

Development of interactive e-books to increase learning independence in statistics

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ABSTRACT

The purpose of this research in general is to develop statistics teaching materials in the form of e-modules by applying Microsoft excel in it. The implementation of the use of statistics teaching materials in lectures is still not optimal. This research offers solutions for the use of teaching materials in the form of e-books that are easy to understand in statistics courses to increase student learning independence. This activity emphasizes more on measuring the achievement of e-modules clearly in their application and implementation in learning. This research uses the Borg & Gall *research and development* pattern method with 10 steps. The results showed that the assessment of media aspects in the form of *E-books* by media expert validators covering general aspects, aspects of material substance, aspects of language feasibility, and aspects of graphic feasibility obtained a percentage of 88.7% were in very good qualifications. Assessment on the material aspect found that the percentage of product feasibility of 95% was in very good qualification. From the assessment of media experts and material experts, the products in this study are feasible or valid to use. In the readability test by students, the average percentage is 80.6%, meaning that it is very easy to understand.

INTRODUCTION

The development of technology is so fast and unpredictable due to digitalization that requires us to improve new skills in keeping pace with these changes (Sitompul et al, 2019). Digital development in the world of education can also make a development of digital technology as a bridge that has creativity, innovation and networks as resources in moving the wheels of education (Gufran et al, 2020). The presence of information and communication technology in life has changed the paradigm of education, one of which is in the delivery of teaching materials or media in learning (Sugeng et al, 2021).

Teaching materials can be used as a medium for teachers to transfer knowledge during learning and can act as a learning guide such as goals and objectives to be achieved in learning (Aryawan et al, 2018). The use of teaching materials and media used in learning has changed from print-based to computer-based and this is an innovation in the development of technology in the world of education (Winatha, 2018).

Learning statistics in basic education at PGRI University Semarang which is currently running is quite good but still less effective in applying learning technology. The teaching materials used have not utilized technology optimally for the application of its application. Along with the rapid development of technology, development by utilizing technology, one of which is the development of electronic-based teaching materials or known as e-books. E-Book is a learning media in the form of books that contain information in electronic form which can be in the form of text, animation or

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images and has advantages such as small size, not easily weathered, easy to carry, and can display multimedia illustrations, such as animation (Andaresta, 2021). Behavior in learning using e-books related to exercise strategies such as affirming important material can affect student learning outcomes (Geng et al, 2020). E-book is the presentation of material using computing technology in a format similar to printed books (Zhang et al, 2020). E-books can also help visualize abstract material so as to help students' understanding (Martha et al, 2018). Readers can access the material digitally through e-books anytime and anywhere (Zarzour et al, 2020). E-books that are designed with ethnomathematics are attractive and involve ethnomathematics can also improve problem-solving skills (Utami et al, 2018). In addition, Nugroho (2014) develop Edmodo's rocky mathematics learning media in basic statistics courses which are packaged in the form of e-learning and produce effective learning. In this study, researchers will develop statistical teaching materials with the application of Microsoft excel applications that will be packaged using technology into e-books.

The designed e-book can later be used by students independently. Learning independence is the skill of a person who does learning independently (Nuritha & Tsurayya, 2021). Learning independence is defined as a learning process within a person in achieving certain goals that are required to be active individually or not dependent on others including teachers (Fajriyah et al, 2019). Self-learning independence has become a popular research topic in various fields with the common goal of better detecting, diagnosing and following up on learning (Li et al, 2022; Molenaar, 2021). Learning independence is the ability possessed by a learner to strive to be independent in exploring learning information other than learning resources provided by the teacher (Fajriyah et al, 2019). Learning independence is an effort made in learning activities in an independent way on the basis of its own motivation in mastering a certain material so that it can be used in solving the problems faced (Egok & asepsukenda, 2017). Learning independence is also a challenge to advance learners' understanding of cognitive, metacognitive, affective, and motivational states over time (Molenaar et al, 2023). The ability of each student is not just science that is the basis of technological development, but the ability of each student is in the character of each individual (Chotimah et al, 2018). The characteristics possessed by each student are different and have a different spirit of learning in each student. One of the characters that can be formed with the right learning method is the independent character of learning students (Bungsu et al, 2019). Based on the description above, this study aims to develop a statistical e-book by applying the Microsoft excel application to increase the learning independence of basic education students.

METHODS

Research is a development research with a focus on developing e-Books for static courses to increase student learning independence. The research procedure uses modifications of Borg and Gall's theory, namely: (a) Preliminary analysis; (b) planning and preparation of the initial product; (c) expert validation and revision; (d) readability test. Data retrieval and analysis techniques are as follows.

- a. Data analysis needs to determine the design of the e-book was taken using documentation studies of current teaching resources. The data were analyzed in a quantitative descriptive manner.
- b. Expert response data was obtained through expert validation questionnaires and analyzed in a quantitative descriptive manner.
- c. Data related to the readability level of books were taken using questionnaire techniques and analyzed in a descriptive statistical manner.

FINDINGS

Preliminary analysis

Needs analysis

Analysis of student needs is carried out by looking at the teaching experience in the Statistics course. The goal in using this *E-book* is to use *Microsoft Excel* as a technology to help students understand statistics. The results of observations and interviews related to student needs are in classroom learning activities, teaching materials guided by modules, *spada*, *SIP* and *powerpoint*. With the development of this technology, students need technology to make it easier to understand the concept of Statistics. Statistics is important because it is the basis for data analysis.

Literature search

Researchers search for literature books in libraries and also through journal studies related to Istika material. Journal studies are searched through E-Resources Perpusnas, Google Scholar, LIPI (Indonesian Institute of Sciences), DOAJ (Directory of Open Access Journals), Library Genesis, Science Direct, and ResearchGate.

Material analysis

Study materials in this course contain understanding statistics, data collection and presentation, size of concentration, spread, hypothesis test requirements, hypothesis testing, interpretation of hypothesis test results, anava, regression, anakova, path analysis, and conclusions. The study material is the basis for making material in this Statistics *E-book* which is described into 13 Chapters, namely: (1) Analysis Data on *Microsoft Excel* consists of an overview of *Microsoft excel* and analysis data on *Microsoft excel*; (2) Basic Understanding in Statistics consists of sub-chapters, namely Statistics, Statistics, Descriptive Statistics; (3) Presentation of Data in Table Form; (4) Presentation of Data in the form of diagrams; (5) the size of the central tendency; (6) Dispersion Size; (7) Layout Size; (8) Data Normality; (9) homogeneity of data; (10) Average Similarity Test; (11) Hypothesis; (12) Regression; (13) Correlation.

Initial product planning and preparation

In planning, curriculum analysis aims to determine the curriculum used in Higher Education as a reference in developing Statistics E-Books to increase student independence. The CPL charged in the Courses is as follows:

- a. Attitude
 - 1). Obey the law and discipline in social and state life (S7)
 - 2). Demonstrate an attitude of responsibility for work in their field of expertise
- b. Knowledge

Able to manage research and development in the field of basic education that is beneficial to society and science and is able to get national and international recognition (P3).
- c. General Skill (KU)

Able to document, store, secure, and recover research data in order to ensure validity and prevent plagiarism (KU8).
- d. Special Skills (KK)

Communicating the results of research and development of science, technology, and art in innovative and creative learning in the field of basic education through national or international publications (KK3).

Learning Outcomes in the Statistics Course have 6 learning objectives (CPMK) , namely students are expected to be able to:

- a. CPMK 1

Understand, contextualize, and develop the scope of lectures; about Introduction to Statistics, Descriptive Statistics (presentation of data, central measures
- b. CPMK 2

Understand, contextualize, and develop the scope of lectures;
- c. CPMK 3

Understand, contextualize, and develop the scope of lectures; about difference tests and Excel/SPSS practices
- d. CPMK 4

Understand, contextualize, and develop the scope of lectures; about Anava test and Excel/SPSS practice
- e. CPMK 5

Understand, contextualize, and develop the scope of lectures; about Regression and Correlation and Excel/SPSS practice
- f. CPMK 6:

Understand, contextualize, and develop the scope of lectures; about Anakova, Path analysis, and Excel/SPSS practices

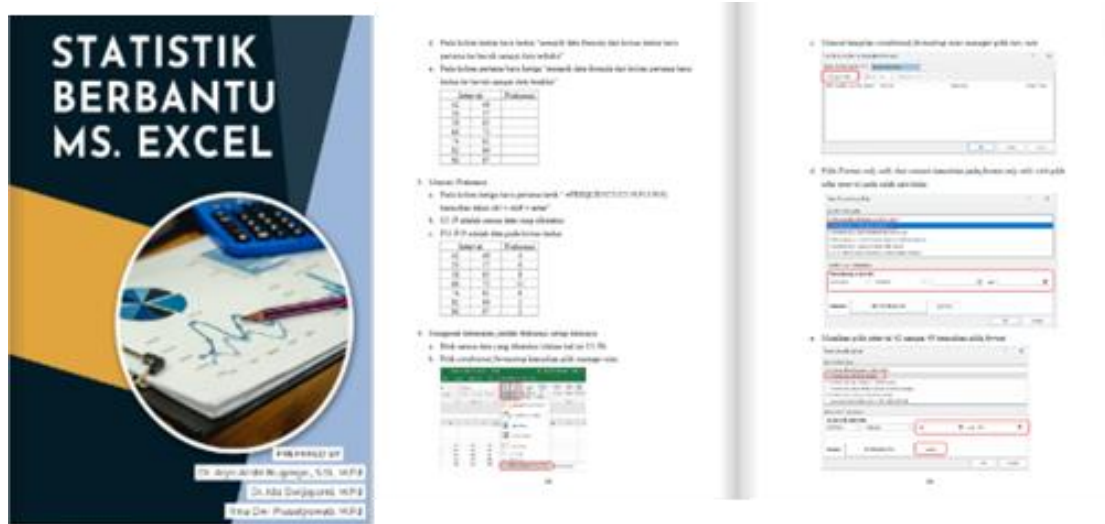


Figure 1. Initial display and content

This e-module is designed using Microsoft Excel to help facilitate learning Statistics concepts and also increase student learning independence. Various Reference Books and Journals are used to develop Statistics books assisted by Microsoft Excel and designed to increase student independence (Figure 1). The product design can be seen in the following display :

a. Initial view

In this initial display, there is an interesting cover and there is the author's name. The publisher used in this study is Potlot publisher which is a publishing company that facilitates the publication of books, software and music, especially in the field of Education.

b. Display of discussion material

The display of material in this book is designed to meet the writing format according to the rules, the structure of this book is made in sequence, writing techniques as a rearrangement of information from textbooks that are made properly and correctly, the use of appropriate language so that readers can understand well, writing clear concepts that are easy for readers to understand, having good cohesion by writing the relationship between one chapter and another, This book packs interesting theories and knowledge so that it can stimulate the brain while reading, this book is attractively designed, this book is designed according to the learning plan, and uses a credible publisher.

Validation and revision phase

The validation and revision stage of this product is carried out to find out the shortcomings that need to be corrected so that the product developed will look good and suitable for use. The products developed in this study were validated by experts.

Media expert validation

Data analysis is performed after the data is presented. The results of this analysis determine the feasibility of products for the teaching and learning process in the Statistics course based on Media Experts. Based on Table 1, the assessment of media aspects in the form of E-books by media expert validators includes general aspects, aspects of material substance, aspects of language feasibility, and aspects of graphic feasibility. The calculation shows that the eligibility percentage of the Statistics E-Book is 88.7%. Then the percentage is converted with a scale conversion table, it is concluded that the percentage of 88.7% is very well qualified, so that the Statistics E-book is feasible or valid to use. But on the other hand, based on improvement suggestions from validators, there needs to be some improvements to the product so that later it can be used more perfectly. The percentages of validator 1 and validator 2 are illustrated in Figure 2. Based on the assessment questionnaire of media expert validators, there are comments and suggestions from learning media experts that can be taken into consideration for using the resulting learning videos. The comments and suggestions from media experts can be seen in Table 2

Table 1.
Overview of learning media expert aspects assessment

No	Assessment Aspect	Observation Score		Max Score	Credentials	
		I	II		I	II
1	Common	16	18	20	80%	90%
2	Material Substance	18	17	20	90%	85%
3	Language Eligibility	14	12	15	93%	80%
4	Graphic Credentials	17	19	20	85%	95%
Score Total		67	66	75	89.3%	88%
Final Percentage		88,7%				

Table 2.
Material expert validation comment and suggestions

Comments and Suggestions	Repair
- The image can be enlarged for clarer clarity	- The image has been enlarged
- The table of contents needs to be linked to each material so that it is easy to learn	- Graphics Image has been enlarged
	- The Table of Contents has been linked in each material

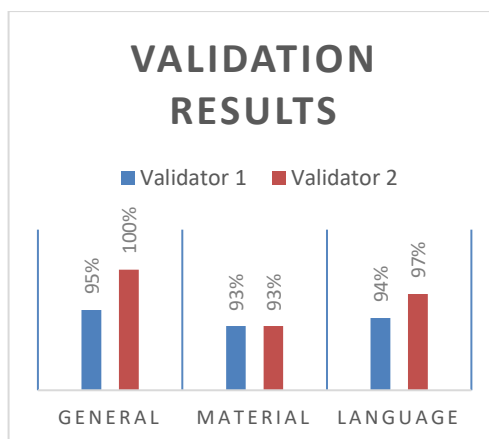


Figure 2. Media validation results

Material expert validation

Material expert validation is used to determine product validity based on material aspects in the e-modules made. Data analysis is performed after the data is presented. The data is analyzed by calculating every aspect of the product. Based on Table 3, the assessment of material aspects by material expert validators includes general aspects, material substance aspects, and learning design aspects. The calculation shows figure 3 that the percentage of product feasibility is 95%. Then the percentage is converted with a scale conversion table, it is concluded that the percentage of 95% is very well qualified, so the product is feasible or valid to use. But on the other hand, based on improvement suggestions from validators, there needs to be some improvements to the product so that later it can be used more perfectly. The percentage of validators is listed in figure 3. Based on the assessment questionnaire of media expert validators, there are comments and suggestions from learning media experts that can be taken into consideration for using the resulting textbook. The comments and suggestions from material experts can be seen in Table 4

Readability test by students

This study conducted a readability test through a survey method by distributing questionnaires via google form to 25 basic education students who were taking Statistics courses. Students were asked to rate with "very good", "good", "enough", "less", and "very less" options. Researchers use the readability aspects given in Table 5.

Table 3.
Overview of expert aspect assessment of material on e-book

No	Assessment Aspect	Observation Score		Max Score	Credentials	
		I	II		I	II
1	Common	19	20	20	95%	100%
2	Material	42	42	45	93,3%	93.3%
3	Substance Learning Design	33	34	35	94,3%	97.1%
Score Total		94	96	100	94%	96%
Final Percentage						95%

Table 4.
Material expert validation comments and suggestions

Comments and Suggestions	Repair
- In the explanation of the material it is necessary to give examples. For example, in the Diagram material in faithful explanation of the various diagrams are given examples of the shape of the diagram.	- Examples of diagrams have been added according to various diagrams.
- Sample questions need to be added	- Sample questions need to be added

Tabel 5.
Readability indicator

Readability Aspect	Easy to read	Interesting to readers	Engender good understanding
Indicator	Text or Writing on <i>the Statistics E-Book</i> is easy to read with appropriate grammar and clarity of writing, the material presented in the textbook is coherent, <i>the E-Book</i> uses clear notation / symbols, and the terms used are clear	Reader interest, density of ideas in reading, and beauty of writing style	Examples of questions used in this textbook are in accordance with the material, Solving problems using <i>Microsoft Excel</i> helps understand the material well, the design of <i>E-books</i> can foster student independence in learning, and there is ease in understanding concepts.

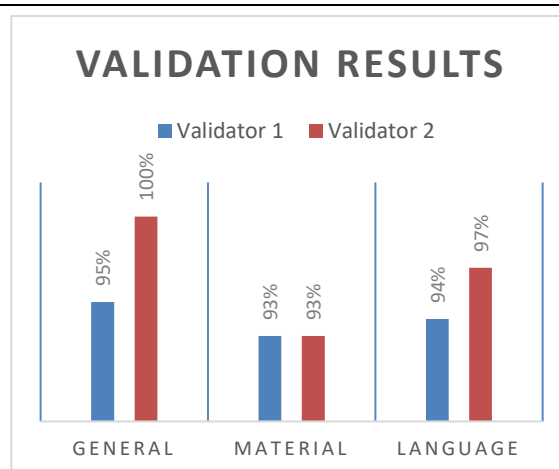


Figure 3. Percentage of material validators

DISCUSSION

This research was carried out with a development procedure that refers to the Borg & Gall model in by modifying it into: (a) preliminary analysis; (b) planning and preparation of the initial product; (c) expert validation and revision; (d) readability test. *E-Book* development is very important because it is needed once the application used to support learning, one of which is *Microsoft Excel*. According to Indriati (2022) stated that the use of Microsoft Excel can increase the activeness and learning outcomes of students.

In the preliminary analysis, this research uses the basis of relevant previous research, there is still minimal related to those who study or research the topic of developing a textbook in the Statistics course, let alone made in the form of an *e-book* or digital, because currently technology has become a necessity where there is easy access by readers, especially after the pandemic. Microsoft excel tools are also the right choice in learning statistics to help in calculations so that students can easily calculate manually. According to Musdalifah (2022) The use of *Microsoft excel* is quite effective in data processing. At this stage, it also identifies study materials on statistical material for statistics courses that are guided by the National Higher Education Standards (SN-Dikti), as regulated in Permendikbud Number 3 of 2020 Article 1 and also KKN1.

At the planning stage, researchers determine the implementation, compile instruments and design design product specifications and e-book structure content starting with the Semester Learning Plan (RPS) guidelines that have been made at the beginning of learning, compiling instruments including: statistical test questions, Expert Validation questionnaires, questionnaires for student responses, practice questions are then designed textbook product designs in the form of *E-Books*. From the student questionnaire, readability will be tested to find out suggestions and input from readers, especially students, and also the feasibility of the E-Book. The rapid development of technology and information has caused the development of more and more product digitalization to emerge that can facilitate its use (Lu et al, 2020; Guo et al, 2020)

This research uses a data collection instrument in the form of a questionnaire, where this questionnaire is shown to validators and student responses in the form of a google form used to see the extent of the feasibility of the product developed. Google Form is very useful for collecting data desired by researchers. The instruments include 1) material expert validation sheets, 2) media expert validation sheets, and 3) student response sheets. The level of feasibility is assessed from the point of view of experts in their fields consisting of 1 person for material experts, 1 person for media experts. Data analysis techniques in this study consist of qualitative and quantitative data, where qualitative data includes expert advice on teaching materials and quantitative data is calculation or analysis of the data used. Data from the collected questionnaires will be analyzed using the Likert scale. This scale is used to assess the attitudes, opinions, and perceptions of society or individuals (Sugiyono, 2015). The Likert scale used in this study consists of 5 choices on each item of the statement or question, where score 1 is the lowest score and score 5 is the highest score. After obtaining quantitative results, the results are then interpreted into qualitative form.

Assessment of material aspects by material expert validators includes general aspects, material substance aspects, and learning design aspects. The calculation shows that the percentage of product feasibility is 95%. Then the percentage is converted with a scale conversion table, it is concluded that the percentage of 95% is very well qualified, so the product is feasible or valid to use. But on the other hand, based on improvement suggestions from validators, there needs to be some improvements to the product so that later it can be used more perfectly. The suggestion is more on the explanation of the material, it needs to be given an example. For example, in the Diagram material in faithful explanation of the various diagrams, examples of the shape of the diagram are given. In addition, it is necessary to add examples of discussion of practice questions. While the assessment of media aspects in the form of *E-books* by media expert validators includes general aspects, aspects of material substance, aspects of language feasibility, and aspects of graphic feasibility. The calculation shows that the eligibility percentage of the *Statistics E-Book* is 88.7%. Then the percentage is converted with a scale conversion table, it is concluded that the percentage of 88.7% is very well qualified, so that the *Statistics E-book* is feasible or valid to use. Improvements have been made by researchers including enlarged images and the creation of links between the table of contents and all chapters in the material so that it is easier for readers to get to the desired page. The validation results

can provide understanding to researchers to interpret and translate validator inputs as consideration for improvement (Ramspek et al, 2021). In product development, validation is one step to confirm the design scheme is appropriate based on input from validators before use (Huang et al, 2022).

The development of electronic books (*E-books*) by researchers follows the requirements of conducting readability tests. Akbari et al (2017) states that the readability of the textbook is said to be good if when read in accordance with the ability and reasoning of the reader (students) so that it can increase their motivation and interest to read and learn the textbook. All aspects of the elements in the textbook that will affect the success of the reader in understanding the concepts in the material at optimal reading speed. Researchers conduct readability tests that aim to find out whether the use in sentences, material presentation, layout and interaction between texts in textbooks can be used by students to understand the materials in them. It is important for researchers to conduct readability tests to minimize errors that can cause misunderstandings between the author's intention and the reader's understanding. From the results of the percentage obtained, the average percentage of 80.6% is included in very easy to understand. Iza et al (2018) stated that learning resources made by lecturers themselves as learning resources are preferred because they will look more real, contextual, and of course adjust to students' abilities. A teaching material has a good readability level means that the teaching material has good quality to use (Asikin et al, 2021).

CONCLUSIONS

The development of *statistical e-books* by applying Microsoft excel applications to increase student learning independence Basic education shows that the assessment of media aspects in the form of *E-books* by media expert validators includes general aspects, aspects of material substance, aspects of language feasibility, and aspects of graphic feasibility obtained a percentage of 88.7% are in very good qualifications. Assessment on the material aspect found that the percentage of product feasibility of 95% was in very good qualification. From the assessment of media experts and material experts, the product in this study is feasible or valid to use. In the readability test by students, an average percentage of 80.6% is included in very easy to understand. Suggestions for research progress from the results of research, there are several suggestions to advance further research activities, namely being able to add LKPS to the E-Book as a companion and use other applications in data analysis.

AUTHOR'S DECLARATION

Authors' contributions

AAN: main idea, conceptualization, analysis data and report wrote the manuscript, ID: review and validation, RDS: collected the data and report.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare that the publishing of this paper does not involve any conflicts of interest. This work has never been published or offered for publication elsewhere, and it is completely original.

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