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Developing Mathematics Teaching Materials Based on Blended Learning for Mechanical Engineering Students of Politeknik Negeri Bali

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ABSTRACT

The objectives of the current study are to 1) investigating the needs for developing teaching materials applied mathematics in the Department of Mechanical Engineering of Bali State Polytechnic; 2) composing a first draft (Draft I) of teaching materials based on the aforementioned investigation, and 3) investigating the feasibility of Draft I application in a blended learning environment. The teaching materials are developed using the Thiagarajan 4-D model. Data for the current study were collected using surveys, documentation, observation, and interview. The data then analyzed using descriptive statistics. The analysis found, firstly, there are 13 learning outcomes with 51 sub-achievement for applied mathematics learning in the Department of Mechanical Engineering. Student appears to have high learning independence and there is a need to develop teaching materials that fit the blended learning context. The study also found that the Draft I teaching materials are feasible to be used as applied mathematics teaching material in a blended learning context, after undergoing minor revisions. The draft I teaching materials is ready to progress to the next development process, namely empiric testing in the field.

INTRODUCTION

One of the great challenges of Indonesian society in the 21st century is globalization. Globalization causes increasingly large competition in all fields of community life (As'ari, 2016). The 21st century is marked by a digital era that requires students to have the competence of thinking and learning. Education becomes a very important aspect to consider. Education must be able to guarantee students have the life skills. All people who live in the 21st century

must have at least 4 skills, namely critical thinking skills, creative thinking, communication skills, and collaboration skills (Daryanto & Karim, 2017). It is necessary to prepare character skills that students must have in the education process for all levels of education and all subjects, including mathematics.

Mathematics is a science that has an important role both in daily life and in the development of science and technology. Mathematics has a strength that can be applied to several aspects, including technology. Since the beginning of its development, mathematics has been a supporting force for technological development. In fact, because of its enormous role mathematics is called the root of science (Suriasumantri, 2010; Sudradjat, 2009). As a basic science, the role of mathematics can be seen in the large demands of mathematical skills that must be possessed, especially in the face of the 21st century.

The development of mathematics learning in the 21st century is by utilizing the development of information and communication technology in the process of learning activities. The process of learning activities in the field of mathematics in vocational education includes the dimensions of knowledge, numeracy skills, daily attitudes to interact with society, the environment, and technology following the era. The learning process has elements such as educators as a source of information, the media as a presentation of ideas and materials, and students as subjects of the learning process (Syuhendri & Wiyono, 2016; Arham & Dwiningsih, 2016). The learning process needed in the 21st century is effective and efficient.

Mathematics as one of the subjects considered to play an important role, so that the purpose of learning mathematics in schools and universities, is to develop the power of mathematics in students. Mathematical power in the National Council of Teachers of Mathematics (NCTM), is referred to as the five standard mathematics learning processes, namely: understanding, reasoning, communication, connections, and solving mathematical problems (NCTM, 2000; Wardani, 2004). However, in reality, mathematics is still a subject that is considered difficult by students, therefore the learning outcomes of mathematics are also low. Some contributing factors include the dominant role of the lecturer in the learning process, students' unpreparedness in learning, boredom, incompatibility between the material taught and the content of teaching materials, learning strategies applied by the lecturer, and lack of self-confidence (Gazali, 2016). According to Cowan, mathematics education in the era of the industrial revolution 4.0 requires qualified human resources, who has comparative & competitive ability, ability to innovate and collaborate so that it can adapt to the changing era (Lubis et al., 2015).

The learning process in the 21st century will be more effective, efficient, interactive, broad, and not patterned only in the classroom (Nasution, 2016). Learning can be done outside the classroom and in the classroom. This learning model is called blended learning (Dwiyogo, 2018). The learning process of blended learning is the use of effective and efficient training solutions, which are implemented in a coordinated way to achieve learning objectives (Husamah, 2014; Sugiarto et al., 2017). Blended learning can be combined with positive aspects of two learning environments, namely learning done in the classroom with e-learning (Bonk & Graham, 2006). E-learning and online classes can provide flexibility, interactive, speed, and

visualization through various technologies. Blended learning brings traditional physical classes with elements of virtual education simultaneously (Finn & Bucceri, 2004).

Blended learning has a basic conceptual framework that is based on the perspective of Behaviorism and Constructivism learning theories. The behaviorism learning activities by providing stimuli to students, while in Constructivism learning activities by allowing them to explore for themselves the knowledge they need. They are given the experience of conducting investigations to ensure concepts are built and assimilated in-depth and meaningfully (Garrison & Vaughan, 2008). Through blended learning, the freedom and variety of media choices can increase the interaction of students to give them a learning experience. Blended learning can increase student interaction with other students as well as teachers (Westover & Westover, 2014). Blended learning is a learning approach that combines face-to-face learning in the classroom with online-based learning activities to improve the effectiveness and efficiency of learning experiences (Bonk & Graham, 2006; Westover & Westover, 2014; Sukarno, 2011; Garrison & Kanuka, 2004).

Blended learning-oriented development is in line with the development of information technology in the digital age. Learning activities are designed in the form of case studies, tutorials, independent training, simulations, or collaboration in networks (Garnham & Kaleta, 2002). Activities outside the network can be done by involving students in utilizing materials available on the internet and discussing them outside the network (Hermawanto et al., 2013). Learning activities require media in the form of teaching materials that are interesting for students, namely books, and learning SAS with blended learning orientation.

Textbooks are printed teaching materials arranged and developed based on learning outcomes that are expected to be mastered by students. Learning outcomes include material standards or content standards and performance standards. Student Activity Sheet (SAS) derived from the translation of students' worksheets is a sheet (not books) that contains guidelines for students to do programmed activities.

One of the stages in conducting blended learning is the development of teaching materials. Wherever teaching materials have been used as per the developments in the word terminology is teaching material. Teaching materials in Web-based learning environments such as blended learning are referred to as teaching objects, which are independent teaching materials or teaching materials that are packaged for self-study of students independently. The contents, also, to teaching material some exercises must be done by students to measure the progress of their learning. Learning the use of text, audio, video, and multimedia for material enrichment, practice, and strengthening students' understanding of one topic. The packaging is done digitally and accessed through web-based solutions.

Teaching materials play a very important role in blended learning because, in such learning, students will interact more with teaching materials online through web pages. Instructional materials are influential in the development of courses. Good teaching materials can provide a deep understanding of the study material presented by lecturers (Haryati, 2007; Prastowo, 2011). Therefore, teaching materials are designed so that they can motivate and refer students to active learning. Well-structured teaching material can provide benefits, namely: 1) increase the

maximum learning process, 2) students are more active in learning because they face several tasks that must be done, 3) provide feedback immediately so that students can know the results of their learning, 4) directed learning activities because teaching materials contain clear learning objectives and 5) the involvement of lecturers in learning is very minimal (Haryati, 2007; Prastowo, 2011). The teaching material must be integrated into the learning management system (LMS) that will be used for blended learning. The material presented is then used by students as independent teaching materials.

Applied mathematics courses are basic science courses given to semester I and II students. Curriculum Learning Outcomes (CLO): Being able to apply basic sciences in engineering to identify and choose methods of solving procedural problems in engineering and to be able to solve technical mathematical problems in the application of engineering fields. Mathematical learning in the 21st century is learning that emphasizes the importance of developing 4 aspects (4C), namely: 1) communication, 2) collaboration, 3) critical thinking and problem solving, and 4) creativity and innovation (Wijaya et al., 2016). This is in line with Daryanto and Karim (2017) that the 21st-century learning paradigm emphasizes the ability of students to think critically, to be able to connect knowledge with the real world, master information technology, communicate and collaborate. The ability to solve problems is one of the highest skills and is called higher-order thinking because in the process of solving the problem it contained thinking, collaboration, communication, and others (Gagne, 1985). The ability to solve mathematical problems is a skill in students to be able to use mathematical activities to solve problems not only in mathematics but also in other sciences and daily life (Soedjadi, 1994; Soedjadi, 2000). The topic of this ability has received great attention from researchers in the field of education even referred to as a skill that must be mastered in the 21st century (Dwiyogo, 2018; Gagne, 1985). Through problem solving, students can transfer their knowledge to, both similar problems and new problems(Dwiyogo, 2014; Dwiyogo, 2018).

Communication is an essential part of mathematics education. Through communication, students can organize and consolidate their thoughts and explore mathematical ideas (NCTM, 2000). Communication refers to the ability to use mathematical language to express mathematical ideas and arguments precisely, consistently, and logically through the process of reflection, refinement, discussion, and development. Mathematical communication plays an important role in the problem-solving process. Communication skills are needed by students to improve their academic abilities and to deal with various problems in daily life (NCTM, 2000; Tandiling, 2012; Sokoine, 2015). To facilitate students achieving communication and problem-solving skills, appropriate learning resources are needed following the 21st-century mathematics learning paradigm. One such learning resource is teaching materials in the form of textbooks and mathematics SAS based on blended learning.

Blended learning conditions that make students more active so they can express their opinions with courage (Marlina & Yusrizal, 2014). During online learning, students communicate their ideas to explore knowledge and find mathematical concepts through SAS online. So that when offline learning is expected they already have a mathematical concept that is ready to be applied in solving offline SAS. When students experience obstacles during online learning, these obstacles might get resolved while working offline and vice versa if they experience obstacles when learning offline, they will be able to pour it in online learning.

It is found that to date, no teaching materials are available that are in line with the learning paradigm demanded by the 21st-century education paradigm. Lecturers still teach based on hand out or based on the conventional curriculum. Students do not have textbooks as a guide. They still use textbooks and the resources they use in doing assignments and learning are not up to date (for example students access them from BlogSpot, which is still less reliable). Based on the phenomenon, it is necessary to develop teaching materials in the form of textbooks and applied mathematics worksheets based on blended learning. Textbooks have a very important role in every education system throughout the world (Seguin, 1989; Altbach, 1991; Widodo &, Jasmadi, 2008; Syamsul & Kusrianto, 2009). Textbooks have been placed in special positions in the educational process (Prastowo, 2011, Tim Jago Nulis, 2016; Utama, 2014). The provision of textbooks and worksheets can effectively improve students' understanding and achievement (Yarmaidi, 2003). Teaching materials and blended learning play an important role in supporting educational development so if these two things are combined it is believed that teaching materials based on blended learning can educate students to be able to live in the digital era. To get teaching materials that are in line with the learning needs of students in the digital era it is necessary to analyze the needs of developing learning materials based on blended learning. The objectives are to 1) describe the needs of developing teaching materials in the form of textbooks and student activity sheets (SAS) based blended learning, 2) get a draft I of applied mathematics teaching materials based on blended learning, and 3) find out the feasibility level of the draft I as a mathematics teaching material applied based blended learning.

METHODS

This research is a development study using the 4-D model developed by Thiagarajan, and Semmel, with several modifications. The stages include: 1) Define, 2) Design, 3) Develop, and 4) Disseminate (Thiagarajan, and Semmel, 1974; Trianto, 2010). The stages of development 1 and 2 and part of phase 3 are carried out in the first year (2019) and partly in the second year (2020) and stage 4 is carried out in the third year (2021). Implementation in the field of engineering of the Bali State Polytechnic, with a population of 588 people distributed in 3 majors and 6 study programs. Samples were taken using purposive sampling as many as 251 students and 20 lecturers supporting basic science.

The procedure can be divided into the first stage (2019) is carried out to define, design, and develop. The define and design stage are the stages of development needs analysis. At this stage, a field survey and a literature study were conducted. The field survey was conducted for students and lecturers in Engineering of Bali State Polytechnic, namely the characteristics of students in learning applied mathematics and students' perceptions about learning applied mathematics today. Subsequently, a draft of applied mathematics teaching material was constructed based on blended learning. The selection of contents is based on the principles of developing teaching materials in general by taking into account issues of scope, depth, and order of presentation. The order of presentation uses a procedural or hierarchical approach. The teaching material will then be integrated with the LMS using the Schoology model. The development phase is to get a validated blended learning textbook draft. This stage was carried out through 1) expert appraisal, 2) revision, 3) developmental testing. Phases 2 and 3 will be carried out in the second year. Validation is currently limited through expert judgment. The

assessment is done by filling out a validation questionnaire for aspects of the design model being developed.

The data were collected using the methods of survey, documentation, observation, and interview. The instruments were developed by the researchers themselves based on the variables that were translated into research indicators, their validity and reliability were tested through empirical tests. Then analyzed using descriptive statistics. The data from each variable was compared with the real average. Furthermore, the tendency was classified into five categories with the norm of the theoretical framework of the ideal normal curve, as follows (Mardapi, 2016).

Mi + 1.5 SDi <x≤ Mi + 3SDi = Very High/very positive
Mi + 0.5 SDi <x≤Mi +1.5 SDi = High/positive
Mi - 0.5 SDi <x≤Mi + 0.5 SDi = Medium/neutral
Mi - 1.5 SDi <x≤Mi - 0.5 SDi = Low/negative
Mi - 3 SDi <x≤ Mi - 1.5 SDi = Very Low/very negative
Information: Mi = ½ (maximum score + minimum score); SDi = 1/6 (maximum score - minimum score)

To find out whether or not a valid textbook was determined from the validation match with the specified validity criteria. One of the criteria that can be used as presented in Table 1 below.

No	Validity Criteria	Level of validity
1	85,01 % – 100 %	Very valid, or can be used without revision
2	70,01 % – 85,00 %	Valid enough, or can be used but needs to be revised slightly
3	50,01 % – 70,00 %	Less valid, or recommended not to be used because it needs a major revision
4	05,01 % – 50,00 %	Invalid, or may not be used

Table 1: Validity Criteria for Teaching Materials
Akbar, 2013 [source]

The first draft of the teaching material developed was tested theoretically by 5 validators, namely: learning content experts, learning media experts, content experts, and 2 users. Learning content experts and learning media experts from the Ganesha Educational University and the Saraswati Institute of Teacher Training, the content experts from the Ganesha Educational University. Whereas 2 users are determined from applied mathematics teaching lecturers in the engineering field of Bali State Polytechnic. Data on the average score of the test results compared with the criteria in Table 1.

RESULTS AND DISCUSSION

The results of a survey of research respondents which included 251 students and 20 teaching staff teaching basic science in the Engineering Bali State Polytechnic, as follows.

The characteristics of students seen from of the age, the majority are (72.5%) aged 18 years. The students belong to the late adolescent age range, even towards adolescent perfection (Rumini & Siti, 2004). They also can do hypothetical-deductive reasoning, namely the ability to arrange a series of hypotheses and test them (Suherman et al, 2003). The implication in

learning is the need to change learning that encourages students to participate actively in both thinkings and carry out so that a systematic, logical, and critical mindset is formed in solving the problems they face. When viewed in terms of ability, identifying that students' abilities vary greatly in terms of academics and talents. Therefore, it is necessary to develop teaching materials that can accommodate this diversity.

One of the factors that influence mathematics learning outcomes is the internal factors of students. Some internal factors include, namely: attitudes, interests, motivation, and independence of learning (Sudjana, 2014; Rusman, 2013; Syah, 2013). Attitude is the tendency of individual behavior patterns to do something in a certain way towards people, objects, or ideas. Student attitudes related to the learning process are inseparable. Its influence is very dominant in mathematics learning activities and mathematics learning achievement (Sudjana, 2014). The survey results obtained a student attitude toward mathematics 73.0% (very positive). This condition identifies that students already have good potential to take mathematics courses.

Independence is defined as the condition of someone who wants to do his activities by himself without depending on others. Learning independence does not mean that students learn on their own, however, the students can solve problems and responsibilities so that the results obtained are optimal as expected. Student learning independence influences learning achievement (Siregar, 2006). If students' learning independence is good, their learning outcomes tend to be good (Suhendri, 2012). Students who have high learning independence will try to complete all the exercises or assignments given by the lecturer with their abilities. Independence is indicated by the ability to solve learning problems faced by behavior. The survey results showed an average of 50.6% (low) student learning independence. This condition is an obstacle in mathematics studies that need to be resolved so that student learning outcomes in mathematics can be improved.

Interest is one of the internal factors that determine the success of student learning (Nawawi & Susanto, 2007). Interest as an internal factor has a role in supporting learning outcomes. The effect is very large on learning because if the learning material learned is not following the interests of students, then they will not be interested in learning it, will not learn as well as possible, and do not get satisfaction from the lesson. The survey results obtained an average student interest of 47.05 or 62.73% (high) from the highest score of 75.

Motivation is a strength that can encourage someone to do something, including learning (Uno, 2012). Its function is as a driver of learning efforts and the achievement of better learning outcomes (Ratumanan, 2004). The greater the learning motivation a person has, the greater his success in learning. The results of a survey of students showed an average learning motivation of 48.33 or 64.44% (very high) from the highest score of 75.

The ability of students to solve mathematical problems, 10.81% was good, 62.03% was moderate, and 27.03% was lacking. This shows that the effectiveness of applied mathematics learning needs to be improved through reform of learning both related to teaching materials and strategies for delivering teaching materials. Teaching materials can be packaged in the form of printed teaching materials such as handouts, modules, teaching books, and SAS. To be able to

encourage students to learn independently, teaching materials can be packaged in the form of textbooks and SAS that are written per the writing procedure of teaching materials.

Studying mathematics is different from studying other sciences. Learning mathematics is regarding abstract ideas or concepts. In mathematics, many formulas must be mastered, ranging from flat formulas, space builds, algebra, logarithms, trigonometry, and so on. Memorizing formulas is certainly different from memorizing subject matter that has a lot of reading. If the formula is only memorized, it is certainly difficult to understand. Mathematical formulas must be understood, not memorized. For this reason, understanding formulas and their use are more important than memorizing formulas according to the topic. The results of a survey of students get, how to learn mathematics 50.6% by recording lecturer explanations, 10.4% memorize formulas according to the topic and 35.1% understand the use of each formula.

Learning materials are an important learning resource for students, the majority (87.8%) of respondents include textbooks/handouts in the learning design while teaching materials in audio and audio-visual format have not been an important part of learning.

Regarding teaching materials used by students, 79.7% had difficulty understanding sub textbooks given by lecturers, 89.6% needed alternative teaching materials to understand mathematical concepts and 83.3% agreed to develop blended-based applied mathematics teaching textbooks learning uses a problem-solving approach. However, some teachers have used computers (92.6% and the internet (65.8%). Most of the lecturers (85.7%) have given questions in the form of solving real problems in their daily lives, as an effort to improve communication skills and mathematical problem-solving.

Learning in the 21st century lead to a combination of face-to-face learning, offline learning (interactive computer), and online learning (internet). Traditional face-to-face learning has now moved towards offline and online learning, likewise online learning has also begun to move towards face-to-face combinations (Dwiyogo, 2018). Therefore, the ability of lecturers to manage to learn must also need to be blended. The survey data obtained: lecturers who were aware of the existence of blended learning discourse, namely: as many as 41% had never heard and others knew after this research activity.

Blended learning material is material developed by combining traditional sources combined with electronic or digital materials that can be accessed online. The teaching material is in the form of textbooks that are packaged in printed and not printed materials. This material was developed by paying attention to the structure, content, and online sources that are integrated into printed learning materials. The structure, consisting of the subject, the purpose of studying the material, a description of the material, sub-topics, exercises, summary material, formative tests, concludes with a glossary, and reading material. While, the SAS structure, in general, is as follows: Title, study instructions, course learning outcomes (CLO), supporting information, assignments and work steps, assessment, and bibliography.

Web-based learning processes such as blended learning, utilizing text, audio, video, and multimedia. Its function is the enrichment of material to practice and strengthen students'

understanding of one topic. The material is packaged using text, audio, video, and multimedia is packaged with certain storage media.

Teaching materials are arranged and developed based on learning outcomes that are expected to be mastered by students. These learning achievements include material standards or content standards and performance standards. Material standards contain the type, depth, and scope of lecture material that must be mastered by students, while the performance standard contains the level of mastery that students must display. Learning activities, the use of textbooks following learning achievements enables students to learn a course achievement in a coherent, systematic, innovative manner so that all competencies are expected to be achieved in a whole and integrated manner (Gunawan, 2000). The textbook material must be integrated into the SAS used.

The teaching material presented in the SAS will be able to function actively, it must be developed based on the principles of developing teaching materials in general, and in particular web-based learning materials. The principle that must be considered, namely; the principle of relevance, the principle of consistency, and the principle of adequacy (Depdiknas & BSNP, 2009). Another thing to note is the issue of scope, depth, and order of delivery. Accuracy in determining the scope and learning material will prevent teachers from teaching too little or too much, too shallow or too deep. The order of teaching materials, namely the order of presentation. The accuracy of the order of presentation will make it easier for students to learn the learning material. The order in which the material is presented is delivered precisely. Without the right order, if some material has a prerequisite relationship, it will be difficult for students. The order of presentation can be delivered with a procedural or hierarchical approach (Depdiknas, 2006). A well-prepared textbook can provide benefits, namely: 1) can increase the maximum learning process, 2) students are more active in learning because they face several tasks that must be done, 3) can provide feedback immediately so that students can know the results of their learning, 4) directed learning activities because teaching materials contain clear learning objectives, and 5) the involvement of lecturers in learning is very minimal (Ratumanan, 2004). Teaching materials that are arranged systematically will facilitate students in the material so that it supports the achievement of learning objectives. Therefore, textbooks must be arranged in a systematic, interesting, high readability aspect, easy to digest and comply with applicable writing rules (Susanto, 2013).

The results of curriculum analysis in each department in the field of engineering get graduate learning outcomes (CPL), namely: be able to apply basic engineering sciences to identify and choose methods of solving procedural problems in engineering, and be able to solve engineering mathematical problems in their respective fields respectively. The learning achievement of applied mathematics courses includes 13 learning outcomes of courses with 51 learning sub-achievements. Thirteen learning achievements and sub-achievements are following aspects of 21st-century mathematics learning emphasis.

To support the achievement of applied mathematics learning at the Polytechnic, several study materials are the subject of the learning material. applied mathematics at the Polytechnic. Judging from its contents, the subject matter is grouped into four parts namely: Algebra, Geometry, Trigonometry, and Calculus. Algebra includes operational real numbers, equations,

functions, and graphs. Geometry includes the geometry of flat fields and geometry of space. Trigonometry includes trigonometric functions, sine rules, cosine rules, double angles, and the application of trigonometric functions. Calculus includes limits, continuity, differential functions, and integrals. This material is arranged hierarchically, the previous material is a prerequisite for the delivery of the next material.

Applied mathematics is one of the basic sciences to become a group of basic subjects in Basic Sciences and Humanities in the field of engineering. Its function is as a support for teaching other subjects and as a tool for solving everyday problems in engineering during the education process and after work. Mathematics is universal knowledge, mathematical concepts arranged hierarchically, structured, logical, and systematic starting from the simple concepts to the most complex concepts. In mathematics, there are prerequisite topics or concepts as a basis for understanding the next topic or concept. So that the selection of book material that is being developed follows the principles: relevance, consistency, and adequacy. The depth of the material refers to aspects contained in the curriculum learning achievements and the learning outcomes of the subjects, while the description is based on a hierarchical approach.

The draft I of applied mathematics learning is based on blended learning, the material refers to the curriculum being implemented, the material is sorted into 2 textbooks and 2 SAS. Textbooks and SAS Mathematics Applied I. Textbooks and SAS Mathematics applied II. The textbook materials and Applied Mathematics SAS I, including Algebra, Geometry, and Trigonometry. The textbook materials and Applied Mathematics SAS II namely Calculus includes a limit, differential, and integral. The selection of material is based on principles: relevance, consistency, and adequacy. Its depth refers to the aspects contained in learning outcomes, learning outcomes of courses, and learning sub-achievements, while the order is based on a hierarchical approach. The material is integrated into the Schoology model Learning Management System (LMS). The delivery approach used problem-based learning. The evaluation of learning used the form of tests that are packaged in the competency test at the end of each subchapter and chapter.

The draft I teaching material that has been constructed is then validated theoretically by 5 validators. The results of the assessment of each validator are presented in Table 2 below.

No	Teaching material	Experts	Percentage (%)	Decision
1	Textbook	Learning content	83,3	It is quite valid, or can be used but needs a little revision
		Learning media	80	It is quite valid, or can be used but needs a little revision
		Fill in mathematical material	81,94	It is quite valid, or can be used but needs a little revision
		The practitioner 1	84,9	It is quite valid, or can be used but needs a little revision
		The practitioner 2	84,4	It is quite valid, or can be used but needs a little revision
		average	82,91	It is quite valid, or can be used but needs a little revision
2	SAS	Learning content	83,07	It is quite valid, or can be used but needs a little revision

		Learning media	80,0	It is quite valid, or can be used but needs a little revision
		Fill in mathematical material	84,6	It is quite valid, or can be used but needs a little revision
		The practitioner 1	87,7	Very valid, or can be used without revision
		The practitioner 2	84,6	It is quite valid, or can be used but needs a little revision
		average	84,0	It is quite valid, or can be used but needs a little revision

Table 2: Results of Expert Validation of Teaching Materials and SAS Applied Mathematics Based on Blended Learning.
Data analysis phase I, 2019 [source]

The results of the assessment of each expert on the draft textbooks and SAS showed sufficient validity. The draft of textbooks and applied mathematics SAS based on blended learning were feasible to use by making small revisions following the input of each validator. The implication, considering the input suggestions provided by each validator, the first draft was revised to get the second draft. The stages of the development process are continued to carry out empirical testing, namely the testing of small groups and larger groups. The aim is to get direct input from lecturers, students, and observers on draft II. This activity is carried out at the next year's stage in 2020.

CONCLUSION

Learning of applied mathematics in the Department of Mechanical Engineering has 13 learning outcomes with 51 sub-achievements, high student learning independence, 79.7% of students have difficulty understanding sub textbooks given by lecturers, 89.6% need alternative teaching materials, and 83.3% agreed to develop applied mathematics teaching materials based on blended learning.

The draft I of applied mathematics teaching material based on blended learning material was developed referring to the learning outcomes of applied mathematics and its sub-achievements cover the fields of Algebra, Geometry, Trigonometry, and Calculus packaged into 2 pieces of teaching material integrated into the Learning Management System (LMS) of the Schoology model.

The draft I is feasible to be used as applied mathematics teaching material based on blended learning after minor revisions are made.

The implication, after making minor revisions following input from each validator, the first draft can be continued to the next development process, namely empiric testing in the field, namely small group test, a larger group so that the level of validity is known as applied mathematics teaching material based on blended learning for improving communication skills and mathematical problem solving in students (draft II).

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