

Development of Physics Book Based on Local Wisdom in an Attempt to Foster Science of Literacy for Students

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Abstract—Book for the student is one of the supporting items in today's Indonesian learning process. Physics book based on local wisdom aims to enhance learner science literacy, particularly in physics class. The study used a qualitative approach with research and development method. The subject in this research is two students who attained the highest and the lowest score in science literacy test in SMA 8 Maros. The results showed that the book based on local wisdom is valid, practical, and effective to enhance student science literacy.

Keywords—local wisdom, science literacy, the supplementary book

I. INTRODUCTION

In the regulation of the Minister of National education about Standard academic qualification and competence of teachers, there is one grain of professional competence must be owned by teachers in SMA. The materials learning developed by teachers can be packaged in various forms of learning materials, one of which was the print materials, such as books, handouts, and worksheets. On each execution of the Education and practice of the teaching profession (PLPG) which takes place during this time in Indonesia, one of the obligations of each participant is doing practice develop learning material in the form of "books/learning materials " with the format provided. Although in PLPG each participant required to compose books/learning materials only refer to one Basic of Competence (KD), but the experience is expected to be the initial step in composing books/learning material that is broader and more inside. The teacher should interpret that any materials used to reach the standards of competence of graduates set by the government. [1]

Along with the establishment of the 2013 curriculum in the territory of a unitary State of Republic Indonesia, the teacher must be able to develop material of learning according to the demands of the curriculum through 2013 with the movement National Literacy (GLN) that took place beginning in 2017. In the context of GLN, science literacy principles in Indonesia are formulated, namely: (1) contextually, in accordance with the local wisdom and the times; (2) the fulfillment of social needs, culture, and the State of the Union; (3) in accordance with the quality standards of learning are already aligned with the learning of the XXI century; (4) the holistic and integrated with various other literacy; and (5) collaborative and

participatory. The principles of this science literacy must be implemented in the process of learning science in school, including in the process of learning physics in high school [2].

In the implementation of the learning process, the book as one of the learning materials occupies a position that largely determines the achievement of learning objectives. Thus, it is the responsibility of the professional teacher learning should be implemented so that they manage to become more qualified, in accordance with the demand of the 21st century. One of them is the ability to develop material in the form of textbooks and supplementary book learning that leads to the development of scientific literacy learners.

Specialized in learning physics in SMA education, a unit of textbooks used relatively the same as finding a password, i.e., the SMA physics textbook has the percentage literacy of science categories that are less prevalent, the category of knowledge science 56.2% compared to another science category [3]. In addition, the textbook of physics not yet fully accommodate the basic principles of science literacy, especially the principle of the number 1 (contextual, in accordance with the local wisdom and the times). Therefore, needing a book of supplementary held in accordance with the principles. Supplementary book has its own characteristics, namely: (1) in accordance with regulation of the Minister of education and culture of the Republic of Indonesia number 8 the Year 2016 About Books used by units of education; (2) the learning of physics material contains contextual and appropriate local wisdom; and (3) serve as enrichment materials on the subjects of physics textbooks, aims to improve science literacy learners as the demands of the times.

The development of supplementary book the physics begins with preliminary studies at SMAN 8 Maros with the following results.

- Initial science literacy Ability in Physics for students of Class XI MIA in accordance with the findings of Rizkita et al., IE the ability of early science literacy of students in the city of Malang still low [4].
- definition of the subjects of physics teachers against literacy science belongs to low.
- There is local wisdom type of artifact (Prophet's Muhammad Birth Festive) Physics rule-rich and

potentially raise science literacy learners SMA Negeri 8 Maros when packaged in book form.

- d. Learners SMA Negeri 8 Maros always involved directly or indirectly in the manufacturing process the Prophet's Muhammad Birth Festive, but they are less interpret of norms of physics contained therein.
- e. The subjects Physics Teacher SMA Negeri 8 Maros never puts Prophet's Muhammad Birth Festive directly or indirectly into the context of learning in order to enrich, deepen, and/or strengthen the physical material being studied.
- f. There are no artificial supplementary book teacher physics subjects oriented to increasing science literacy learners SMA Negeri 8 Maros.

Physics subjects Teacher SMA Negeri 8 Maros has not had the inspiration of developing/compiling the book of supplementary-based local wisdom to improve science literacy learners.

II. METHOD

This study uses design research and development (Research and Development) of the Borg and Gall modified [5]. In this study, only its implementation until the stage of Product Revision 1, as in the picture below.

Follow the product development stages according to Thiagarajan et al. are known by the acronym 4 D (define, design, develop, and disseminate) [6]. In a limited study, phases define, design, and develop.

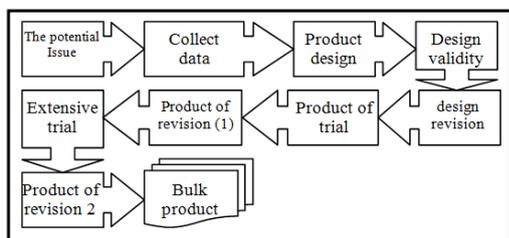


Fig. 1. Stages of research

On the stage of the analysis, the component defines of default and the regularity of the raw relationship with literacy science relating to physics. Based on the analysis results of the formulated definitions of book learning supplementary contains the manufacturing process the raw content of interfacing, and in the event of Maulid laden with rules of physics.

At the stage of design, developed the main components of the book, namely: (1) introduction; (2) instructional material in physics; and (3) exercise. On the part of the introduction contains the basic history' for the community and the importance of Maros preserved as one form of local wisdom. On the learning materials section contains the implementation of the rule of Physics in the raw ' with based on the formula of Competence basic knowledge for the students of Class XI MIA, i.e. "applying the concept of torque, moment of inertia, point to weight, and the angular momentum on objects overdrive in everyday life". On the part of exercise learners confronted with a number of problems, questions, and questions that could spur increased science literacy learners.

On the stages of development, performed the initial prototypes based on the arrangement of the components

defined in the design stage. The initial prototype further validated by two experts who have experience in the writing of the book, particularly textbook. Based on the advice of both the revision carried out repairs for validator tests is limited. According to Setyosari, in the limited trials can involve 1-3 people [7]. In the study set 2-person learners class XI MIA SMA Negeri 8 Maros, namely: 1 a person who obtains 30 (highest) scores and 1 person who obtains a score of 3 (the lowest) in the initial tests of sciences literacy. Based on limited conducted trial results revision products (1) and accommodate the experience of teachers and learners in using such products in learning physics.

Research instrument used in this study consists of (1) instruments validity and be supplementary book assessment format which is assessed by two expert validators; (2) the form of practicality assessment instruments is practically not book supplementary that will be used by two practitioners; and (3) the effectiveness of the instruments in the form of science literacy ability test and perceptions of learners and educators to books supplementary used.

Data analysis techniques used in this research is the justification expert/experts many as 2 (two), using the techniques of analysis of Gregory. The supplementary book is said to be valid if the results of the analysis of the data show that the book is developed in the supplementary category is valid with a value of reliability $(r) \geq 0.75$.

The supplementary book is said to be practical when results data analysis 2 (two) practitioners stating that the book supplementary used the learners are in the category were carried out properly. While the book supplementary is said to be effective if retrieved science literacy ability enhancement learner and learner response criteria to books supplementary used.

III. RESULT AND DISCUSSION

The research resulted in a book of supplementary products that serve as amplifiers textbooks so as to increase science literacy learners. The material in this book is limited to Basic Competency Curriculum Knowledge 2013 (Permendikbud Number 24 years 2016) stating "applying the concept of torque, moment of inertia, center to weight, and the angular momentum on a rigid body (static and dynamic) in the life for example in the daily sport.

Data results score validity of supplement book are shown in the table below.

TABLE I. THE RESULT OF SCORE VALIDITY

Indicator/Aspect	Average Score
Material	3.7
Construction	3.7
The Language	3.3
The Overall Average	3.6

Aspects of the material book supplementary are a very valid category. The valid category refers to the valid category which had been used by Report. This refers to (1) the suitability of the material against SK and KD; (2) the material in the book refers to an environment that made learning resources; (3) has the feel of local wisdom as part of a major component of science literacy.

Construction books supplementary aspects are a very valid category. It is well-grounded because the book has supplementary; (1) a complete presentation of the systematics and coherently; (2) it has sentences, images, and illustrations are clear and balanced book size is based on the ISO standard; (3) the size and shape of the letter as well as the layout of the balance.

Aspects of the language of the book of supplementary are on the category of valid. It is well-grounded because the book supplementary has: (1) the language used to follow the intellectual level of development, social and emotional learners; (2) the language communicative and easy to understand; (3) an idea published in the book supplementary was developed in ECE and coherently. The form of the book of supplementary can be seen in Fig. 2.

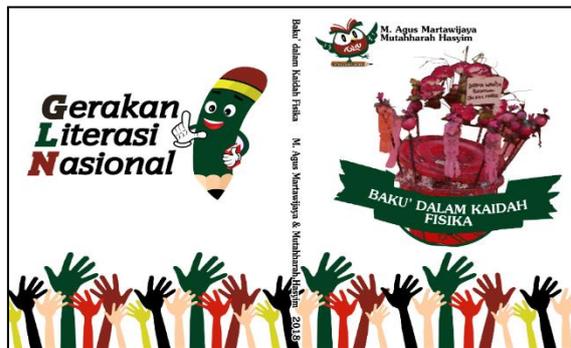


Fig. 2. Book cover supplementary

The book of Supplementary consists of 4 main components namely science as torso knowledge, science as a way to investigate, science as a way of thinking, and the interactions of science, technology, and society. The components of the science as the torso on the books of knowledge supplementary it can be seen on footage content supplementary on images below.

<p>Satuan dari momen gaya atau torsi ini adalah N.m yang setara dengan joule.</p> <p>Momen gaya yang menyebabkan putaran benda searah putaran jarum jam disebut momen gaya positif. Sedangkan yang menyebabkan putaran benda berlawanan arah putaran jarum jam disebut momen gaya negatif.</p>  <p>Gambar 3.2. Pemikul Air www. google.com</p> <p>Besar momen gaya yang bekerja pada batang bergantung pada besar gaya yang diberikan dan panjang lengan momen. Semakin besar gaya yang diberikan, semakin besar momen gayanya. Demikian juga jika lengan momen semakin besar maka semakin besar pula momen gayanya. Lengan momen adalah jarak tegak lurus sumbu rotasi ke arah gayanya.</p> <p style="text-align: center;">- 23 -</p>	<p>Pada contoh gambar di atas panjang lengan momen gaya adalah OB dan OA. Jika titik O sebagai titik poros atau titik acuan maka momen gaya yang disebabkan oleh gaya F₁ dan F₂ adalah sebagai berikut:</p> <p>Momen gaya yang disebabkan oleh gaya:</p> $F_1 : \tau_1 (\text{tau}) = + F_1 \cdot d_1 \quad (3.2)$ <p>Momen gaya yang disebabkan oleh gaya:</p> $F_2 : \tau_2 = -F_2 \cdot d_2 \quad (3.3)$ <p>Pada sistem kesetimbangan resultan momen gaya selalu bernilai nol, sehingga dirumuskan:</p> $\sum \tau = 0 \quad (3.4)$ <p>Pada permainan jungkat-jungkit saat kondisi setimbang dicapai yaitu saat batang mendatar terhadap bidang datar, dapat diterapkan resultan momen gaya = nol. Dengan demikian, resultan momen gaya yang bekerja dirumuskan:</p> $\sum \tau = 0 \quad (3.5)$ $-F_1 \cdot d_1 + F_2 \cdot d_2 = 0 \quad (3.6)$ $F_1 \cdot d_1 = F_2 \cdot d_2 = 0 \quad (3.7)$ <p>Pada mekanika dinamika untuk translasi dan rotasi banyak kesamaan-kesamaan besaran yang dapat dibandingkan simbol besarnya. Adapun analogi gerak</p> <p style="text-align: center;">- 24 -</p>
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Fig. 3. Science as knowledge torso

Components of science as a way of investigating that is contained in the book of supplementary is demonstrated by a snippet of content supplementary on images below.

Dalam gambar ini menunjukkan jari telunjuk melakukan torsi terhadap sumbu putarnya dan ibu jari juga melakukan torsi terhadap sumbu putarnya.



Gambar 4.4. Torsi pada Anyaman

c. Bagian alas yang telah dibuat akan memiliki bagian yang belum teranyam seperti pada gambar.

Bagian bambu yang belum teranyam akan diputar dari posisi horisontal ke arah vertikal sebesar 90 derajat.



Gambar 4.5. Sumbu Putar pada Anyaman

- 46 -

$$L = mr^2 \frac{v}{r}$$

$$L = mrv$$

Hukum Kekekalan Momentum Sudut:

“jika tidak ada momen gaya yang bekerja pada sistem, maka momentum sudut benda yang berotasi adalah tetap.”.

Secara matematis dirumuskan:

$$\sum \tau = 0 \quad (3.23)$$

$\frac{dL}{dt} = 0$, maka L konstan sehingga:

$$I_1 \omega_1 = I_2 \omega_2 \quad (3.24)$$

Soal Hukum Kekekalan Momentum Sudut pada Gerak Rotasi

1. Sebuah bola pejal dengan jari-jari 10 cm dan massa 5 kg berotasi dengan sumbu sebagai porosnya. Mula-mula dalam keadaan. Kemudian bola mengalami percepatan sudut $0,2 \text{ rad/s}^2$. Tentukan besar momentum sudut bola pada detik ke 10!
2. Sebuah roda memiliki massa 40 kg dan diameter 120 cm. Roda tersebut berputar dengan kecepatan sudut 5 rad/s. Hitunglah besar momentum sudutnya!

- 43 -

Fig. 4. Science as a way to investigate

Components of science as a way of thinking that is contained in the book of supplementary is demonstrated by a snippet of content supplementary in the picture below.

Gambar di atas menunjukkan bagian bambu yang belum teranyam melakukan torsi dengan gaya sebesar F dengan sumbu putar seperti yang ditunjukkan oleh gambar. Besar gaya F mengarah 90 derajat ke arah vertikal.

$$\vec{\tau} = \vec{r} \cdot \vec{F} \quad (4.1)$$

$$\tau = r \cdot F \sin \theta \quad (4.2)$$

d. Bagian bambu yang telah di putar ke atas kemudian dianyam antara sisi satu dengan sisi lainnya seperti pada gambar.

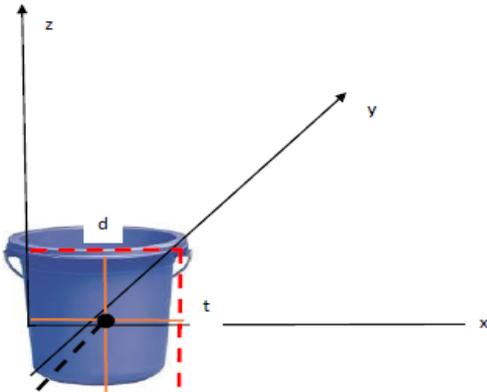


Gambar 4.6. Seseorang sedang Menganyam
www.google.com

Posisi tangan pada bagian menganyam dinding bakul harus memiliki kerja sama dengan baik antara tangan kiri dan tangan kanan untuk membuat setiap bagian bambu saling menjepit dan membentuk anyaman yang kuat.

- 47 -

Jika melihat bentuk ember maka ember ini memiliki bentuk tabung. Untuk menentukan titik beratnya maka bentuk ember dimasukkan dalam kurva *cartesius*.



Gambar 4.11. Kurva Cartesius pada Ember
Dokumen Pribadi

Dengan berdasar pada gambar di atas maka dapat ditentukan bahwa koordinat titik berat ember adalah

$$R = \frac{1}{2} d \text{ atau vektornya } (\frac{1}{2} x, \frac{1}{2} y) \quad (4.3)$$

$$Z = \frac{1}{2} \cdot T \quad (4.4)$$

- 50 -

Fig. 5. Science as a way of thinking



Fig. 6. The interactions of science, technology, and society

Component of the interactions of science, technology, and society contained in the book of supplementary is demonstrated by a snippet of content supplementary in the picture below.

The practicability of the book Supplementary Learning physics-based local wisdom is shown in table 2.

TABLE II. DATABOOK PRACTICALITY SUPPLEMENT BOOK

Aspect	The Category Of Practicality
Early Learning Activities	Good
Core Learning Activities	Good
End of learning activities	Good

The practicality of the use of the supplementary book on early learning activities is good. It is well-grounded because educators make use of the material in the book supplementary to motivate and prepare learners to learn meaningfully. The motivation for learning activities conducted by educators refers to Robert m. Gagne and preparing for learners to learn to refer to Jerome s. Bruner. In addition, educators conducting activities referring to David Ausubel, i.e., the activities setup (advance organizer). These activities aim to link the knowledge already owned by the learners with the new knowledge that will be studied.

The practicality of the use of the supplementary book on core learning activities is good. This is quite reasonable because there are a number of activities on the students who ask questions are oriented to the rules of physics that apply to raw components Maul found in the book supplementary. These activities facilitated by educators which refer to the

phase of introduction in the learning events, according to Robert m. Gagne and Permendikbud number 22 the Year 2016. In addition, the educator facilitates learners in groups in resolving the question of the exercise of the supplementary book. Grouping learners are facilitated by educators to refer to the establishment of cooperative group learning the Practicality of the use of the book supplementary at the end of the learning activity is good. This is quite reasonable because on this activity learners are to facilitate educator group to conclude the learning outcomes by engaging the material in the book of supplementary. In addition, educators conduct follow-up activities in the form of granting the outer class to supports the achievement of basic competencies the skills stated: "makes papers that apply the concept of point weight and rigid body equilibrium." Competence this basis is inseparable with the material competence of the basic knowledge that is contained in the supplementary book.

Overview of the effectiveness of supplementary book is shown in the table below.

TABLE III. DATA ON THE EFFECTIVENESS OF SUPPLEMENTARY ON THE SUBJECT OF BOOK 1

Aspect	Close to initial tests	Test product 1
Science as knowledge	0	4
Science as a way to investigate	1	8
Science as a way of thinking	1	10
The interactions of science, technology, and society	1	8
Total Score	3	20

TABLE IV. DATA ON THE EFFECTIVENESS OF SUPPLEMENTARY ON THE SUBJECT OF BOOK 2

Aspect	Close to initial tests	Test product 1
Science as knowledge	5	10
Science as a way to investigate	10	15
Science as a way of thinking	5	12
The interactions of science, technology, and society	10	17
Total Score	30	54

The effectiveness of this supplementary book explains to increase of the score obtained by both learners from initial tests to test 1. Both learners who became the subject of the trial showed a significant increase in the components of the science as the torso component, but knowledge of science as a method of investigation, science as a way of thinking, and the interactions of science, technology, and the community has also increased.

IV. CONCLUSION

Physics book supplement was found in the category of valid and effective I enhancing science literacy of learners.

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