The Development of Statistics Textbook Supported with ICT and Portfolio-Based Assessment

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Abstract. This research was development research that aimed to develop and produce a Statistics textbook model that supported with information and communication technology (ICT) and Portfolio-Based Assessment. This book was designed for students of mathematics at the college to improve students' ability in mathematical connection and communication. There were three stages in this research i.e. define, design, and develop. The textbooks consisted of 10 chapters which each chapter contains introduction, core materials and include examples and exercises. The textbook developed phase begins with the early stages of designed the book (draft 1) which then validated by experts. Revision of draft 1 produced draft 2 which then limited test for readability test book. Furthermore, revision of draft 2 produced textbook draft 3 which simulated on a small sample to produce a valid model textbook. The data were analysed with descriptive statistics. The analysis showed that the Statistics textbook model that supported with ICT and Portfolio-Based Assessment valid and fill up the criteria of practicality.

1. Introduction

Analysing data is the main part of the research process because from data analysing, researcher can draw a conclusion and make a concept or theoretical framework that will be used [1]. In the universities, Statistics subject discusses statistical method which is used in the data processing and analysing to gain a conclusion useful for a decision-making. By understanding the concept of statistics, students are expected to be able to implement the material of any cases in the real life related to the statistical application and also to solve the problems related to the statistical data analysis.

All this time, many students find difficulties in statistical data analysis. The difficulties are about the test used in data analysis, inaccuracy in counting the data analysis and the solution that resulted in a conclusion. In the lecture, the students tend to discuss the cases given by the lecturer so that the cases are less common. On the other hand, limited access to the data source in the field, either directly or indirectly, giving less encouragement to the students to explore the examined data analysis issue further. In order to make students understand better about the various cases related to the actual statistical data, also to have good ability in analysing data, it is necessary to develop a more aspirational lecture design and also be able to accommodate a wide range of these issues. Therefore, in the lecture is deemed necessary to arrange a textbook which can help students understand the Statistics materials and create a students' learning oriented.

Most college lecture material tends toward the theoretical understanding of a particular science. In fact, any knowledge learned applicative often have many applications that can be implemented in everyday life. Meanwhile, the use of software statistics that are currently developing and is used by many parties, tend to only use the software as a tool count by not linking with the underlying theory, so most students

who use the software tend to be able to use the software but do not understand the underlying theory that it is difficult to develop the results of the analysis to a broader stage.

Mathematics learning in university is not only simply memorizing or implementing but also it needs High Level Mathematical Thinking Ability which is beneficial to the students themselves [2] [3]. In Education Unit Level Curriculum, it is told that the students are expected and demanded to have (1) The ability to solve the problems in mathematics, other subjects, or any problems related to the real life; (2) The ability to use mathematics as a means of communication; (3) The ability to use mathematics as a means to think logically that can be used in any situation, like thinking critically, logically and systematically. Those abilities included in High Level Mathematical Thinking Ability that is strongly needed to solve mathematical problems by logical thinking, to illustrate mathematical ideas into mathematical models to relate to the other mathematical concepts or other knowledge.

[4] states that, according to the National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics, communication is an essential part of mathematics. The communication process helps build meaning. When students are challenged to think and reason and then communicate their ideas orally or in writing, true conceptual understanding develops. By having students communicate their ideas and thinking, teachers have better understanding of what student know and do not know. Forcing students to communicate the mathematics idea with practice can make student become confident communicate their ideas and thinking, teachers have a better understanding of what students know and do not know. Mathematical communication important because through communication, students reflect upon, clarify and expand their ideas and understanding of mathematical relationships and mathematical arguments. To understand the mathematics, students should know and build relationships between mathematical ideas. In this case the mathematical connection capabilities need to be developed.

This research develops mathematical communication and connections ability which is a high level mathematical thinking ability that is important in relation to the data analysis in Statistics subject. Cognitive ability will be enhanced by developing textbook containing various material of Statistics in accordance with the competence to be achieved in accordance with the applicable curriculum.

Popped-up criticism of the low quality of education in any education unit and one thing to note is the instrument or evaluation tool used is considered invalid and unreliable, and also considered as less complete aspects. Therefore, assessment approach done at this time is needed to be renewed with other approaches. Portfolio-Based Assessment is a model of assessing expected to reveal and assess students more accurately and more completely based on the evidence the students have.

According to [5], globalization and rapid technological change have made knowledge an important determinant of competitiveness in the world economy. Countries should take advantage of information and communication technology (ICT) for educational purposes and contribute to poverty reduction strategies. With globalization, the information revolution and the increasing demand for skilled labor, it is clear that the state should give high priority to building capacity to effectively use technology in education. In this cases, the use of ICT in the learning process needs to get attention and important place. In the classroom, besides the abilities in cognitive range, the students also have to possess good affective and psychomotor abilities. The use of information technology today, especially the development of computer software can be used to help accelerate and simplify the statistical data analysis understanding which is expected to improve the students' competence in Statistics lecture. The affective and psychomotor abilities will be developed with the ICT and portfolio assessment approach and one of which is to train the students' cooperation ability in teamwork.

Based on that background, the research of the textbook development as an effort to increase students' mathematical communication and connection ability in Statistics lecture is done. The purpose to be achieved in this research is to produce a Statistics textbook supported with ICT and Portfolio-Based Assessment which can increase students' mathematical communication and connection abilities. The developed textbook is designed for students to connect the knowledge they get with the real life cases they face and then they can provide the accurate solutions and communicate it appropriately.

2. Review Of Related Literature

2.1. Mathematical Communication Ability

Mathematical communication is an ability to state and illustrate the mathematical ideas into mathematical model and vice versa. The mathematical model itself can be equations, inequalities, figure notations or graphics [6]. It is known that mathematical communication is not easy, many educator know how difficult it is to communicate mathematics. The difficulties to communicate mathematics are because that objects in mathematics are abstract and mathematics has developed its own language, more than any other science [7].

In learning activities, there will be an interaction in the form of communication both oral and written between students and lecturer or among students. Interaction in the form of communications in learning mathematics is aimed to help students reach the mathematical understanding. The importance of communications in learning process is written in Peraturan Menteri 22 Tahun 2006 about graduation competency standards in mathematics. The mathematical communications is important in order for student to learn the mathematical thinking, acquire the mathematical concept and deepen knowledge about learning contents through an interaction [8].

Reviewing [9] research on mathematical communication reiterated between communication and learning. "Classroom environments that place communication demands on students can facilitate the construction and sharing of mathematical meaning and promote student reflection on the nature of the mathematical meanings they are required to communicate". In this research, students constructed their own mathematical meaning by orally presenting their mathematical thinking and solutions to project and homework problems, as well as explaining and justifying their mathematical understanding in a writing portfolio. Oral communication developed includes talking, listening, questioning, explaining, defining, discussing, describing, justifying, and defending. Written communications enables students to think about what they know. The use of oral and written communication in mathematics learning can promote deeper conceptual understanding. Communicate mathematics with writing also provides evidence of students' mathematical understanding. By students communicating their mathematical thinking and ideas, lecturer can assess students understanding about the material their studying.

According to Romberg and Chair (in [3]), there are seven indicators of mathematical communication abilities. Yet, in Statistics textbook designed is only developed four indicators of communication abilities, i.e.: (1) relating real things, Figures and diagrams into mathematical ideas; (2) explaining ideas, situations, and mathematical relations both oral and written with real things, figures, graphics, and algebra; (3) stating daily activities in mathematical language or symbols; and (4) making conjecture, arranging argument, formulating definition and generalization.

2.2. Mathematical Connection Ability

According to [10], the mathematical connection ability is an ability relating mathematical concepts either among mathematical concepts themselves (in mathematics) or relating mathematical concepts with other scopes (beyond mathematics). Mathematical connection ability is required in learning process because the material of mathematics is an interconnected unity. It is appropriate with [11] opinion about

the importance of giving exercise to the students related with connection questions is that in mathematics every concept related to each other like a theorem with a theorem, between theory and theory, between topic and topic, and among mathematics branch. Therefore, to be successful in learning mathematics, the students have to be given a chance to observe that relation by doing a mathematical connection.

Next from the opinions of some experts, [6] summarize the indicators of mathematical connection ability are (1) searching for the relationship of any concept and procedure representation; (2) understanding the relationship among mathematics topics; (3) applying mathematics in other fields or in daily life; (4) understanding the equivalent representation of a concept; (5) searching for the relationship between one procedure to another procedure in an equivalent representation; (6) applying the relationship among mathematics topics and between mathematics topics and topics beyond mathematics. Statistics textbook is designed to develop three indicators of connection abilities, i.e.: applying mathematics in daily life, understanding equivalent representation of a concept; applying relationship among mathematics topics and between mathematics topic and topics beyond mathematics.

2.3. Learning Supported with ICT

Much of the quoted evidence of the beneficial ICT impact on education outcomes is based on the largely subjective assessment of student attitudes and behaviour. Thus, ICT is often claimed to be popular with students and welcomed by parents. ICT use is also claimed to have changed teacher-pupil working relationships and teaching-learning dynamics in the classroom [12]. Globalization and rapid technological change have made knowledge an important determinant of competitiveness in the world economy. Countries should take advantage of information and communication technology (ICT) for educational purposes and contribute to poverty reduction strategies. With globalization, the information revolution and the increasing demand for skilled labor, it is clear that the state should give high priority to building capacity to effectively use technology in education [5].

[13] states, ICTs as well as newer digital technologies such as computers and the internet have been touted as potentially powerful enabling tools for education change and reform. ICTs help to expand access to education, strengthen the relevance of education to the increasingly digital workplace, and raise educational quality by, among others, helping make teaching and learning into an engaging, active process connected to real life. By using ICT as a learning support, students can get additional knowledge and easiness in applying the learned theory. Learning that is not monotonous and only oriented on theory in the textbook will be more interesting and meaningful.

The use of ICT can also make the students understand the abstract object of mathematics study easier so that the occurrence of misinterpretations can be avoided. It is according to the opinion of [14] state that abstract mathematics is easier to understand and more interesting to learn by using ICT. While the monotonous learning is usually caused by the lack of lecturers' creativity so that it makes the students get bored and not interested in mathematical subject. ICTs have the potential to innovate, accelerate, enrich, and deepen skills, to motivate and engage student, to help related school experience to work practices, and strengthening teaching [15].

2.4. Portfolio Assessment

Portfolio-Based Assessment is an assessment model that is expected to reveal and assess students more accurately and completely based on the evidence (documents) they have. The portfolio assessment is a continuous assessment with the information or data collecting methods systematically of the students' work results in a particular period of time [16]. Portfolio as a form of physical object is a selection of selected works of an activity of a student or a group according to the learning objectives or formulated competencies. When it is linked with the concept of learning, it appears a term portfolio based learning.

Portfolio assessment approach is different with the other assessment approaches. Applied portfolio assessment approach is aimed to measure how far the students' ability in constructing or reflecting a work by collecting relevant objects in the purpose to be constructed by them, so that the results can be assessed and commented by the lecturers in a particular period of time. The portfolio assessment here is an assessment approach of students' work. Based on the shape and kind of information, portfolio assessment is divided into three, i.e.: (1) Working portfolio, (2) Document portfolio, and (3) Show portfolio.

The use of portfolios for assessment can document varied experiences of the learner in a course, provide points for discussions between learner and teacher or among learners, and represent change in the student's technique or skill over time [17]. Portfolio as assessment have high face validity, positive educational impact toward the curriculum outcomes, feasible, acceptable, and reliability may be acceptable if it prepared to sample through the source of bias [18].

2.5. Relation between Statistics Textbook Supported with ICT and Portfolio Assessment of Students' Mathematical Communication and Connection Ability

Statistics Textbook Supported with ICT with portfolio assessment approach is designed to improve students' mathematical communication and connection in addition to improving students' outcome. The design of developed Statistics textbook will give chance to students to understand more about statistical data analysis and they will be given a project to directly enter a field of study to study data source and any real cases which directly related to the analysis and statistical data calculation. In this case, the students is trained to provide the accurate solution of any real cases in life by connecting real problems with knowledge they get and then communicating it in mathematical language. Each data analysis required in this case is done with statistic test by using help of statistic software to give more accurate result and help students understand about material they study. Every student's work is arranged in structured papers arranged in a portfolio.

3. Research Methodology

This research is about the development of statistics textbook supported with ICT and Portfolio-Based Assessment to improve students' communications and mathematical connections in Statistics lecture. This research was conducted in Mathematics Department FMIPA Semarang State University in March until June, 2015 with the subject of this research is the first year student of mathematics education.

This research was conducted by using development research steps developed by S. Thagarajan, Dorothy S. Semmel, dan Melvyn I. Semmel that is 4-D model consists of four main stages, i.e.: (1) define, (2) design, (3) develop, and (4) disseminate.

Stage 1: Defining

This stage consists of front-end analysis, student analysis, concept and task analysis, and also formulation of objectives

Stage 2: Designing

This stage consists selection of format draft and textbook preliminary design.

Stage 3: Developing

This stage consists of valuators' assessment, readability test and limited trials of designed textbook.

Stage 4: Limited Dissemination

Dissemination to the field is conducted at this stage by doing application research of the use of textbook to Statistics students.

In this research, the step used is only until the third stage that is the development stage, because this research is conducted to produce statistics textbook that has been through expert validation and test of readability and practicality of the book.

4. Result of the Research

4.1. Define

Several preliminary studies that had been carried out in this research were doing the steps in defining stage. Such steps are as follows:

- Front-end Analysis
  This stage conducted curriculum study, supported learning theory, and also various abilities that will be developed so that an ideal learning patterns description was obtained. This research conducted some efforts to improve the result of study and also the students' mathematical communications and connections ability by development of statistics textbook supported with ICT and Portfolio-Based Assessment.
- Student Analysis
  This analysis was aimed to study the students' characteristic which was appropriate with the design and development of the textbook. Based on the students analysis result, we selected learning media by using textbook integrated with any project that was given with portfolio assessment approach. The textbook was equipped with subject description, learning objectives, and exercises, and application of ICT in the study which related to the data analysis using Statistics program software application.
- Material Analysis
  Material analysis was used to identify the main parts that would be taught and arrange it systematically in a textbook. The material that would be discussed in this research was the material in Statistics subject which comprised of Data Presentation, Parameter Estimation, Hypothesis Examination, Regression and Correlation Analysis, and also Variance Analysis.
- Task Analysis
  This analysis covered the understanding about the given tasks in the study and it was corresponded with the material analysis. Based on the task analysis result, giving the task in learning was done either individually or in group. The task given was designed with portfolio assessment approach.
- Specification of Learning Objectives
  This analysis was aimed to converse the concept and task analysis to be learning objectives (Competency Standard, Basic Competency, and Competency Achievement Indicator) which were the basic in forming test and design of textbook.

4.2. Design

This stage was developed the textbook based on the competency standard, basic competency, and competency achievement indicator in Statistics subject and it was corresponded with the learning objectives. One of the research objectives was to improve the students' mathematical communication and connection abilities.

In this research, Statistics textbook supported with ICT and Portfolio-Based Assessment was made. The material designed in the textbook was corresponded with standard competency of Statistics subject which comprises of Data Presentation, Parameter Estimation, Hypothesis Examination, Regression and Correlation Analysis, and also Variance Analysis. The material was organized into 10 chapters; each chapter consisted of the learning main material description, examples in accordance with the main material, and was also equipped with exercises. The examples of cases and exercises given were made by referring to the indicator of the students' mathematical communication and connection ability. The exercise was designed to be evaluated with Portfolio-Based Assessment.

The designed textbook was designed with ICT support, so that in every topic it was presented the data processing and analysis using Statistics software MS. Excel and SPSS. Because the use of MS. Excel and SPSS to process the data for the first-year students was a new thing, so in every chapter there was a

detail explanation about data processing steps until interpreting the output result of data analysis using that statistics software.

The textbook that was already designed in early stage research (*Draft 1*) was then tested through some stages. First stage was textbook validity test by using expert validity assessment. Textbook validity assessed was about content validity related to the subject competency standard and also mathematical communication and connection ability that would be developed. After going through expert validity stage, then it continued with first revising of textbook by adjusting with the assessment from the expert so that it produced Statistics textbook *Draft 2*. Then Draft 2 textbook was tested limitedly to some students to check the readability of the book. Next stage, with the assessment of book readability test, it was conducted a further revision and the textbook was revised into textbook *Draft 3*. This textbook *Draft 3* then being tested to some students in a small class for seeing the validity and reliability before it was stated to be widely used.

4.3. *Develop*

This research created Statistics textbook supported with ICT and Portfolio-Based Assessment. Before the designed textbook was valid and reliable and also could be used widely, it had to be validated by some experts first. Assessed textbook validity was about content validity related to the competency standard of the subject and also mathematical communication and connection ability that would be developed. There are three experts in Statistics, Mathematics Education and Mathematics Evaluation as validator's who gave consideration of Statistics textbook validity with ICT support and Portfolio-Based Assessment. The validator consideration of textbook content validity with ICT support and Portfolio-Based Assessment was given to the main subject which in this research was arranged in the textbook chapter. Aspects observed on the textbook can be seen in table 1.

Table 1. Textbook content validity

Item No.	Observed Aspects
1	The book is in accordance with curriculum syllabus
2	The book is in accordance with expected basic curriculum
3	The book is relevant with material the students have to learn
4	The material content has the correct and exact concept
5	The book helps explain the concept
6	The book contains examples of question
7	The book contains exercises
8	The compatibility of the exercises with the explained material
9	The compatibility of the examples and exercises with the developed abilities
10	The exercises have complied difficulty level proportion
11	The language used properly
12	The language used is easy to understand
13	The book display and arrangement is interesting
14	The Figure and table arrangement is interesting
15	The font size is obvious
16	The students can use the book independently

Based on the consideration result of those three experts about 16 aspects observed from 10 chapters in Statistics textbook, then analyse nonparametric statistical analysis using Q-Cochran test to know that the validator had the same consideration related to the content validity from the arranged textbook. The Q-Cochran test show that statistical value Cochran Q test was 0.667with Asymp.Sig = 0.717 greater than $\alpha = 0.05$. So it is concluded that those three validator's had the same consideration about textbook

content validity. This analysis was done into10 chapters in the textbook. The same result was obtained to textbook content validity analysis to the other main subject, so it could be concluded that the experts had the same consideration about the validity of the content of Statistics textbook with ICT support and Portfolio-Based Assessment that was created.

Some suggestions given by the validator to the contents of the book are:

- It needs to be added some data presentation exercises without using the help of computer.
- It needs to be added some examples of questions in some chapters and completed by the steps of using MS. Excel and SPSS.
- The book needs to be made as interesting as possible.

4.3.1. Experts' Consideration of Textbook Related to the Mathematical Communication and Connection Ability

The experts' consideration about the validity of the content of Statistics textbook with ICT support and Portfolio-Based Assessment based on the compatibility to the indicator of mathematical communication and connection ability was also given to each subject consists of 10 Chapters in a textbook. Some indicators of mathematical communication and connection ability observed in the textbook can be seen in table 2.

Based on those three validator consideration about 14 indicators of mathematical communication and connection ability observed in Statistics textbook, next it was conducted a nonparametric statistical analysis using Q-Cochran test to know whether the validators had the same consideration related to mathematical communication and connection ability in the textbook.

Table 2. Indicator of mathematical communication and connection ability

Item No	Description	Indicator
1a	The compatibility of presented material in a book with the improved mathematical communication ability	Connecting real things, Figures, and diagrams into mathematical ideas
1b		Explaining mathematical ideas, situation, and relation in written with Figures, graphic, and algebra
1c		Explaining mathematical situation into mathematical model
1d		Making conjecture, compiling argument, formulating definition and generalization
2a	The compatibility of examples and exercises with the improved mathematical communication ability	Connecting real things, Figures, and diagrams into the mathematical ideas
2b		Explaining mathematical ideas, situation, and relation in written with Figures, graphics, and algebra
2c		Explaining mathematical situation into mathematical model
2d		Making conjecture, compiling argument, formulating definition and generalization
3a	The compatibility of the presented material with the improved mathematical connection ability	Applying mathematics in a daily life
3b		Applying mathematics in other fields
3c		Understanding the same concept equivalent representation
4a	The compatibility of examples and exercises with the improved mathematical connection ability	Applying mathematics in a daily life
4b		Applying mathematics in other fields
4c		Understanding the same concept equivalent representation

From Q-Cochran test result, we can see that statistical value Cochran Q test was 5.091 and the value of Asymp.Sig = 0.078 is greater than the value of $\alpha = 0.05$. So it can be conclude that those three validators has the same consideration about the content validity of the textbook based on the indicator of Mathematical Communication and Communication on Chapter I. The same result was obtained for the content validity of the textbook on the other main subjects, although there were some chapters where the validators had different considerations, i.e.: in Chapter III, Chapter IV, and Chapter X. But generally it could be concluded that generally the validators had the same consideration about the content validity of textbook with ICT support and Portfolio-Based Assessment based on the indicator of mathematical communication and connection ability.

Some suggestions given by the validator to the contents of the book related to the indicator of mathematical communication and connections are:

- It can be increased in making conjecture, constructing arguments, formulating definition and generalization, and applying mathematics in daily life and other fields.
- It needs to be added some examples and exercises related to mathematical connections related to reading or understanding figures.

4.3.2. Textbook Readability Test Result

Textbook readability test was conducted for the purpose to test the book readability if later it will be used at the larger sample. The book readability test was conducted on the textbook *Draft 2* which was a revision from the textbook *Draft 1* according to the assessment and suggestion of the expert validators at the previous stage. As the validators on the textbook readability there are five students of third grade who had ever joined Statistics lecture.

Some textbook readability indicators which were observed along with readability test result on limited samples consisted of five students can be seen on table 3.

Table 3. Book readability assessment on limited samples

Item No.	Readability Variable	Indicator	Students 1	2	3	4	5	Total Score
1	The easiness related to the word introduction acceleration, error level, visual fixation per second, clarity of writings (form and size)	Easiness of language (vocabulary, sentence, and reading)	5	4	5	5	5	24
2		Typography: a. Writing clarity, writing form and font size	4	4	4	5	4	21
3		b. Space width	5	4	5	4	4	22
4		Level of writing error	5	4	5	4	4	22
5	The attractiveness related to the reader interest, idea accuracy in a reading, writing style	Graphic aspects	4	4	4	4	4	20
6		Attractiveness of textbook presentation in accordance with readers' interest	4	4	5	5	5	23
7		Writing style	4	4	4	5	5	22
8	The understanding related to the sentence and word characteristics, like the long-short and frequency of the use of word and sentence, sentences constructing, paragraph arrangement	Idea intensiveness and information in a reading (long-short sentences)	4	5	4	4	4	21
9		Compatibility with basic grammar	4	4	4	5	5	22
10		Easiness to understanding the material presenting systematics	4	4	5	4	5	22

Based on the readability test result, can be see that those five students gave high scores (Score 4 = Agreed, Score 5 = Highly Agreed) towards all readability indicators. It means that Statistics textbook with ICT support with portfolio assessment that was arranged can be read and understood well by students. The textbook readability test result then being measured using likert scale by range 0 – 25. Based on that range then it could be determined the good criteria or the bad ones of the indicators from a textbook to know the practicality of textbook usage in accordance with table 4.

Table 4. Textbook practicality criteria

Interval	Criteria
0 – 5	Poor
6 – 10	Weak
11 – 15	Medium
16 – 20	Strong
21 – 25	Very Strong

Based on the assessment on the limited samples, it could be concluded that most of the textbook readability indicators were at the score interval with very strong criteria, only indicators which related to the textbook graphic aspects which have strong criteria. Yet it can be said that the developed book had reached the readability and practicality criteria.

Yet, there are some suggestions given by the students toward the textbook i.e. about the writing related to the width of space also the using of some terms in the book that need to be clarified. So that the textbook can be used for the next stage after being done some writing revision.

4.3.3. Textbook Trial Result to a Small Sample

After the stage of textbook expert validity test and readability test, next on the development process of textbook was a limited trial to a sample in a small class. Textbook *Draft 2* which was a revision based on validators' assessment and book readability test used in small class sample research. In this limited trial stage, one class of Mathematics Education Study Program of second grade 2014/2015 academic year was chosen as a sample class. There were 24 students in this class consisted of 21 female students and 3 male students. The textbook trial was held until 12 times lectures, with 10 meetings using textbook, 1 meeting in the beginning of the lecture as a coordination and delivery of research purposes and 1 last meeting for interview and questionnaire.

Based on the interview and questionnaire result given to the students, showed that most of the students got advantages after using Statistics textbook with ICT support and Portfolio-Based Assessment. In the first meeting, students tended to be lazy in reading the book and chose to learn the material through the lecturer's explanation during lecture. But as the material developed, it had changed. Besides, giving task in portfolio obliged the students to understand well the learned material.

Meanwhile, the use of computer media in this case statistics software application used as analyzing and data processing aid also helped students to understand about statistics formulas which tend to be complicated and abundant. The material content of Statistics textbook that was developed along with the examples of case and exercise inside could dig up the students' mathematical communication and connection ability. This can be observed from the work result either individual portfolio or end-lecture test result. But that data can only be explained descriptively, because the evaluation tool used to measure the mathematical communication and connection ability was not tested yet and would be developed on the next research.

5. Conclusion

Based on the result of learning tools development, it was produced Statistics textbook model designed with ICT support and portfolio assessment approach. The developed Statistics textbook with ICT support with Portfolio-Based Assessment is valid based on the expert validations and has met the practicality criteria, so that the developed textbook model can be used for Statistics lecture.

Since this research is only developing textbook, so for the next stage it needs to expand a valid and reliable learning tools also instrument of mathematical communication and connection test as an evaluation tool to measure students' ability after using a developed Statistics Textbook with ICT support and Portfolio-Based Assessment. Besides, it can be analysed the students' respond after using the textbook also conducting class experiment to test the textbook effectiveness.

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