based on Aiken's V scale. So it can be concluded that the e-module developed is valid and practical and can be considered by teachers and students as teaching materials for the independent curriculum.

Kata Kunci : E-module, Independent Curriculum, Learning Independence, Global Warming, Environmental Pollution.

FOREWORD

Thank God for the grace and grace of Allah SWT who has made it easier and gave way so that researchers can complete the research entitled "Development Of Physics E-Modul for the Independent Learning Curriculum to Enchance Learning Independence on Global Warming and Environmental Pollution for Grade X High School ".

Shalawat and greetings to the noble lord of nature, namely the Prophet Muhammad SAW, as a special and most meritorious human being in bringing all mankind, especially Muslims to civilized and knowledgeable to prepare for life in the world and hereafter as it is today

This thesis is prepared as one of the requirements to obtain a Bachelor of Education degree in the Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang. This thesis can be completed properly thanks to the help and guidance of various parties, both moral and material assistance. Therefore, on this occasion the researcher would like to thank you:

1. Mr. Prof. Pakhrur Razi, S.Pd, M.Si, Ph.D as an Academic Advisor and Supervisor who provides motivation and guides the author in planning, implementing and reporting the results of this research.
2. Mrs. Dra. Hidayati, M.Si and Mrs. Silvi Yulia Sari, S.Pd, M.Pd as examining lecturers who have provided input, criticism and suggestions in completing this thesis.
3. Mr. Rahmat Hidayat, S.Pd, M.Si, Mr. Dr. Fuja Novitra, S.Pd, M.Pd, Mr. Zuhendra, S.Pd, M.Si, Mrs. Dea Stivani Suherman, S.Pd, M.Pd, Mrs. Dr. Riri Jounuarti, S.Pd, M.Si and Mrs. Putri Dwi Sundari, S.Pd, M.Pd as experts who validate the independent curriculum physics e-module to increase learning independence on global warming and environmental pollution class X high school.
4. Mr. Prof. Dr. Asrizal, M.Si as Chairman of the Department of Physics FMIPA UNP.

5. Mr. and Mrs. Lecturers, Education Staff and Employees of the Department of Physics FMIPA UNP.
6. Mr. Nuragusman Eka Putra, M.Pd as the principal of SMAN 2 Padang and Mrs. Fitri Sari Ramadhani, M.Pd as a teacher of SMAN 2 Padang who has given permission and assisted research at SMAN 2 Padang.
7. Mr. Muhammad Isya, M.Pd as the principal of SMAN 10 Padang and Mrs. Hj. Nita Andra, M.Pd as a teacher of SMAN 10 Padang who has given permission and assisted research at SMAN 10 Padang.
8. Mr. Afrizal, S.Si as the principal of SMA Pembangunan Laboratorium UNP School and Mrs. Andhika Sari Putri, M.Pd as a physics teacher who has licensed and assisted research at SMA Pembangunan Laboratorium UNP.
9. Mr./Mrs. teaching staff and class X students at SMAN 2 Padang, SMAN 10 Padang and SMA Pembangunan Laboratorium UNP who have assisted in completing this thesis.
10. Father Indra Taruna Hareva and Ibu Dewi Kusuma Yanti as parents who have provided prayers, motivation and assistance to the author both morally and materially.
11. Dinda Putri Dewi, Bunga Sri Dayu, Anugrah Akbar, Syakira Ramadanti, and Raudhatul Jannah as siblings who have encouraged the author.
12. All parties who have helped the author to realize and complete studies that cannot be mentioned one by one.

The author realizes that this thesis is not yet at the perfect stage. Researchers receive suggestions, input and positive criticism for the perfection of this thesis.

Padang, 4 January 2024

Writer

TABLE OF CONTENTS

	Page
ABSTRAK	i
ABSTRACT	ii
FOREWORD.....	iii
TABLE OF CONTENTS	v
TABLE LIST	vii
LIST OF PICTURE.....	viii
APPENDIX LIST	x
CHAPTER I	1
INTRODUCTION	1
A. Background of the Problem.....	1
B. Identify the Problem	9
C. Issue Limitation	9
D. Problem Formulation.....	10
E. Research Objectives	10
F. Research Benefits	11
CHAPTER II	12
LITERATURE REVIEW	12
A. Theoretical Studies	12
B. Relevant Research	24
C. Framework of Thinking.....	27
CHAPTER III.....	28
RESEARCH METHODS.....	28

A. Types of Research	28
B. Object of Research	28
C. Research Procedure	28
D. Research Instrument	32
E. Data Engineering and Analysis	37
CHAPTER IV.....	41
RESULTS OF RESEARCH AND DISCUSSION	41
A. Research Results.....	42
B. Discussion	82
CHAPTER V	89
CLOSING.....	89
A. Conclusion.....	89
B. Suggestion	89
REFERENCES.....	91
APPENDIX	97

TABLE LIST

	Page
Table 1. Data collection instrument	33
Table 2. Components and indicators of self-evaluation instruments	34
Table 3. Components and indicators of validity instruments.....	35
Table 4. Components and indicators of practicality instruments.....	36
Table 5. The value of the instrument validity of the self-evaluation stage	38
Table 6. E-module validity criteria using Likert scale	38
Table 7. The value of the instrument validity of the expert review stage	39
Table 8. E-module validity criteria using Aiken's V scale.....	39
Table 9. The value of practicality instruments.....	40
Table 10. Practicality criteria of e-modules	40
Table 11. Needs analysis based on teacher interviews	42
Table 12. Results of Literature Review	49
Table 13. Self-evaluation comments and suggestions	56
Table 14. Validator's Comments and Suggestions.....	65

LIST OF PICTURE

	Page
Figure 1. Framework of thinking	27
Figure 2. Formative evaluation design flow	31
Figure 3. Self-evaluation results	56
Figure 4. Cover repair results	57
Figure 5. Results of adding Google Classroom invitations.....	57
Figure 6. Results of adding Google Classroom invitations.....	58
Figure 7. The results of the analysis of the validity test of the components of the material substance	60
Figure 8. The results of the analysis of the validity test of learning design components	61
Figure 9. Results of the analysis of the validity test of display components (visual communication)	62
Figure 10. Results of the validity test analysis of software utilization components	62
Figure 11. Results of the validity test analysis of all components	63
Figure 12. Improvement results according to validator 1 comments and suggestions.....	66
Figure 13. Improvement results according to validator 3 comments and suggestions.....	67
Figure 14. Improvement results according to validator 4 comments and suggestions.....	68
Figure 15. Improvement results according to validator 5 comments and suggestions.....	69
Figure 16. Results of the one-to-one stage practicality test on the content component of the e-module	70
Figure 17. Results of the one-to-one stage practicality test on the display and media components of the e-module	71

Figure 18. Results of the one-to-one stage practicality test on the ease of use component	73
Figure 19. Results of the one-to-one stage practicality test on the learning independence component.....	74
Figure 20. Comparison of the results of the one-to-one stage student practicality test.....	75
Figure 21. Results of the one-to-one stage student practicality test.....	75
Figure 22. Results of the practicality test of the small group stage on the content component of the e-module	77
Figure 23. Results of the practicality test of the small group stage on display and media components.....	78
Figure 24. Results of the practicality test of the small group stage on the component of ease of use.....	79
Figure 25. Results of the practicality test of the small group stage on the component of learning independence	80
Figure 26. Comparison of practicality test results of small group stage	81
Figure 27. Results of the practicality test of the small group stage	81

APPENDIX LIST

	Page
Appendix 1. Observation license	97
Appendix 2. Research License	99
Appendix 3. Certificate from School	100
Appendix 4. Guidelines for interviews with teachers	103
Appendix 5. Self-evaluation Instrument	107
Appendix 6. Validation sheet	111
Appendix 7. Validity test results	118
Appendix 8. Sample of student practicality test at the one-to-one stage	154
Appendix 9. Practicality test sample at the small group stage	158
Appendix 10. Documentation	162

CHAPTER I

INTRODUCTION

A. Background of the Problem

Curriculum changes are nothing new in education. The curriculum continues to be developed following the times because the nature of the curriculum cannot be used at one time continuously considering the demands of the times continue to change. Starting from the signing of the Decree of the Head of the Education Standard, Curriculum, and Assessment Agency of the Ministry of Education, Culture, Research, and Technology number 044/H/KR 2022 concerning the implementing education unit for the implementation of the Independent Curriculum in the 2022/2023 school year on July 12, 2022, the implementing education unit for the implementation of the Independent Curriculum has been established. Based on the narrative of the Minister of Education, Culture, Research, and Technology (Mendikbudristek) Nadiem Makarim, this curriculum change is intended to provide flexibility for teachers to design learning activities that are tailored to the characteristics of students and focus students on essential materials (CNN Indonesia, 2022). The implementation of the Independent Curriculum is adjusted to the times which are focused on the current condition of students.

The Independent Curriculum was developed with the principle of diversification in accordance with the conditions of education units, regional potentials and students in the context of reducing learning lag or better known as

learning loss contained in the Decree of the Minister of Education, Culture, Research and Technology Number 56/M/2022. The trick is to give teachers the flexibility to create quality learning in accordance with the needs and learning environment of students (Kurikulum.Kemendikbud.go.id, 2022). The independent curriculum provides flexibility to teachers in choosing the most effective teaching methods for students. Not only is that, through the independent curriculum, schools given the opportunity to adjust learning to the needs of students. This can help reduce the impact of learning loss by focusing on recovery or improvement in areas where learners are struggling.

Just like the previous curricula, in learning activities, the independent curriculum is supported by teaching materials that have been subsidized by the government. The main teaching materials provided by the government are teacher and student handbooks containing essential materials. Especially in the subjects of physics, biology and chemistry for class X, the textbooks used in schools are Natural Science (Science) books consisting of teacher and student handbooks. This class X science book is not only given in print to the school but can also be accessed through the Indonesian Book System (SIBI) which can be downloaded for free. Class X science books are prepared based on Learning Outcomes (CP) contained in the Decree of the Head of the Education Standard, Curriculum and Assessment Agency of the Ministry of Education and Culture Number 033/H/KR/2022 concerning CP in early childhood education, primary education level and secondary education level in the Independent Curriculum.

Given the relatively new implementation period of the Independent Curriculum, of course, improvements are still needed in this curriculum so that

learning activities can take place optimally. One of them is about the problem of teaching materials. Based on the results of initial studies that have been conducted by researchers, it was found that in class X science books for physics materials, there is one material that is not yet available, namely environmental pollution material and global warming material that has not been presented properly. Based on the Decree of the Head of the Education Standard, Curriculum and Assessment Agency of the Ministry of Education and Culture Number 033/H/KR/2022 for class X CP physics material, namely: students are able to describe natural symptoms within the scope of process skills in measurement, climate change and global warming, environmental pollution, alternative energy, and their use.

Initial studies were conducted to see the problems directly at SMAN 10 Padang, SMAN 2 Padang, and SMA Pembangunan Laboratorium UNP. The reason for choosing the school is because each school has represented other schools, namely SMAN 10 Padang and SMAN 2 Padang representing driving schools, and SMA Pembangunan Laboratorium Padang representing private schools. The results of initial studies conducted with physics teachers at SMAN 10 Padang, SMAN 2 Padang, and SMA Pembangunan Laboratorium Universitas Negeri Padang (UNP), showed that in class X science books there is no physics material available for environmental pollution and the depth of material in science books for physics materials can still be developed, one of which is global warming material which can be associated with problems in daily life that are close to participants educate. Not only that, from the results of initial studies, it is also known that in learning physics, various multimedia is needed.

If this condition is left unchecked, of course, for schools whose teachers do not look for other teaching materials or compile teaching materials themselves, they cannot teach global warming and environmental pollution. Even if the teacher compiles his own teaching materials, of course, the teaching materials have not been tested for feasibility. In addition, the problem arising from this condition is the increasing burden on teachers to be able to compile new teaching materials that are tailored to the character of students, regional potential and also school conditions. Seeing that teaching materials that are widely circulated still use the 2013 Curriculum, of course teachers will find it difficult to compile teaching materials on this material, especially environmental pollution material is a new material in the Independent Curriculum and was not in the previous curriculum.

The incomplete physics material in class X science books is most likely due to the application of the new Independent Curriculum which of course still requires improvement in various aspects, especially in the fulfillment of teaching materials. Its new application also causes not much research, especially on physics teaching materials that use the Merdeka Curriculum.

The independent curriculum gives freedom to teachers to design learning according to the conditions of the education unit, regional potential and the ability of students (Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Nomor 56/M/2022). Teachers are given the freedom to develop teaching materials that are adapted to the guidelines that have been given. Not only developing teaching materials, teachers are also given the freedom to reduce Learning Objectives (TP)

and Learning Objectives Flow (ATP) by triggering existing CP. To be able to design its own learning activities and develop teaching materials, the government has provided training on the Independent Curriculum, examples of TP and ATP, and assessment. But for teaching materials, especially in physics subjects on environmental pollution materials, there is no one, and research on teaching materials on this material does not yet exist.

The fulfillment of teaching materials on global warming and environmental pollution is something that cannot be ignored. The material in CP should be delivered well to students in order to achieve learning objectives. It is necessary to develop teaching materials for environmental pollution in accordance with the characteristics of students, regional potential and school conditions. Of course there are various types of teaching materials that can be chosen by taking into account the characteristics of students, regional potential and school conditions. The main key to choosing the type of teaching material lies in the characteristics, conditions and situations of students.

Given the purpose of implementing the Independent Curriculum, namely to restore learning loss, it is appropriate that the teaching materials developed also support the purpose of the Independent Curriculum. An effective step in recovering the impact of learning loss is to increase student learning independence. Learning independence can increase academic achievement, increase motivation and confidence, foster awareness of their limitations and their ability to manage those limitations, enable teachers to assign different tasks to and encourage social inclusion by fighting alienation (Lestari, 2015), enhance

creativity, problem solving, leadership, communication and innovation (Escolar-Llamazares dkk, 2019). Learning independence is actually the initiative and motive of students to determine learning plans, sources and decisions of their own will, their own choices accompanied by their own learning schedules, choosing places to study on their own and being able to use the media that will be used to learn independently Learning independence is actually the initiative and motive of students to determine learning plans, sources and decisions of their own will, their own choices accompanied by their own learning schedules, choosing places to study on their own and being able to use the media that will be used to learn independently (Hidayat dkk, 2020). Therefore, learning independence is something that must be owned by every student.

Based on preliminary studies conducted, it is known that there is a decrease in the level of independence of students when compared to before the pandemic. The negative impact of Covid-19 felt by students at all levels of education was "forced" to learn from home because face-to-face learning was eliminated. This sense of compulsion students no longer has strong initiative and learning motives. In the concept of learning independence, learning without coercion from the surrounding environment which aims to foster accountability as a student in facing learning difficulties. The compulsion of learning felt by students is real.

The independence of learning students is very important, especially in physics learning. The essence of physics is physics as a product, as a process and as an attitude. Physics as a product of its meaning, namely physics is a collection of knowledge in the form of facts, concepts, principles, laws, formulas, theories and

models. Physics as a process deals with the key words phenomena, alleged observations, measurements, investigations and publications. Physics as a food attitude is a creative idea, ideas to explain a natural phenomenon can be compiled through self-confidence, curiosity and independence (Murdani, 2020). In order to be able to study physics as a product, process and attitude requires the independence of learning students. Through independent learning, learners will grow the initiative to learn (Sujono et al., 2022).

E-module is a teaching material that is proven to increase learning independence (Mulyasari & Sholikhah, 2021) which can be used in digital form. E-modules can be opened at anytime and anywhere (Handayani et al., 2021), Students are able to learn independently according to their interests and abilities (Puspitasari, 2019), Overcoming the limitations of learning space and time, can increase student motivation (Yusra et al., 2023), making students comfortable to learn with various multimedia that can be in e-modules (Yulando et al., 2019). The main characteristic of e-modules is that independent teaching materials are arranged systematically with easy-to-understand language presented in learning activity units (Komikesari et al., 2020) For self-study needs (Wahyuni et al., 2018). Not only that, the e-module is also equipped with self-assessment that can increase self-awareness, increase engagement, facilitate self-correction, and encourage independent learning, making it suitable for restoring student independence that decreases due to learning loss in line with the purpose of implementing an independent curriculum.

Judging from the importance of learning independence and the need for supporting teaching materials, the author is interested in conducting research on "Development of Physics E-Module for the Independent Learning Curriculum to Enhance Learning Independence on Global Warming and Environmental Pollution for Grade X High School ". With this research, it will make it easier for teachers and students because there are already valid and practical teaching materials that can be used in the physics learning process, especially on environmental pollution materials.

The process of developing teaching materials in the form of e-modules on global warming and environmental pollution is an Education Design Research research using the Plomp development model that is suitable for development research because it is flexible with coherent research stages. In order for e-modules to be used in learning activities, validity tests and practicality tests are needed. Validity tests are carried out by experts by providing questionnaire sheets of validity instruments and products to personnel. The practicality test is carried out through two stages. The first stage is through one-to-one which is carried out by providing products and also practical instrument questionnaire sheets to students at SMAN 2 Padang, SMAN 10 Padang and SMA Pembangunan Laboratorium UNP. The second stage is through a small group which is similar to the one-to-one stage, but this test is only carried out to students at SMAN 10 Padang, and SMA Pembangunan Laboratorium UNP.

B. Identify the Problem

Based on the description of the background, the identification of problems in this study can be formulated as follows:

1. Teaching materials that use an independent curriculum are still limited so teachers need to find other teaching materials or make their own teaching materials.
2. The lack of complete physics material in class X Natural Science books is used as a handbook for teachers and students in the learning process.
3. There is no physical material for environmental pollution in the Natural Science book class X.
4. Global warming material has not been explained well in the Natural Science book class X.
5. Student learning independence has decreased compared to before the pandemic.

C. Issue Limitation

In order for the research carried out to be more thorough and directed, it is necessary to limit the problem. The problem limitation of this study is as follows:

1. The developed environmental pollution e-module was tested for validity by 6 experts.
2. E-modules of environmental pollution that have been valid are tested for practicality through the one-to-one stage and the small group stage. The one-to-one stage practicality test was carried out on students at SMAN 2 Padang, SMAN 10 Padang, and SMA Pembangunan Laboratorium UNP. The

practicality test of the small group stage was carried out on students at SMAN 10 Padang, and SMA Pembangunan Laboratorium UNP.

3. The research procedure carried out in this study is only up to the validity test and product practicality test.
4. The indicators of learning independence focused on this study refer to the indicators proposed by Hendriana and Soemarmo (2014 in Ariyanti, 2019) namely initiative and motivation, learning needs, learning goals/targets, relevant learning resources, process evaluation, and learning outcomes by students.

D. Problem Formulation

Based on the background and limitations of the problem, the formulation of the problem that can be stated in this study is:

1. What is the level of validity of the independent curriculum physics e-module to increase learning independence on global warming and environmental pollution in class X of Senior High School?
2. What is the level of practicality of the independent curriculum physics e-module to increase learning independence on global warming and environmental pollution in class X of Senior High School?

E. Research Objectives

Based on the formulation of the research problem, the purpose of this research in general is to develop an independent curriculum e-module to increase learning independence on global warming and environmental pollution in grade X Senior High School.

The objectives of this study specifically are:

1. Knowing the level of validity of the independent curriculum physics e-module to increase learning independence on global warming and environmental pollution in class X senior high school.
2. Knowing the level of practicality of the independent curriculum physics e-module to increase learning independence on global warming and environmental pollution in grade X senior high school.

F. Research Benefits

The results of this study are expected to be useful for:

1. For researchers, to increase knowledge in physics learning and the requirements to complete the undergraduate program in physics education at the Department of Physics, FMIPA UNP.
2. For teachers, as a source of information and alternative teaching materials that can be used in physics learning.
3. For students, as an alternative source of learning and can increase the independence of learning students in learning. For other researchers, as a reference or source of ideas for further educational research.