Validity and practicality book chapter’s model on thermodynamics and mechanical waves material integrated new literacy and disaster literacy of students for grade XI high school

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Abstract. In the 4.0 revolution era, 21st century skills are needed that will build superior human resources who can compete in their lives. One of the 21st century skills is literacy. However, the real conditions that occur indicate the lack of new literacy and disaster literacy abilities possessed by students. The solution made to overcome these problems is to develop a book chapter’s model integrated new literacy and disaster literacy. The type of research carried out is Research and Development (R&D) with Sugiyono's development. The instrument used was an instrument at the potential and problem stage consisting of observation sheets of physics learning implementation, document analysis sheets, and analysis sheets of students' initial knowledge tests in physics learning, then the validity test instruments and practicality test instruments. The results of data analysis from the research are book chapter’s model integrated with new literacy and disaster literacy with a validation value of 79.78 with good category and a practical value of 84.77 with excellent categories. So, it can be concluded that the book chapter’s model on thermodynamic and mechanical waves material integrated new literacy and disaster literacy is valid and practical for students of grade XI high school.

1. Introduction
The global society is currently facing the rapid development and advancement of technology. For this reason, the state needs superior human resources (HR) so that they are not left behind from other countries, especially in the 21st century which is full of competition. The 2015 World Economic Forum stated that human resources who are ready to face the times should have three pillars, namely mastery of literacy, competence, and character. Literacy is not just about reading and writing, but includes scientific literacy, information technology literacy, and financial literacy. With these three pillars, the country develops superior human resources who can compete in the 21st century.

The world of education has an important role in building superior human resources. According to Law No. 20 of 2003 concerning the national education system, what is meant by education is a conscious and planned effort to create an atmosphere of learning and the learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills. which is needed by himself, society, nation and state.
Education in a country is organized by means of an education system and is regulated in a curriculum. The 2013 curriculum is a curriculum that changes passive learning patterns in which students are told to learn and also change from the teacher as the only learning source to learning based on various learning sources. Because of the misunderstanding and difficulty of students in understanding a concept of learning, learning is only teacher-centered. Teacher-centered learning means that the teacher dominates the learning, while students are not actively involved in building concepts [1]. In this case the teacher only acts as a guide and facilitator for students to be able to develop their potential optimally [2].

The structure of the 2013 high school level curriculum based on the Regulation of the Minister of Education and Culture Number 36 of 2018 stipulates that physics is a compulsory subject for group C which is a curricular program. Physics subjects are aimed at developing attitudes, knowledge competencies, and competency skills of students according to their interests, talents and / or academic abilities in analyzing the phenomena of life and the environment. Halliday said that physics is a science that studies how the world works so that it is interesting [3]. In the world there have been many natural events such as earthquakes, tsunamis, flash floods and hurricanes. These natural phenomena are observed by physicists to try to find the principles of these natural phenomena [4]. Basically, the concept of learning physics can be understood by paying attention to daily activities, natural events and phenomena such as disasters. Such contextual learning must be applied to 21st century learning [5].

Indonesia is an archipelago located at the confluence of four tectonic plates, namely the Asian continent, the Australian continental plate, the Indian oceanic plate, and the Pacific oceanic plate [6]. Due to this geographical position, Indonesia is a country that has high potential for disasters. With this potential, it requires students and community awareness about disasters and the ability to avoid disaster risks, which is known as disaster management literacy or known as disaster literacy. The disaster information literacy factor is divided into four parts, namely knowing the source of disaster information, evaluating disaster information, organizing disaster information, and utilizing and delivering disaster information. As a real example, people who do not know the source of disaster information will be very confused about what types of disasters might occur in their area, how to deal with and overcome them [7].

Apart from disaster literacy, new literacy which is an important skill in the 21st century can also be trained in physics learning. New literacy is all efforts to gain knowledge and answer the challenges of the times with competency aspects of data literacy, technology and HR / humanism [8]. Literacy is divided into 3, namely data literacy, technological literacy and human literacy. Data literacy is literacy that focuses on reading data, writing data, and archiving data. Data must be widely understood, not only quantitative, but also qualitative. More specifically, data literacy is the ability to read, analyze, and use information (Big Data) in the digital world. Technological literacy is a follow-up to digital literacy which emphasizes the importance of introducing cyber media, social media, the messaging service to sort and choose. The essence of technological literacy is the development of science, the application of literacy pillars from conventional to digital, and engaging in reading, writing and disseminating information. While the general definition of technological literacy is the ability to understand how machines work, technology applications (coding / programming, artificial intelligence, and engineering principles). Human Resource Literacy. Human literacy can be understood as an ability to communicate, collaborate, think critically, creatively, and innovatively. In human literacy, a person is required to have leadership skills, teamwork, cultural agility, background / personality, and entrepreneurship (including social entrepreneurship) [9].

In physics learning, students can read data, take advantage of technology, and can cooperate with fellow students or with teachers in learning activities. In order for learning activities to achieve learning objectives and creating a conducive learning environment, it is necessary to apply a learning model that takes into account new literacy skills for students, namely data literacy, technology literacy and human literacy) [10]. The existence of good literacy skills will help students find and understand various learning resources such as oral, written, and visual texts that are needed in life [11].
literacy needs to be accustomed to various activities including learning physics, so that students become superior human resources who can face challenges and compete in the 21st century. Based on a preliminary study conducted at the SMA Pembangunan Laboratorium UNP, the learning conditions for the 2013 curriculum which was integrated with literacy had not been implemented as expected, both new literacy and disaster literacy [6]. There are three field conditions found for the application of new literacy and disasters in learning, especially physics learning. This condition is observed through three instruments, namely the observation sheet of the implementation of physics learning, the book analysis sheet, and the analysis sheet of the students’ initial knowledge test in class XI high school physics learning.

The first real condition relates to the integration of data literacy, technological literacy, human literacy and disaster literacy in learning physics. Based on the results of the observation sheet on the implementation of physics learning, the integration of new literacy and disaster literacy is still in the poor category. This can be seen from the value obtained for each of the new literacy indicators which include technology literacy, data literacy, and human literacy as well as disaster literacy.

The second real condition is obtained from analyzing five high school physics textbooks for grade XI based on the integration of new literacy and disaster literacy. Based on the results of the analysis, the average value of the analysis of the five books was 41.47. This shows that the integration of new literacy and disaster literacy in physics textbooks used by students is still in the poor category, so that it is not yet able to support students' new literacy skills and disaster literacy.

The third real condition is taken from the analysis sheet of the student's initial knowledge test in physics learning at 3 high school in Padang. The test was conducted by giving 20 items for the material that the students had studied with each question having integrated knowledge about new literacy and disaster literacy. Based on the results obtained, the average results of the students' initial knowledge test was 30.37. This illustrates that students' knowledge regarding new literacy and disasters is still low.

The impact of these real conditions creates a gap between the real conditions and the expected conditions. This results in low new literacy skills and student disaster literacy. The causes of low student literacy skills and the existence of misconceptions in the learning process include the students 'own factors, educators' factors, textbooks, learning context and teaching methods by educators [12]. Therefore, learning in the classroom, one of which is very dependent on textbooks. If the teacher does not meet the requirements, then the textbook is a guide and support in teaching. For students, textbooks serve as a basis for systematic learning, to reinforce, repeat, and to follow advanced lessons [13]. Because textbooks used in schools are still not integrated with new literacy and disaster literacy, the authors suggest the solution to this problem is to developing a model book chapter physics model integrated with new literacy and disaster literacy. The material written in this book chapter model model is thermodynamics and mechanical waves because in this material there are data that can be analyzed so that students are able to think critically, then communicate it and can be linked to technology which will later support the application of physics learning in the century 21. In addition, there are also natural disasters related to the material so that disaster mitigation efforts can be included which can increase students' knowledge about disaster management that occurs. In addition, there are also disasters related to the material so that disaster mitigation efforts can be included which can increase students' knowledge about disaster management that occurs.

Research relevant to this research is research written by Asrizal [14], Theresia [15], Asma [16]. In this study, there are several differences with relevant research, namely the first book chapter’s model on thermodynamics and mechanical waves integrated with new literacy and disaster literacy of student, second, book chapter’s model were made for grade XI high school, third, materials used in this book chapter’s model are thermodynamics and mechanical waves to improve students' new literacy skills and disaster literacy. The purpose of this study was to determine the validity and practicality of the book chapter’s model on the material of thermodynamics and mechanical waves integrated with new literacy and disaster literacy of students for grade XI high school.
2. Research Methods

This type of research is Research and Development (R & D). Research and development methods are research methods used to produce certain products and test the practicality and effectiveness of these products [17]. The product produced from this research is a book chapter’s model on thermodynamic material and mechanical waves which can improve new literacy and disaster literacy of students for grade XI high school. The steps taken in this study were initiated with planning by identifying potential and problems, then information gathering, creating product designs, product validation, product revisions, and product testing according to research and development procedures by Sugiyono.

![Figure 1. Research and Development Procedures][17]

The potential for this research was first seen based on the observation of supporting factors for physics learning in SMA Pembangunan Laboratorium UNP using observation questionnaire. While the problems that exist in SMA Pembangunan Laboratorium UNP are seen from observation sheet physics learning in schools, from the results of textbook analysis based on the integration of new literacy and disaster literacy used by students of SMA in Padang City and based on tests of students' initial knowledge related to new literacy and disaster literacy.

Information gathering is done by literature review of books and several articles. The information collected is related to the book chapter’s model, new literacy, disaster literacy, thermodynamic material and mechanical waves. The product that is designed is in the form of a book chapter’s model on thermodynamic material and mechanical waves. The book chapter’s model produced in this study is a book chapter’s model on thermodynamics and mechanical waves integrated with new literacy and disaster literacy of students for grade XI high school. The design form of the book chapter’s model can be seen in the image below.

![Figure 2. Design of the book chapter’s model][20]
The book chapter’s model developed has the characteristic of integrating new literacy and disaster literacy with a structure following the development guide for book type teaching materials. After the product has been designed, the product is validated. Product validation is carried out by a team of validators who are referred to as experts. The experts consist of three physics lecturers at the Faculty of Mathematics and Natural Sciences, UNP. After the product has been validated, a revision is made to some of the deficiencies obtained from the validator’s suggestions. The product that has been revised is then in limited trials for grade XI MIA 2 students at SMA Pembangunan Laboratorium UNP to be assessed for practicality.

The instrument used to determine the validity of the product was a validation sheet based on the indicators contained in the Ministry of National Education (2008) regarding the Guidelines for the Development of Teaching Materials. This indicator includes components of the feasibility of content, language, presentation, and graphics. This indicator is translated into several points to make it easier to analyze the advantages and disadvantages of the design book chapter’s model physics material, thermodynamics and mechanical waves integrated with new literacy and disaster literacy.

The practicality test instrument was used to determine student responses regarding the attractiveness and ability of this book chapter’s model to motivate students to learn and understand the material. The practicality test instrument according to the students is also arranged according to predetermined indicators based on the use of the physics book chapter’s model. The instrument indicators used were the ease of use of teaching materials, the attractiveness of the presentation, the clarity of the material and the benefits received by students using teaching materials integrating new literacy and disasters. These indicators are translated into several statements.

The validity and practicality instruments that have been made are in the form of questionnaires filled out by validators and practitioners. The value of the validation and practicality results is determined based on the interpretation criteria of the scores obtained. The following criteria are used to determine the validity and practicality of the physics book chapter’s model which is integrated with new literacy and disaster literacy. The following criteria are used to determine the validity of the book chapter’s model with new literacy and disaster literacy.

| Table 1. Validation and Practicality Criteria [18] |
|-----------------------------------------------|
| Interval | Category |
| 30-39    | Failed   |
| 40-55    | Less     |
| 56-65    | Enough   |
| 66-79    | Well     |
| 80-100   | Very well|

There are five criteria for the validity and practicality of the physics book chapter’s model. This validity and practicality assessment is determined based on the interpretation criteria of the scores obtained.

3. Result and Discussion
3.1. Research Result
The results of the research at the stage of searching for research potential were seen based on the observation of supporting factors for physics learning in SMA Pembangunan Laboratorium UNP to support physics learning activities in schools both in terms of curriculum, educators, facilities and infrastructure and the environment. While the first problem that is obtained is based on the results of the observation sheet of physics learning in the integration school for new literacy and disaster literacy in learning physics is still in poor criteria. Both the integration of new literacy and disaster literacy in physics text books used by students are still in the inadequate category, so they have not been able to support students' new literacy skills and disaster literacy. The text books namely are a physics textbook for class XI written by Mediatama, a physics textbook for class XI BSE, a textbook for class
XI by Marthen Kaingin, a textbook for class XI by Sunardi Paramitha, and a textbook for class XI by Media Pratama. The last problem is seen based on the average acquisition of the results of the students’ initial knowledge test, namely 30.37. This illustrates that students’ knowledge regarding new literacy and disasters is still low. This comparison is seen from the number of correct answers written by each student.

The information collected is related to the book chapter’s model, new literacy, and disaster literacy. The composition of the book framework according to the Ministry of National Education (2008) in the Teaching Material Development Guide, which contains the title, the competencies to be achieved, the content of learning materials, exercises, and evaluation.

Further information regarding new literacy. New literacy is something that is integrated into the book chapter’s model. New literacy includes three types of literacy, namely technological literacy, data literacy and human literacy. 1) Technological literacy is an understanding of how the tools work and their application. Technological literacy indicators include the ability to set experiments, use measuring tools, change variables and use the internet. 2) Data literacy is the ability to read, analyze and process data. Data literacy has several indicators that will be included in the book chapter model, such as the ability to read, analyze, communicate the results of data analysis, and make conclusions. 3) Human literacy is an individual’s ability to communicate and think.

The book chapter’s model that is designed has the characteristic of integrating new literacy and disaster literacy with a structure following the guidelines for developing teaching materials (Depdiknas, 2008). The content design of the book chapter’s model for the integration of new literacy and disaster literacy is integrated into the presentation of learning, training and evaluation materials.

Validity this book chapter’s model is seen from the expert validity instrument. The results of validity by experts are used to determine the feasibility of the book chapter model and guidelines in revising the design. Based on the instrument for assessing the validity of experts on the book chapter model, four assessment components were analyzed. The four components used are content, presentation, language, and graphic feasibility.

The number of experts validating the book chapter’s model is 3 physics lecturers of Faculty of Mathematics and Natural Sciences, UNP. Four experts validate the appropriateness of content, presentation, language and graphic. The lowest score for each statement is 1, while the highest score is 4. The average score of all indicators is converted into a value of 0-100. The following plots the value of the validation results for each component can be seen in Figure 1 below,

![Figure 3. Validation Results](image)

The results of the validation analysis for each component shown in Figure 1 above indicate that the value for the content eligibility component (K1) is 81.64. In the content feasibility component, new literacy, namely technology literacy, data literacy, human literacy and disaster literacy are integrated, which are included in several sub indicators. The integration of new literacy and disaster literacy is by including new literacy indicators and disasters in it, then calculating the feasibility of the content of each indicator of the content eligibility component. The presentation component (K2) is 83.33, the
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The language component (K3) is 70.83 and the graphic component (K4) is 83.33. The presentation component and the graphic component received the highest score, and the language component received the lowest score. The value of each validation component is averaged to obtain a value of 79.78.

The product testing that was carried out was a practical test of the book chapter’s model on thermodynamics and mechanical waves integrated with new literacy and disaster literacy for grade XI high school students. The practicality test was carried out by students who were obtained from the practicality questionnaire instrument given after the use of the book chapter’s model which was integrated with new literacy and disaster literacy. The following plot of the validation results of each component can be seen in Figure 2 below,

![Practicality Results](image)

**Figure 4. Practicality Results**

Based on the practical results of the book chapter’s model, the first component of the practicality instrument is ease of use (P1) scores 87.19, attractiveness component (P2) 83.18, clarity component (P3) 85.71 and student benefits (P4) 83. The integration of new literacy and disaster literacy is included in the student benefit component which is divided into several indicators, namely general benefits, technological literacy, data literacy, human literacy, and disaster literacy. Indicators on the benefit component for students are translated into sub indicators based on indicators of new literacy and disaster literacy. The results of the practicality analysis of each component shown in the picture above indicate that the lowest value is in the benefit component for students. While the highest value is found in the ease of use component with a value of 87.19. The value of each practical component is averaged so that the value of 84.77 is obtained. The practical results of the book chapter’s model integrating new literacy and disasters are included in the very good category.

3.2. Discussion

The results of the validation of the book chapter’s model which is integrated with new literacy and disaster literacy are classified as good because the book chapter’s model on thermodynamic material and mechanical waves integrated with new literacy and disaster literacy is made in accordance with the existing structure in the guidelines for making teaching materials in the Ministry of National Education [19] which consists of introduction, basic competencies and indicators, learning materials, training and evaluation. In addition, the book chapter’s model developed has met the validity criteria as expected, both in terms of content and construction, so it is suitable for use in learning. The validity results obtained are also in accordance with Theresia’s research [15] where the integrated science textbook is oriented to scientific literacy which is made valid because it contains components of content feasibility, presentation components, Presentation techniques and linguistic aspects as well as the appropriateness of the contents of scientific literacy competencies and science components are well integrated. The content eligibility component is very good. This is because the material in the
book chapter’s model has integrated new literacy and disasters according to the indicators which are integrated into the material, exercises and evaluations.

The presentation component gets a validation value that is categorized very well because the objectives and indicators are made in accordance with the achievement of competencies and the information contained in the teaching materials is complete. The linguistic component with the validity category is good because the information presented in the book chapter’s model is clear and the language used in the book chapter’s model is effective in accordance with Indonesian rules. The last component, namely the graphic design, gets the validity category very well because the use of the font (type and size) of writing in the book chapter’s model is proportional, and the cover image design represents the contents of the book chapter’s model, and the color combination on the cover is proportional.

The same result was also conveyed by Fitri [21] where practical teaching materials are teaching materials that are used to make learning more interesting to read and understand and integrate appropriate illustrations and relate directly to events around students and are also practical because they are appropriate with a sign of practicality conveyed by Andromeda [22], namely a sign of practicality of printed teaching materials, which can be easily used in the teaching and learning process by teachers and students. In addition, with the integration of new literacy and disaster literacy into material, exercises and evaluations in the book chapter’s model help students find and understand various learning sources such as oral, written, and visual texts that are needed in life [11]. So, it can be concluded that the integrated book chapter’s model of new literacy and disaster literacy is practically used in learning physics.

4. Conclusion
Based on the data analysis that has been done, there are two conclusions. First, the validity of the book chapter’s model on thermodynamic material and mechanical waves which is integrated with new literacy and disaster literacy of students for grade XI high school is in a good category in terms of content feasibility, presentation and graphics and good in terms of language. Second, the practicality of the book chapter’s model on thermodynamic material and mechanical waves integrated with new literacy and disaster literacy students for grade XI high school is in a very good category in terms of ease of use, attractiveness of offerings, clarity and benefits for students. The book chapter’s model can be implemented in the classroom to see the increase in new literacy and student disaster literacy.

References

[1] Mufit F, Festiyed, A Fauzan and Lufri 2019 The Application Of Real Experiments Video Analysis In The CCBL Model To Remediate The Misconceptions About Motion’s Concept. IOP Conf. Series: Journal of Physics
[2] Putrayasa I M, S. Syahruddin and I. Margunayasa 2014 Pengaruh Pembelajaran Discovery Learning & Minat Belajar terhadap Hasil Belajar IPA Siswa MIMBAR PGSD. vol. 2. no. 1
[3] Halliday and Resnick 2011 Fundamental Of Physics Ninth Edition United States of America: John Wiley and Sons, Inc
[4] Young and D. Hugh 2012. Fisika Universitas. Jilid 1. Jakarta: Erlangga
[5] Asrizal, A. Ali, Ananda, Festiyed and Sumarmin 2018. The Development Of Integrated Science Instructional Materials To Improve Students’ Digital Literacy In Scientific Approach, Jurnal Pendidikan IPA Indonesia, vol. 4, no. 7, pp. 442-50
[6] Mufit F, Asrizal, S. A. Hanum and F. Fadhilah 2020. Preliminary Research In The Development Of Physics Teaching Materials That Integrate New Literacy And Disaster Literacy. Journal of Physics: Conference Series. no. 1481
[7] Merlyono S G, G. K. Pasya and Nandi 2016. Pengaruh Literasi Informasi Bencana Terhadap Kesiapsiagaan Masyarakat Dalam Menghadapi Bencana Di Provinsi Jawa Barat. Jurnal Pendidikan Geografi. vol. 6. pp. 117-18
[8] Ibda H 2018 Penguatan Literasi Baru pada Guru Madrasah Ibtidaiyah dalam Menjawab Tantangan Era Revolusi Industri 4.0. *Journal of Resourch and Tough of Islamic Education*. vol. 1, pp. 1-21

[9] Anggaira A S 2019. Literasi Terkini Dalam Pembelajaran BIPA Pada Era Revolusi Digital. *Prosiding Seminar Nasional Pendidikan Program Pasca Sarjana Universitas PGRI Palembang*, p. 36

[10] Mufit F and A. Fauzan, 2019 *Model Pembelajaran Berbasis Konflik (PbKK)*, (Disertai Penerapan Untuk Remediasi Miskonsepsi Pada Sains Dan Matematika). Malang: CV IRDH

[11] Asrizal, A. Amran, A. Ananda and Festiyed 2018. Effectiveness of Adaptive Contextual Learning Model of Integrated Science by Integrating Digital Age Literacy on Grade VIII Students, *IOP Conf. Series: Materials Science and Engineering*, no. 335

[12] Mufit F, Festiyed, A. Fauzan and Lufri 2018. Impact of Learning Model Based on Cognitive Conflict Toward Student's Conceptual Understanding. *IOP Conf. Series: Materials Science and Engineering*, no. 335

[13] Muslich and Mansur 2010 *Text Book Writting*, Jakarta: Ar-Ruzz Media

[14] Asrizal, A. A, A. A, Festiyed and K. S 2018. Effectiveness Of Integrated Science Instructional Material On Pressure In Daily Life Theme To Improve Digital Age Literacy Of Students. *International Conference on Science Education*. no. 1006

[15] Theresia 2015. Pengembangan Buku Ajar Ipa Terpadu Berorientasi Literasi Sains Materi Energi Dan Suhu. *Journal of Innovative Science Education*. p. 2

[16] Hanum S A, F. Mufit and Asrizal 2019. Pengembangan LKS Berbasis Konflik Kognitif Terintegrasi Literasi. *Pillar of Physics Education*. vol. 12, no. 4, pp. 793-800,

[17] Sugiyono 2012. *Metode Penelitian Kuantitatif, Kualitatif, dan R & D*. Bandung: Alfabeta

[18] Arikunto 2015. *Dasar-Dasar Evaluasi Pendidikan*. Jakarta: Bumi Aksara

[19] Depdiknas. 2008. *Pengembangan Bahan Ajar*, Direktorat Pembinaan Sekolah Menengah Atas Direktorat Jenderal Manajemen Pendidikan Dasar dan Menengah Departemen Pendidikan Nasional

[20] Firmonia N A, Asrizal and F Mufit, 2020. Pengembangan Bahan Ajar Fisika Materi Fluida Terintegrasi Literasi Baru dan bencana untuk Meningkatkan Hasil Belajar Siswa Kelas XI. *Pillar of Physics Education*. vol. 13, no. 1, pp. 9-16

[21] Fitri H R, F. Mufit and Asrizal, 2020. Validitas dan Praktikalitas Bahan Ajar Materi Kalor dan Teori Kinetic Gas Mengintegrasikan Literasi Baru dan Literasi Bencana untuk Kelas XI SMA. *Pillar of Physics Education*. vol. 13, no. 1. pp. 169-176

[22] Andromeda, Ellizar, Iryani 2018. Validitas dan Praktikalitas Modul Laju Reaksi Terintegrasi Eksperimen dan Keterampilan Proses Sains untuk Pembelajaran Kimia di SM. *Jurnal Eksakta Pendidikan*. vol. 2. no 2