Simple Harmonic Motion Electronic Teaching Materials Based on Authentic Learning to Train Students' Problem-Solving Skills: Aspects of Validity

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Abstract. The absence of teaching materials that can train students' problem-solving skills optimally is the background of this research. This study describes the validity of simple harmonic motion electronic teaching materials based on authentic learning to train students' problem-solving skills. This research is development research with the ASSURE model that focuses on the Utilization of Instructional Materials stage. The instrument used is the validity sheet of electronic teaching materials. The validity of electronic teaching materials is viewed from the aspect of content, construct, and appearance. The validation of electronic teaching materials is carried out by three validators: two expert validators and one practitioner validator. The data analysis technique used descriptive statistics. The results showed that the validity of electronic teaching materials with an average score of 3.87 was categorized as good. It was concluded that the simple harmonic motion electronic teaching material based on authentic learning was declared valid to train students' problem-solving skills. Furthermore, these electronic teaching materials can be used as teaching materials in the classroom to determine the practicality and effectiveness of the developed teaching materials.

1. Introduction
Students in school need teaching materials that are closely related to the daily life of students so that students do not get bored in learning. Teaching materials that present real problems in physics learning are expected to train students' problem-solving skills. Problem-solving skills are generally defined as a person's ability to engage in cognitive processing to understand and solve a problem [1]. This problem-solving ability can be trained by suitable teaching materials, namely teaching materials related to physical matter and phenomena around [2]. So, such teaching materials are needed by teachers.

Based on the observations at one of the public high schools in Banjarmasin, it was obtained that students' problem-solving skills are still low. The lack of learning resources such as manuals is one of the contributing factors to learners' low level of problem-solving skills. In addition, the low mathematical ability of learners also affects the common problem-solving ability. Reddy & Panacharoensawad [3] also added that the low problem-solving skills of learners are caused by the inability of learners to understand the content of the material and the principles of physics in the form of formulas. Therefore, teachers should take initial steps to address the problem.

The solution that can be done to train students' problem-solving skills in physics subjects is to develop authentic learning-based teaching materials. Authentic learning in learning design is essential to create learning opportunities for students [4]. The use of authentic learning shows that knowledge and skills must be learned in a real-world context [5].
Authentic learning-based teaching materials are worth using to train students' problem-solving skills. Teaching materials that authentic associate learning with the region's culture can improve learners' understanding in practising problem-solving skills [6]. Using contextual-based teaching materials by integrating local wisdom is very used in physics learning [2]. Incorporating authentic learning in education allows long-term retention of what has been learned and improves understanding [7]. Therefore, students' problem-solving skills can be trained by developing simple harmonic motion electronic teaching materials based on authentic learning.

Integrating authentic learning-based teaching materials with the local wisdom of learners can improve learners' understanding in practising problem-solving skills. There are various physical concepts related to the local wisdom of South Kalimantan, one of which is the local wisdom of "Baayun Maulid", related to simple harmonic motion.

Researchers believe that developing authentic learning-based electronic teaching materials will pique learners' interests and make it easier for students to understand and solve the problems presented in the teaching materials. Bruner's theory of learning underlies learning with problem-solving, which explains that learners are encouraged to think and learn through problem-solving activities [8]. In addition, authentic learning must be set up so that students have the opportunity to practice their problem-solving skills [9]. Authentic learning is based on a constructivist view in which students create their understanding [10].

During pandemics like this, the need for teaching materials in electronic form is indispensable. One of the applications used to create electronic teaching materials is flip PDF professional. Teaching materials developed with professional PDF flip applications are worth using in the learning process [11] [12]. Flip PDF Professional has several advantages, including the resulting teaching materials that can be inserted into images, videos, animations, and simulations that can absorb interactive learning mediums so that learning becomes monotonous.

The use of electronic teaching materials can transform physics from less-liked subjects into students' favourite subjects. On the other hand, there is a significant change in the attitude of learners [13]. Electronic teaching materials are interactively designed and incorporate technologies that evolve [14]. The content of students' interactive electronic modules varies more by integrated inserting motion pictures (videos), animations, simulations, and materials.

The absence of authentic learning-based electronic teaching materials on this simple harmonic motion material caused researchers to produce the teaching material. Through this teaching material is expected to train students' problem-solving skills. This study aims to describe the validity of authentic learning-based electronic teaching materials using the Flip PDF Professional application. Electronic teaching materials are expected to be used as teaching materials that help students learn independently during the Covid-19 pandemic.

2. Methods
This study uses the ASSURE development model. This development model consists of four stages, as shown in Figure 1.

![Figure 1. Development stages](image-url)
The validity of electronic teaching materials is reviewed from the aspects of content, construct, and appearance. Data on the validity of teaching materials was obtained from the assessment of 3 validators, namely two expert validators and one practitioner validator. Electronic teaching material validation sheet instruments using scales 1 to 5. The validation result data is calculated in the form of an average score for each aspect of the assessment, then adjusted to the assessment criteria in Table 1.

**Table 1. Criteria for validation of electronic teaching materials**

| No | Average score | Category          |
|----|---------------|-------------------|
| 1  | \( \bar{x} > 4,2 \) | Very good         |
| 2  | \( 3,4 < \bar{x} \leq 4,2 \) | Good             |
| 3  | \( 2,6 < \bar{x} \leq 3,4 \) | Sufficiently good |
| 4  | \( 1,8 < \bar{x} \leq 2,6 \) | Less good        |
| 5  | \( \bar{x} \leq 1,8 \) | Not very good     |

3. Results and Discussions

The product developed is authentic learning-based electronic teaching materials adapted to the characteristics of simple harmonic motion materials and the characteristics of X-grade students at the high school level. Electronic teaching materials developed using multimedia software that is flip pdf professional. This electronic teaching material aims to train students' problem-solving skills and their application through direct teaching-learning models.

At the beginning of the meeting, authentic pictures and questions motivate students to be actively involved in learning. The electronic teaching materials developed contain authentic learning information about simple harmonic movements related to the environment of the learner's area, as stated in Figure 2 (a). Early knowledge in this electronic teaching material is presented in the corner of the recall (Figure 2b). As well as physical events related to learners' daily life, it is loaded in your know-how section. Electronic teaching materials also present an understanding test that is completed individually, as stated in Figure 2c.

![Figure 2](image)

**Figure 2.** a) Initial meeting view; b) Remembering corner view; c) Understanding test display

Competency tests are also provided on electronic teaching materials that are developed to find out the level of students' understanding of the lessons they have learned. The final part of the teaching material contains a bibliography as a reference source information used by researchers in developing electronic teaching materials. Problem-solving in this electronic teaching material uses Heller's problem-solving stages. First of all, students will be required to visualize the problem; at this stage, students will describe the physical situation of the physics problem presented. Then students must describe the problem, namely writing down the quantities that are known and asked. Then students plan solutions; at this stage, students write down concepts, principles, equations, and mathematical stages in
a coherent way to solve problems. Furthermore, students carry out the planned solution by substituting the values of the related physics quantities into mathematical stages. Finally, students evaluate solutions regarding the problem-solving stages that students have done. Three validators have validated this electronic teaching material. Here are the differences between the before and after validation teaching materials, as stated in Table 2.

| Differences before and after validation | Before | Validator Suggestion | After |
|----------------------------------------|--------|----------------------|-------|
| Every problem-solving activity be adapted to reality |        | Add motivational content | Work on student worksheets online |
Based on Table 2, it can be seen some differences between electronic teaching materials before and after revision. Revisions are made following suggestions and input from the validator. The validator requests that every problem-solving activity be adapted to reality. Therefore, the author includes an illustration video to strengthen the authentic learning content in this electronic teaching material. This allows students to observe directly through video to accelerate students' understanding in solving problems. The validator also asked to add motivational content to the teaching materials to increase students' enthusiasm in the learning process, so the author made a "Tahukah Kamu" presentation in the teaching materials to add insight and knowledge of students. The validator suggests that it is better to work on student worksheets online, and this can be done directly through teaching materials to shorten the time of learning implementation. In addition, the collection of student worksheets can be done quickly and in a short time to make the learning process more practical. To improve local wisdom in electronic teaching materials, the Validator asks to explain authentic learning that is applied to teaching materials. The validity of teaching materials seen in the assessment aspect can be observed in Table 3.

### Table 3. Validation results of electronic teaching materials

| No | Assessment Aspects | Average | Category |
|----|---------------------|---------|----------|
| 1. | Content             | 3.84    | Very Good|
| 2. | Construct           | 3.89    | Very Good|
| 3. | Display             | 3.87    | Very Good|

This electronic teaching material was developed to provide students with convenience in understanding physics concepts in simple harmonic motion materials and their application into daily life. Teaching materials designed to train students' problem-solving skills can also simultaneously train their high level of thinking skills through activities to explore surrounding problems to obtain a better conceptual understanding [15].

This electronic teaching material consists of front cover, steering cover, foreword, introduction, table of contents, instructions for using electronic teaching materials, concept map, competency achievement indicators, keywords, material description, authentic learning, problem-solving, "Tahukah Kamu", remembering corner, know the character, comprehension test, summary, essential material, competency test, glossary, bibliography, and answer key.

This electronic teaching material was developed about the internet subscription-based publication model to be accessible [16]. In addition, the development of electronic teaching materials using Flip PDF Professional is one of the solutions in answering educational challenges in the era of industrial revolution 4.0 [17].

Sub-material is divided into three, namely: characteristics of harmonic vibration, period and frequency of the spring, and period and frequency of simple swing. These electronic teaching materials are arranged in a systematic, sequential, and orderly manner. Systematics in this electronic teaching
material aims to make students' thinking activities run regularly. Thus, students can follow the flow of the material and easily understand the material presented [18].

Electronic teaching materials developed regarding language and readability aspects of electronic teaching materials must meet several standards, such as using sentences according to reasonable and correct Indonesian language rules. The sentence structure used must also be communicative and following the stage of language mastery of students. The same thing is also explained by Arsanti [19] that the language of suitable teaching materials must be communicative and easy to understand by students.

The last evaluation is used for the achievement of learners and their conformity to the standards that have been set. Evaluations are based on predetermined indicators and learning objectives. This is so that teachers can know the weaknesses or difficulties that students still face. This is in line with Tosuncuoglu's opinion that teachers should evaluate in order to classify students, make improvements, provide feedback, and develop appropriate teaching [20].

Furthermore, the validation of the constructs of simple harmonic motion electronic teaching materials that were developed fulfils the characteristics of authentic learning mentioned by [21] in (1) learning-centred on authentic tasks interesting for students. Authentic tasks in the form of solving real problems that are relevant to the lives of students; (2) students are involved in digging and investigating activities; (3) learning is interdisciplinary; (4) students learn to be active and driven by the students themselves, while teachers, parents, and resource persons are helpful or directing; (5) the teacher uses a scaffolding strategy, namely assisting as needed and letting students work freely when they can do it themselves; (6) students work with many sources (simple harmonic motion electronic teaching materials, and student worksheets); (7) students often work together and have broad opportunities to discuss to solve problems.

This electronic teaching material developed is designed using a direct teaching model. The direct teaching model helps learners learn declarative and procedural knowledge step by step. Through the direct teaching model, teachers can explain simple harmonic motion materials and problem-solving stages to students gradually. The problem-solving stage can be achieved well if the learning process in the classroom conditioned students are accustomed to solving the problem [22]. According to Arends [23], the direct teaching model is designed to gradually help learners master declarative knowledge and procedural skills. This reinforced the research results Amrita et al. [24] that direct teaching can improve students' problem-solving skills.

The developed electronic teaching materials are also made to train students in using their skills in solving a problem. Heller's problem-solving skills in this material are applied to solving sample questions and other practice questions in electronic teaching materials. Problem-solving skills [25], consist of 5 stages of problem-solving skills, namely (1) visualizing the problem; (2) describe the problem; (3) planning solutions; (4) implement solutions; (5) solution evaluation. This problem-solving stage is also the theoretical basis for developing simple harmonic motion electronic teaching materials containing authentic learning, which is contained in the evaluation criteria for the validation of electronic teaching materials.

Problem-solving skills are one of the essential skills of the 21st century, so it needs to be measured to know how readiness learners face the challenges of the 21st century [26]. This electronic teaching material presented authentic problems so that students are trained in solving problems in daily life. This authentic learning encourages learners to create a direct relationship between the new material being studied and their previous Mims [27]. Experiences like this will increase students' motivation.

Validation of the display of electronic teaching materials depends heavily on the role of visual communication. Layouts, colours, and themes on electronic teaching materials are made consistent at every meeting. The appearance of electronic teaching materials also relies heavily on the cover; the cover design is created with a combination of bright colours and an authentic cover image that attracts students to open and read the teaching material. Electronic teaching materials can be characterized as fully electronic hypertext interactive learning materials [28]. Thus, electronic teaching materials contain text and elements that can attract learners' attention.
The electronic teaching materials developed have a clear and appropriate numbering system, type, and size of letters, namely using the Comic Sans MS font with a font size of 14 which makes the appearance of the letters not monotonous and visible. In terms of design and space/layout in the content of electronic teaching materials, it is appropriate, with the balanced placement of authentic text and illustrations, to understand the material presented efficiently. According to [29], the presentation aspect relates to the method used in packaging teaching materials to be easy to understand and interesting for students. Judging from the presentation aspect, the teaching materials are arranged systematically and following the learning indicators. The teaching materials developed are also accompanied by language that invites or motivates. The goal is that students are more enthusiastic about completing all the stages contained in the teaching materials.

This electronic teaching material obtains a validity assessment with a good category. These results show that the teaching materials developed to meet the standards of good teaching material characteristics and can be used [30]. Thus the content of electronic teaching materials based on authentic learning can be tested in the learning process.

4. Conclusion
Simple harmonic motion electronic teaching materials based on authentic learning are declared valid and can train students' problem-solving skills. In addition, this teaching material can be used later to know the practicality and effectiveness of the developed teaching materials.

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References
[1] Shute V J, Wang L, Greiff S, Zhao W and Moore G 2016 Measuring problem solving skills via stealth assessment in an engaging video game Comput. Human Behav. 63 106–17
[2] Satriawan M and Rosmiati R 2017 Pengembangan Bahan Ajar Fisika Berbasis Kontekstual Dengan Mengintegrasikan Kearifan Lokal Untuk Meningkatkan Pemahaman Konsep Fisika Pada Mahasiswa JPPS (Jurnal Penelit. Pendidik. Sains) 6 1212
[3] Reddy M V B and Pancharoensawad B 2017 Students Problem-Solving Difficulties and Implications in Physics : An Empirical Study on Influencing Factors J. Educ. Pract. 8 59–62
[4] Herrington J, Reeves T C and Oliver R 2010 A Guide to Authentic e-Learning (London & New York: Murdoch University)
[5] Kartoglu U, Vesper J, Terás H and Reeves T 2017 Experiential and authentic learning approaches in vaccine management Vaccine 35 2243–51
[6] Ridho M H, Wati M, Misbah M and Mahtari S 2020 Validitas Bahan Ajar Gerak Melingkar Berbasis Authentic Learning Di Lingkungan Lahan Basah Untuk Melatih Keterampilan Pemecahan Masalah J. Teach. Learn. Phys. 5 87–98
[7] Smeds P, Jeronen E and Kurppa S 2015 Farm education and the value of learning in an authentic learning environment Int. J. Environ. Sci. Educ. 10 381–404
[8] Maulida M, Wati M and An’ nur S 2015 Pengembangan Bahan Ajar Berbasis Pendidikan Karakter Dalam Mendukung Implementasi Kurikulum 2013 Berk. Im. Pendidik. Fis. 3 11
[9] Iucu R B and Marin E 2014 Authentic Learning in Adult Education Procedia - Soc. Behav. Sci. 142 410–5
[10] Roach K, Tilley E and Mitchell J 2018 How authentic does authentic learning have to be? High. Educ. Pedagog. 2696 1–15
[11] Sriwahyuni I, Risdianto E and Johan H 2019 Pengembangan Bahan Ajar Elektronik Menggunakan Flip Pdf Professional Pada Materi Alat-Alat Optik Di Sma J. Kumparan Fis. 2 145–52
[12] Susanti T, Kurniadiw F and Nurjayadi M 2021 Development of Protein Metabolism
Electronic Module by Flip PDF Professional Application *J. Phys. Conf. Ser.* **1869**

[13] Zahorec J, Haskova A and Munk M 2010 Impact of Electronic Teaching Materials on Process of Education - Results of an Experiment *Informatics Educ.* **9** 261–81

[14] Suwatra W, Suyatna A and Rosidin U 2018 Development of Interactive E-Module for Global Warming to Grow of Critical Thinking Skills *Int. J. Adv. Eng. Manag. Sci.* **4** 543–9

[15] Trevathan J and Myres T 2013 Towards Online Delivery of Process - Oriented Guided Inquiry Learning Techniques in Information Technology Courses Motivation for adopting POGIL for use in online courses *IEEE Trans. Syst. Man, Cybern. Part A Systems Humans* **6** 1–11

[16] Sawyer S K 2002 Electronic books: Their definition, usage and role in libraries *Libres* **12**

[17] Misbah M, Sasmita F D, Dinata P A C, Deta U A and Muhammad N 2021 The validity of introduction to nuclear physics e-module as a teaching material during covid-19 pandemic *IOP Conf. Ser. Earth Environ. Sci.* **1796**

[18] Prasetiyo N A and Pertiwi P 2017 PENGEMBANGAN BUKU AJAR BERBASIS LINGKUNGAN HIDUP PADA MATAKULIAH BIOLOGI DI UNIVERSITAS TRIBHUWANA TUNGGADEWI The Development of Environment based Textbook in Biology Course at Tribhuwana Tunggadewi University *J. Pendidik. Biol. Indonesia* **3** 19–27

[19] Arsanti M 2018 Pengembangan Bahan Ajar Mata Kuliah Penulisan Kreatif Bemuatan Nilai-Nilai Pendidikan Karakter Religuis Bagi Mahasiswa Prodi Pbsi, Fkip, Unissula *KREDO J. Ilm. Bhs. dan Sastra* **1** 71–90

[20] Sasmita F D 2020 *Pengembangan modul elektronik bermuatan literasi sains melalui pengajaran langsung pada materi hukum gravitasi newton skripsi*

[21] Budiyanto M A K 2016 *Sintak 45 Model Pembelajaran dalam Student Centerd Learning (SCL)*

[22] Susanto H A 2015 *Pemahaman Pemecahan Masalah Berdasar Gaya Kognitif* vol 1 (Yogyakarta: Deepublish)

[23] Arends R I 2015 *Learning to Teach* (New York: The McGraw Hill Companies)

[24] Amrita P D, M. Arifuddin J and Misbah M 2016 MENINGKATKAN KEMAMPUAN PEMECAHAN MASALAH SISWA MELALUI MODEL PENGAJARAN LANGSUNG PADA PEMBELAJARAN FISIKA DI KELAS X MS 4 SMA NEGERI 2 BANJARMASIN *Berk. Ilm. Pendidik. Fis.* **4** 248–61

[25] Heller P, Keith R and Anderson S 1992 Teaching problem solving through cooperative grouping. Part 1: Group versus individual problem solving *Am. J. Phys.* **60** 627–36

[26] Hidayat S R, Setyadin A H, Hermawan H, Kaniawati I, Suhendi E, Siahaan P and Samsudin A 2017 Pengembangan Instrumen Tes Keterampilan Pemecahan Masalah pada Materi Getaran, Gelombang, dan Bunyi *J. Penelit. Pengemb. Pendidik. Fis.* **3** 157–66

[27] Mims C 2003 Authentic learning: A practical introduction & guide for implementation *Meridian 6*

[28] Klement M, Dostál J and Marešová H 2014 Elements of Electronic Teaching Materials with Respect to Student’s Learning Styles *Procedia - Soc. Behav. Sci.* **112** 437–46

[29] Habibi M, Chandra C, Mahyuddin R and Hendri S 2018 Validity of Teaching Materials for Writing Poetry Based on Creative Techniques in Elementary Schools *Mimb. Sekol. Dasar* **5** 145

[30] Sugiyono 2015 *Metode Penelitian Pendidikan. Pendekatan Kuantitatif, Kualitatif, dan R&D* (Bandung: Alfabeta)