

## The Development of Student Textbooks with Problem-Based Learning Approach in Higher Education: is Effective?

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### ABSTRACT

**Objective:** This study aims to investigate the feasibility, practicality, and effectiveness of Statistics textbooks in Economic Education based on problem-based learning. **Method:** This research used a development research model. Model development in teaching materials contextual-based and problem-solving used model 4-P is adapted from the development model of the 4-D by Thiagarajan. **Results:** Recently, we revealed a novel acquisition of statistics textbooks at a very feasible level. A very practical level of practicality was obtained by the perception of 87% of students and 80% of lecturers, and then the effectiveness of the category is very effective with 80% classical completeness. **Novelty:** Therefore, this statistics textbook for economics education attempts to integrate a project-based learning model, from pre-research to publication, to provide students with a comprehensive research experience. This is based on validation results from various aspects, including material coverage, updates, and productivity insights. Based on the material coverage, there is a good match between the available core competencies and students' needs for the material.

### INTRODUCTION

The development of teaching materials in a tertiary institution is necessary, as each teacher prepares teaching materials before giving them to students (Rai & Kaur, 2023). In Indonesia, there are very different levels of understanding and competence of students, so a paradigm equation is needed in terms of the expected final ability in each course that will be given to students (Widiyatmoko & Shimizu, 2018). By implementing the national standard-based curriculum, universities are ready to score undergraduate at level 6 (six) (Nugroho & Ediyono, 2020) with competencies including (1) Being able to apply their fields of expertise and utilizing technology in their fields in problem-solving and being able to adapt to the situation at hand; (2) mastering theoretical concepts in a particular field of knowledge in general and the theoretical concepts of special sections in that field of knowledge in depth, as well as being able to formulate procedural problem solving; (3) able to make appropriate decisions based on analysis of information and data, and able to guide in choosing alternative solutions independently and in groups; (4) is responsible for the work itself and can be given responsibility for the achievement of the work of the organization.

Learning is a complex activity, and learning outcomes are in the form of capabilities, the emergence of capabilities caused by (1) stimulus originating from the environment and (2) cognitive processes carried out by students (Gagné, 1966). Meanwhile, Leinenbach & Corey (2004) argue that learning is "a process in which a person's environment is intentionally managed to enable him to participate in certain behaviors

in special conditions or produce a response to a certain. In other words, learning is a subset of special education".

It can be concluded that learning is every activity designed by the teacher to help someone learn a new ability and value systematically through the stages of design, implementation, and evaluation in the context of teaching and learning activities. Therefore, in the learning component, a teacher is a source of learning, facilitator, manager, demonstrator, administrator, motivator, organizer, and evaluator.

According to Guthrie (2009), teaching materials are all used to help teachers or instructors carry out the learning process in class. The material in question can be either written or unwritten. Learning materials contain knowledge, values, attitudes, actions, and skills that contain messages, information, and illustrations in the form of facts, concepts, principles, and processes related to specific subjects to achieve learning objectives.

Lewis Says that learning materials are every collection of materials that can be used by a teacher in the teaching process to achieve the objectives of a planned learning process (Lewis, 2020). Teaching materials will help students construct the experience of a learning process so that students feel that learning becomes more exciting and fun (Hakim et al., 2020).

According to Arends (2015), Problem-based learning is a learning model using problems that can help students develop higher-order thinking skills, confidence and independence and overcome a problem. Problem-based learning becomes one of the learning models that apply problems that occur in the real world, intending to practice thinking critically, develop problem-solving skills, and learn to play the role of adults by involving themselves with real experiences.

According to Sani (2014), the teacher's role in problem-based learning is to facilitate students in solving problems and supporting the learning process carried out by students. Problem-Based Learning syntax guides students in solving problems to think, analyze, research, and report results. The core of the model is the process of thinking and analyzing the problem carried out in the Problem-Based Learning model by students independently or in groups. Student activities at this stage are collecting data, formulating hypotheses, and finding solutions and conclusions so that students' ability to solve a problem can be built and used (Sari, Y. I., Sumarmi., Utomo, D. H., & Astina, 2021).

Curriculums in tertiary institutions change very quickly following the development of market needs; changes in each curriculum must be planned carefully and wisely (Conrad, 2019). From the top in whole or in part from: (a) Personality Development Subjects consisting of subjects relevant to the purpose of enrichment of insight, deepening the intensity of understanding and appreciation of the course core, (b) Group of Scientific and Skills Courses consisting of relevant courses to strengthen scientific competency insights on the basis of competitive advantage in organizing the study program concerned, (c) the Group of Work Skills consisting of relevant courses, aims to strengthen mastery and broaden the competency insight of expertise in working in the community in accordance with excellence Comparative implementation of the relevant study

program, (d) Working Behavior Subjects Group consisting of relevant subjects, aims to strengthen mastery and broaden the insight into work behavior in accordance with the applicable provisions in the community for each study program, (e) the Subject Group ah Community Life which consists of courses that are relevant to the efforts of understanding and mastering the provisions that apply in society both nationally and globally, which limits a person's work according to the competence of his expertise.

The course is a basic course that prepares students in preparation using research data analysis tools (Reinhart & Genovese, 2021). Learning activities in these courses are theory and practice (Magalhães & Magalhães, 2014). In this regard, students need to be equipped with skills in analyzing data. Prospective researchers must possess these special skills to conduct research properly and correctly (Rivera, 2021). Thus, the skills relate to some fundamental skills or abilities that must be mastered by prospective researchers in carrying out research (Weston et al., 2017).

In this regard, teaching materials that specifically discuss Statistics courses need to be used as guidelines and provisions for students in the preparation of research both for students' thesis and research campus program (Barron & Apple, 2014). This teaching material is needed, considering no teaching material specifically discusses how to analyze research data (Krismawati et al., 2019; Retnawati et al., 2019). The teaching material referred to in this study is a student textbook. This textbook is necessary because students can learn the basics and important points of the studied material (Matić & Gracin, 2020; Thufailah & Rejeki, 2024). Therefore, this research is expected to provide adequate teaching material to support statistics subjects in creative skills groups. The product of this activity is manifested in teaching materials in the form of student textbooks, where examples of application in statistics courses accompany each chapter.

Several benefits can be obtained if a teacher or lecturer develops their teaching materials. First, teaching materials that meet the learning needs of students or students can be obtained. Secondly, it is no longer dependent on textbooks, which are sometimes difficult to obtain; thirdly, teaching materials become richer because they are developed by using various references; fourth, adding to the knowledge and experience of teachers or lecturers in writing teaching materials; fifth, teaching materials will be able to build effective learning communication between teacher/lecturer and students/students because students will feel more trust in the teacher or lecturer (Kurniawan et al., 2019).

Teaching material is very important for teachers and students in the learning process (Simanjuntak et al., 2022). With teaching materials, it will be easier for teachers to improve learning effectiveness (Simanjuntak et al., 2022). Likewise, it will be easier for students to adjust to learning with teaching material, especially if the teacher teaches the material quickly and needs to be clarified (Hakim et al., 2018; Surjanti et al., 2022). According to Lau et al. (2018), textbook learning resources contribute well to the learning process involving basic to intermediate cognitive processes, such as remembering, understanding, applying, and analyzing. The statement shows that the development of textbooks with the Problem-Based Learning model will be very appropriate because, according to (Sari, Y. I., Sumarmi., Utomo, D. H., & Astina, 2021) the core process of the Problem-Based Learning model carried out by students is at the stage of thinking and

analyzing problems so the packaging of textbooks with the Problem-Based Learning model will achieve student learning goals in training to solve problems independently or in groups (Hakim et al., 2015). There is little research that develops statistics textbooks by integrating them with problem-based learning methods. Therefore, this study attempts to develop this approach so that it can be applied to universities.

## RESEARCH METHOD

### Research Design

This research uses a development research model. Research and development methods, or in English, *research and development*, are used to produce certain products and test the effectiveness of these products.

Model development in teaching materials is contextual-based and problem-solving using model 4-P, which is adapted from the development model of the 4-D by Thiagarajan. (Thiagarajan et al., 1974) consists of four stages definition (*define*), stage design (*design*), stage of development (*develop*), and the stage of dissemination (*disseminate*). Thiagarajan's 4D Model is a research and development (R&D) approach widely used in education to produce valid, practical, and effective learning tools. This model consists of four main stages.

The first stage is Define, which is the process of identifying development needs through curriculum analysis, student analysis, concept analysis, and task analysis to formulate clear learning objectives. The second stage is Design, where researchers develop an initial product design, including the selection of formats, media, assessment instruments, and the preparation of the first prototype. The third stage is Develop, which focuses on expert validation, revisions based on input, and limited trials up to field trials to test the product's validity, practicality, and effectiveness. The final stage is Disseminate, which is disseminating the developed product through publication, distribution to schools, or wider implementation. In practice, many studies in Indonesia only reach the development stage due to time and cost constraints, but still emphasize product quality through validity, practicality, and effectiveness tests. Thus, the 4D model provides a clear systematic framework for producing reliable and useful learning products in educational contexts. However, in this study, the implementation phase was not carried out due to the time constraints of conducting research.

### Data Collection Tools

Collection techniques can be done through the analysis of documentation, observation and questionnaires. The explanation of each data collection technique is as follows:

**Table 1.** Data Collection

Techniques	Instrument	Achieved by
Documentation	Outputs achievement of study	Curriculum study
Study of	program study	results
	Lesson Plan of Statistics course	

Techniques	Instrument	Achieved by
Observation	Sheet	Identification of
Observation	Sheet	students' characteristics
Questionnaire	Expert study instruments and sheets validation	Expert study and Validation by material experts

### Data Validity

Expert study instruments consist of validation of content, presentation, linguistic, and graphic validation sheets. Evaluation experts and linguists fill out this validation sheet with a check/ *checklist* in the "Yes" or "No." Completing this validation sheet will produce quantitative data to assess the appropriateness of self and peer assessment. Self and peer assessment is included in the alternative assessment (non-test assessment).

### Data Analysis

Analysis in this study was carried out in the test, evaluation, and revision phases. The collected data is then analyzed. Data on the study sheets filled in by evaluation experts and linguists were analyzed qualitatively. Qualitative description analysis is obtained from criticisms and suggestions given by experts. The validation analysis was obtained from the evaluation results of the evaluation experts and linguists on the self- and peer-assessment sheets. The eligibility percentage is obtained by calculating the score of each component according to the Guttman scale.

## RESULTS AND DISCUSSION

### Results

The initial Statistics draft (*draft 1*) was submitted to the expert for review and validation. As for the criticism from the material experts, among others, some sub-chapters have not included examples of practice questions; in the discussion of example problems, it should include a description of the problem-solving steps, pay attention to the form of making evaluation questions based on operational verbs on the objectives/learning indicators. The results of the material expert validation are shown in the following table:

**Table 2.** Material Expert Validation Result

No	Aspects	Σ Score	
		Validation 1	Validation 2
1	Scope Materials	28	31
2	Accuracy Materials	26	30
3	Recency	26	31
4	Contains Insights Productivity	28	31
5	Stimulating Curiosity (Curiosity)	24	29
6	Develop a sense of Diversity	26	29
7	Develop Life Skills ( <i>Life Skills</i> )	25	30
8	Using standard Indonesian	27	27

No	Aspects	$\Sigma$ Score Validation 1	$\Sigma$ Score Validation 2
	<b>Total</b>	210	233
	<b>Percentage (%) Information</b>	75	85.37
		Eligible	Very Worthy

The score obtained from the material experts is 75%, categorized as "feasible". Critics and suggestions obtained from experts were used as material to improve textbook 1 draft into textbook 2 drafts. The material experts' review and validation of the textbook 2 draft showed that draft document 1 had been improved and was declared "very feasible" to be tested. This is evidenced by the acquisition of a validation score of 85.37%.

As for criticism from graphic experts, among others: Adjust the theme of the book's appearance, both cover and content, for example, the sea/beach. While the results of the graphic expert validation are shown in the following table:

**Table 3.** Graphic Expert Validation Results

No.	Aspect	$\Sigma$ Validation Score 1	$\Sigma$ Validation Score 2
1	Book Size	5	5
2	Section book skin	3	4
3	Part book content	24	30
	<b>Total</b>	32	39
	<b>Percentage (%) Information</b>	71	86
		Eligible	Very Feasible

The score obtained from the graphic experts is 71%, categorized as "eligible." Criticisms and suggestions obtained from the graphic experts were used as material to improve the textbook's 1st draft and make it into the textbook's 2<sup>nd</sup> draft. The results of the review and validation of the textbook 2<sup>nd</sup> drafts by the graphic expert showed that draft document 1<sup>st</sup> had been improved and was declared "very feasible" to be tested. This is evidenced by the acquisition of a validation score of 86%.

As for the criticisms from the presentation experts, among others, the answer sheet should be packaged in an easy, systematic way, balancing the layout of the image. While the results of the presentation expert validation are shown in the following table:

**Table 4.** Presentation Expert Validation Results

No.	Aspects	$\Sigma$ Validation Score 1	$\Sigma$ Validation Score 2
1	Systematic in presenting material must be consistent	27	29
2	Logic in presenting material must be in accordance with the path of deductive and inductive thinking	28	28
3	Corruption in presenting material	28	28
4	Present material review in the form of pictures or illustrations	28	28
5	Using the picture presentations that fit the chapter on material	32	32

No.	Aspects	$\Sigma$ Validation Score 1	$\Sigma$ Validation Score 2
6	Presenting a summary of the material before starting the new material	23	31
7	Presenting practice exercises in each chapter	21	28
8	Developing concept maps at the beginning of chapter	23	32
9	Making practice questions at the end of chapter	28	30
10	<i>Student centered</i> , according to the concept of Problem Based Learning	25	29
11	Scientific Approach	28	29
12	Creativity and diversity of material	23	31
13	Introductory section	28	28
14	Table of contents	28	28
15	Bibliography	21	32
<b>Total</b>		391	443
<b>Percentage (%)</b>		74	84,3
<b>Information</b>		Eligible	Very Eligible

The score obtained from the presentation expert is 74%, categorized as "eligible." The results of the presentation expert's review and validation of draft textbook 2 showed that draft document 1 had been improved and was declared "very eligible" to be tested. This is evidenced by the acquisition of a validation score of 84.3%.

### *The Practicality of Statistics Textbook*

After reviewing and validating the material expert, the graphics and presentation are subjected to limited trials. This trial was conducted to determine the practicality of statistics textbooks based on the problem-based learning model. The subjects that became a limited trial in this research were students of the economic study program UNESA 2018, class A, which is a class of 32 people. In addition to students, trials are also conducted on statistics teaching lecturers. The practicality data of Statistics textbooks based on models of Problem-Based *Learning* can be seen in the following table:

**Table 5.** Practicality Test Result

User	Average	Percentage (%)	Information
Student	4.4	88.9	Very Practical
Lecturer	4.3	87	Very Practical

Practicality textbooks based on the problem-based learning model from the student get a percentage of 88.9%. While the practicality gained from the lecturers was 87%. Thus, textbook 1, based on the model, is Problem-Based Learning, which is said to be "very practical" and does not need to be improved.

### *The Effectiveness of Statistics Textbook*

The effectiveness of 1 based on the model is problem-based learning, which is measured through tests given after learning takes place. The method used is a one-shot case study. The minimum completeness criteria used is 60. The test results obtained are as follows:

**Table 6.** Student Test Score Results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50.00	1	3.1	3.1	3.1
	55.00	2	6.3	6.3	9.4
	60.00	2	6.3	6.3	15.6
	64.00	1	3.1	3.1	18.8
	70.00	1	3.1	3.1	21.9
	75.00	5	15.6	15.6	37.5
	77.00	1	3.1	3.1	40.6
	78.00	2	6.3	6.3	46.9
	79.00	1	3.1	3.1	50.0
	80.00	11	34.4	34.4	84.4
	83.00	2	6.3	6.3	90.6
	84.00	1	3.1	3.1	93.8
	85.00	1	3.1	3.1	96.9
	86.00	1	3.1	3.1	100.0
	Total	32	100.0	100.0	
Classical completeness					84%

The number of students with a test score above 60 is 27 of 32 students. Therefore the classical completeness obtained is as much as 84%. Thus statistics textbooks based on the model Problem-Based *Learning* can be said to be "very effective" in improving student learning outcomes.

## Discussion

Based on the eligibility of material experts, the validation results found in validation score 1 obtained the highest validation score of 28, which is the aspect of material coverage and contains the lowest productivity insight and scores on aspects of curiosity. This happened when the preparation of the first phase of the textbook did not include a small summary of the material, which, in this case, was referred to as larva (statistical window), so after the revision, it rose to 29. Based on the validation score for eligibility, it was categorized as very feasible, with a validation score of 85,37%. This is based on the results of the validation of various aspects and from those aspects for the scope of material, updates, and contains insight into productivity. Based on the scope of the material, there is a match between the basic competencies available and the student's needs for the material. As for the latest aspects, seen from the material's content, it has been updated based on current economic developments. The same thing applies to the latest aspects; aspects containing productivity insights also have a high score because this is seen from the case study example at the end of the chapter containing insight into productivity. Textbooks are much more complex than most other publications; they need to cover a body of knowledge in a structured and logical way and utilize design elements to help the learner better understand the subject (OTN Publishing Curriculum, n.d.).

Based on the feasibility of the graphic expert, the validation results found in validation score 1 obtained the highest validation score of the book size. In contrast, the validation of 2 high scores in addition to the book size is part of the book content. Input from the valuator relates to the book's theme, which originally had no theme because the color is

still irregular. Then, it is recommended for the sea theme, which is dominated by blue. This product is worth trying out based on the validation results, which obtained an 86% score with a very decent category.

Based on the feasibility of the presenter, validation results are obtained for the lowest score on the aspect of presenting the exercises in each chapter with a score of 21 and also, the bibliography still needs to be consistent. After a revision and reassessment, the results of the second validation using aspects of the image presentation by the chapter on the material, preparing a concept map at the beginning of the chapter, and compiling the bibliography. Based on the total score obtained, 84.3% with a very decent category.

The practicality of Statistics Textbook in Economic Education Based on Problem-Based Learning is obtained when trials are limited. The data is obtained through a questionnaire given to *users*, namely students and lecturers. The aspects assessed are the textbook instructions, the textbooks' content, and the textbooks' ease of use. The three aspects are further elaborated into several questions. Instructional aspects of textbooks are first described whether the instructions for using textbooks can be clearly understood. The score given by students is 86.9%, while the value given by lecturers is 80%. Students and lecturers with high grades give this value because the statistics I developed in each chapter of the textbook are available and can be understood clearly and easily.

The second aspect is about the content of statistics textbooks. The derivative is whether the user becomes understanding after reading the statistics textbook. Students give this value by 87% and lecturers at 80%. Language also, according to students and lecturers, is very easy to understand because it uses standard Indonesian in all chapters. The last derivative from the aspect of the contents of the statistical book 1<sup>st</sup> is about the design of the textbook and whether it has attracted users, both students and lecturers. Of course, the results obtained are very interesting, considering the cover design and the content, which are pinned on the beach-based display theme. In addition, the contents section has a picture that illustrates the objects/goods that are counted on the material. It provided a statistical window (small note on the side), which is abbreviated as "wiggler." It also gives a more attractive impression to the user because it makes it easier for the reader to understand the definition or understanding of the terms.

The last aspect is the ease of use of Statistics Textbook in field of Economic Education *Problem Based Learning in the*. This also felt to be very easy for students and lecturers because the size of the book was adjusted to the standard, the size of Enesco. Besides, textbooks have also been equipped with examples of questions and discussion, practice questions, and answer keys. Thus, overall, Statistics Textbook in the Field of Economic Education Based on *Problem Based Learning* based on the perception of students believes "very practical" (Downing et al., 2011; Raihan et al., 2018; Stentoft, 2017; Suprpto & Basri, 2017).

The Effectiveness of Statistics Textbook in the Field of Education Based on *Problem-Based Learning is measured through tests of learning outcomes given*. The test is also given at the end of a limited trial. The test is given once with classical completeness above 80%. This indicates that Statistics Textbook in the Field of Economic Education Based *Problem-Based Learning is effective in improving* student learning outcomes (Goh & Fang, 2017; Raihan et al., 2018; Walstad & Wagner, 2016a, 2016b).

This results in line with research conducted by (Nainggolan et al., 2020) which found that the innovative workbook succeeded in helping students to learn independently and actively in completing projects so that it was proven to have increased their knowledge and skills based on the results of the knowledge and skills of each student in the experimental group. It was found to be higher than the control group, and the two groups differed significantly. This result is also in line with research conducted Palocsay & Stevens (2008) , which states that learning business statistics by giving homework assignments is very effective (Albrecht et al., 2015; Fouché, 2017; Lynch et al., 2013).

## CONCLUSION

**Fundamentals finding:** Statistics Textbook in the Field of Education Based on Problem-Based Learning is feasible, practical, and effective for improving student learning outcomes. Suggestions for Statistics Textbook in the Field of Education Based on Problem-Based Learning. **Implications:** This problem-based learning statistics book is suitable for use as a textbook in universities. It can be used by education programs that produce prospective teachers. **Limitations:** This research is limited to knowing the process of developing a statistics book based on problem-based learning but has not continued to the research process as an example of experimental research. **Future Research:** In the future, it is better to improve the example of questions on different conditions or variables so that it will make it easier for students to understand the different research conditions, giving a display theme that is rarely encountered so that the user impression is more interested because different from the books they used to read. Statistics textbooks in the field of economic education should be integrated with a project-based learning model ranging from pre-research to publication to give students experience doing research as a whole.

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