

Development of Wood and Pulp Chemicals in Wood Sub Materials and Fiber Morphology as Teaching Material Supplements

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Abstract: This development research aims to develop wood and pulp chemicals in wood and fiber morphology as supplementary teaching materials for students of the Chemical Education study program at Sriwijaya University using the 4STMD (Four Step Teaching Materials Development) method. The steps of the 4STMD method, namely the first stage is the selection stage, carried out by analyzing needs, curriculum and analyzing the material by looking for references in various sources. The second stage, namely the structuring stage, is carried out by adding or subtracting material and compiling the material. The third stage is the characterization stage, carried out by developing the results of material analysis. The fourth stage is the didactic reduction stage, but the researcher did not carry out the didactic reduction stage. Data collection techniques used in the form of interviews, pre-research questionnaires and validation questionnaires. In the material validation test, the validity of teaching materials was obtained based on the Aiken coefficient of 0.75 which was categorized as high. Based on these results, it shows that the development of wood and pulp chemicals in wood sub-materials and fiber morphology has met the valid criteria.

Keywords: Constructivism Needham's 5-phases; Qualitative analysis of protein; Student perception

Introduction

Online lectures are lecture systems that use internet services as online media designed to be used in the learning process. In online lectures, lecturers and students must prepare learning tools or materials that can support teaching and learning activities. The online media used for online lectures is carried out with several applications or internet services such as Zoom Meeting, Google Meet, E-learning, WhatsApp Group, Google Classroom and others.

E-learning is a modern way of learning that includes electronic media in the field of education (Agarwal & Pandey, 2013; Du et al., 2013; Garad et al., 2021). E-learning involves various types of media that provide audio, video, text, and images (Ehlers, 2011; Buhari & Roko, 2017; Chow & Croxton, 2017; Divayana,

2017). The internet has enabled online learning to improve student learning outcomes, it is very important for educators to consider the effectiveness of online learning rather than face-to-face (Zhao et al., 2005; Nguyen, 2015). Effectiveness can be measured by looking at students' interest in learning activities (Bartley & Golek, 2004; Xu et al., 2014). Through the online lecture system, students must learn independently and take the initiative to develop their potential and insights. Therefore, educators or lecturers must be able to develop teaching materials for the effectiveness of online learning (Wang et al., 2006; Florin et al., 2011).

Teaching materials are learning tools used by teachers in the learning process (Busljeta, 2013; Yeagley et al., 2016; Kapur, 2019). Teaching materials are all forms of materials, both written and unwritten, which

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are used to help teachers carry out learning and become materials for studied by students in order to achieve predetermined competency standards (Pannen & Purwanto, 2001; Brydges, 2016). Teaching materials contain a set of materials that are arranged systematically in such a way that teachers and students can use them in the learning process (Kadtsyna et al., 2022).

The development of teaching materials must pay attention to several aspects to help students learn independently and master the learning process, such as providing examples or illustrations according to the intended learning material, providing practice questions or assignments as feedback for students to measure contextually, and using simple language to facilitate students' independent understanding of the material (Widodo & Jasmadi, 2008).

Tarigan et al. (2009) stated that the failure to attract students' interest was caused by teaching materials that did not meet the eligibility standards. The Development of Teaching Materials (4STMD) developed by Anwar (2019) includes selection, structuring, characterization and didactic reduction. At each stage, reviews and assessments are carried out by experts to minimize the weaknesses of teaching materials so that they can meet the eligibility criteria. The 4STMD model has a different step from other teaching materials development methods, namely didactic reduction. Didactic reduction is a strategy to reduce the difficulty level of teaching materials so that they are easier to teach.

Based on the results of the questionnaire distributed to students, as many as 80% of students stated that the chemistry of wood and pulp in wood material and fiber morphology is a difficult material to understand, as many as 97% of students stated that students need material development in order to help complement student learning resources.

Method

The type of research carried out by the researcher is Development Research with a qualitative approach to produce certain products, namely the development of wood material and fiber morphology in wood and pulp chemistry courses using the 4STMD (Four Steps Teaching Material Development) model or method.

The research was conducted at the Chemistry Education Study Program, FKIP Sriwijaya University from November 2021 to May 2022. The research subjects were chemistry education students class 2018 FKIP Sriwijaya University who had taken Wood and Pulp Chemistry courses. The object of this research is the development of wood material and fiber morphology using the 4STMD method.

In this research procedure, the researcher developed wood material and fiber morphology with the 4S TMD (Four Steps Teaching Material Development) development model that had been developed by Anwar (2019) which had four stages, namely selection, structuring, characterization and didactic reduction, only do the selection, structuring and characterization.

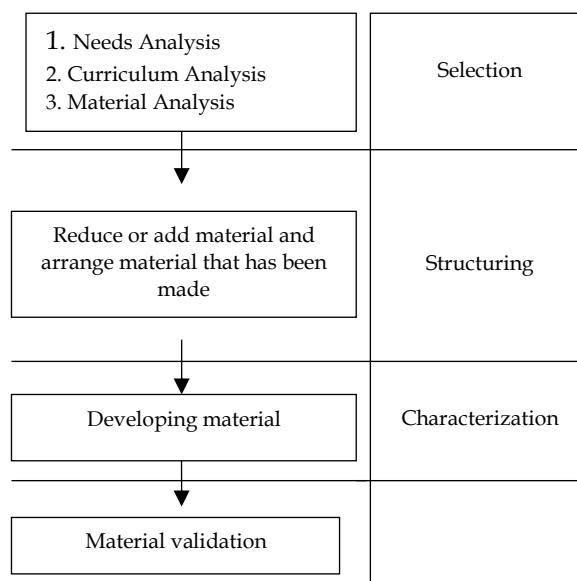


Figure 1. Research procedure

The data collection technique carried out by researchers through interviews was carried out on lecturers of wood and pulp chemistry courses at the Chemistry Education Study Program, FKIP Sriwijaya University to find out the problems contained in the study of wood and pulp chemistry. Pre-research questionnaire, given to 2018 class chemistry education students who have taken wood and pulp chemistry courses with the aim of analyzing student needs and material validation. Data analysis uses Aiken's V statistics to determine material validity. The following is the formula from Aiken's in Azwar (2012).

$$V = \frac{\sum s}{n(c - 1)} \tag{1}$$

Information:

- s : r-lo
- lo : the lowest score of validity
- c : the highest validity rating score
- r : the number given by the rater

The results of the V'Aiken scores are interpreted into the questionnaire score interpretation criteria as shown in Table 1.

Table 1. Categories of Teaching Material Validity (Aiken, 1985)

V Value	Category
0.00 - 0.33	Low
0.34 - 0.67	Medium
0.68 - 100	High

Result and Discussion

*Selection Stage
Needs Analysis*

The needs analysis was carried out by distributing pre-research questionnaires to the 2018 batch of FKIP chemical education students who took wood and pulp chemistry courses. Based on a pre-research questionnaire conducted by researchers to students, students need other teaching resources that can help learning in wood and pulp chemistry courses on wood and fiber morphology sub-materials.

The results of the 2018 chemistry education student questionnaire distribution showed that as many as 80% of students stated that wood and pulp chemistry on wood material and fiber morphology were difficult subjects to understand, as many as 91.4% of students liked to seek references from other sources, and as many as 97% of students stated that students need material development in order to help fulfill learning resources on wood and pulp chemistry. The results of the questionnaire above are that it is necessary to develop wood and pulp chemistry on wood sub-materials and fiber morphology to meet student learning needs

Curriculum Analysis

Researchers analyzed whether there was a change in the curriculum in the FKIP chemistry education study program. Based on the results of the analysis, the chemistry education curriculum of FKIP UNSRI used was the revised 2017 curriculum. In addition, the researchers conducted an analysis of the RPS (Semester Program Plan) for Wood and Pulp Chemistry. Based on the RPS, it is known that odd semester students are expected to be able to understand the chemistry of wood and pulp in the sub-topics of wood and fiber morphology with 1 meeting a week, which are 2 credits.

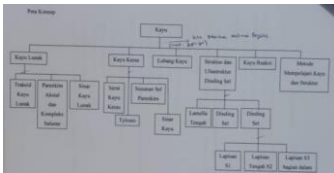
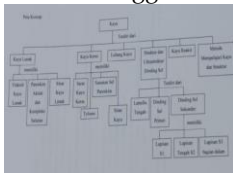
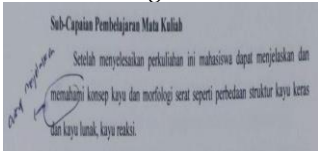
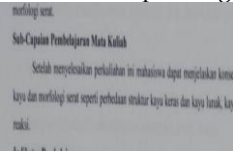


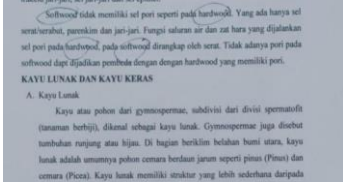
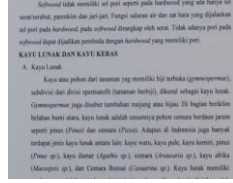
Material Analysis

Researchers analyze material on teaching materials or e-books that have been used as references by looking for other references such as journals, articles, books and other teaching materials. So that researchers can choose which references are appropriate to be used as material development.

Material Validation

After the researcher developed the material, the next step was to validate the material with the aim of knowing the validity of the product being developed (Hendryadi, 2017).

Table 2. Result of Correction of Validation Process

Comments	Suggestions for Improvement
The concept map should be clear	Fixed according to suggestions
	
In the introduction, sub-CPMK no longer writes understanding	In the introduction to the sub-CPMK only write explaining
	
Fix captions on images.	The caption on the picture has been fixed
	
Scientific writing must be italicized	Fixed according to suggestions
	

The results of the validation questionnaire were then calculated using V'Aiken can be seen from Table 3.

Table 3. Calculation of V'Aiken

Expert	Descriptor	r	s	Σs	Aiken's value	Category
1		16	35	72	0.75	High
2		16	37	72		

Based on the results of the V Aiken calculation, it produces a value of 0.75 which is categorized as high according to the table of categories for the validity of teaching materials.

Characterization Stage

After conducting the selection and structuring, the researcher carried out the characterization stage where the researcher developed the material that had been compiled using his own sentences.

Structuring Stage

At this stage the researcher compiles the material that has been selected or analyzed according to the e-book reference that has been given. The arrangement of the material is related to the format in the e-book, and adding or subtracting the material.

Conclusion

The development of wood and pulp chemistry on wood and fiber morphology as a supplement for teaching materials was developed using the 4STMD method which has four stages. The first stage is the selection stage, carried out by analyzing the needs, curriculum and analyzing the material by looking for references in various sources. The second stage is the structuring stage, carried out by adding or subtracting materials and compiling the materials. The third stage is the characterization stage, carried out by developing the results of material analysis. The fourth stage is the didactic reduction stage, but the researcher did not carry out the didactic reduction stage. The development of wood and pulp chemistry on wood and fiber morphology for chemical education students of FKIP which was developed using the 4STMD method met the valid criteria. In the analysis of material validity data, the average value of 0.75 is categorized as high or declared valid.

Author Contributions

Conceptualization, Sanjaya.; methodology, Hadel.; software, Sari and Ad'hiya.; validation, Sukaryawan, & Ibrahim.; formal analysis, Suharman.; investigation, Sanjaya.; resources, Hadel.; data curation, Sanjaya.; writing—original draft preparation, Sari and Ad'hiya.; All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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