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FEASIBILITY TEST AND PRACTICALITY OF BLENDED LEARNING DESIGN OF APPLIED MATHEMATICS FOR VOCATIONAL EDUCATION

I Ketut Darma[1)], I Gede Made Karma[2)], I Made Anom Santiana[3)]

1) Department of Mechanical Engineering, Politeknik Negeri Bali, Indonesia
2) Department of Accounting, Politeknik Negeri Bali, Indonesia
3) Department of Civil Engineering, Politeknik Negeri Bali, Indonesia

[1), 2), 3)] Politeknik Negeri Bali, Bukit Jimbaran, P.O. Box. 80364 Kuta Selatan, Tuban Badung Bali, Indonesia, Telp. (0361) 701981 Fax. 701128.
Email: poltek@pnb.ac.id

Correponding email [1)] : ketutdarma@pnb.ac.id

Abstract. This study aims to determine the feasibility and practicality of the design of blended learning applied mathematics for vocational education. Research using the 4D model development method from Thiagarajan includes: Define, Design, Develop, and Disseminate, carried out in stages at the Bali State Polytechnic. Currently the Develop stage is being carried out. Data were collected using a validation sheet and a questionnaire for the responses of lecturers and students. Data were analyzed descriptively. The results, 1) the content validity and constructs of blended learning applied mathematics 3,8 and 3,6 are categorized as very valid with a reliability of 88.6% and 91.1% are categorized as very reliable, and 2) the level of practicality by lecturers and students respectively also 83.5% and 83.5% in the practical category. The implication, draft II of this design is very feasible and practical to be used as a learning strategy in vocational education. Draft II can be continued to the next stage of development, namely testing the effectiveness, evaluation and dissemination, but for optimization it is necessary to revise a small receipt referring to the practicality test results.

Keywords : Feasibility, Practicality, Blended Learning, Applied Mathematics, Vocational.

1. INTRODUCTION

Vocational education is higher education that prepares students to have jobs with certain applied skills at a maximum equivalent to undergraduate programs [1]. Vocational education directs students to develop applied skills, adapt to certain fields of work and can create job opportunities. Vocational education is education for the world of work [2], preparing a highly skilled skilled workforce who are subject to employers [3]. Vocational education has the opportunity to develop a whole person with a sufficient theoretical and academic base, while at the same time developing the ability to work in accordance with established competency standards [4].

The demands of changes in the global era make vocational higher education have a strategic role and are at the forefront in handling the age of the workforce. Vocational higher education is programmed to produce graduates who have mastery of science and technology, are independent, skilled and trained in accordance with the demands of the industrial world or the world of work. The learning outcomes are needed as capital in facing regional and global competition. It is necessary to develop a learning model that is in accordance with the characteristics of vocational education.

The learning model is one of the important factors that determine the achievement of learning outcomes. The vocational learning model is defined as a process method of learning approach in an effort to transfer knowledge to students [5]. The learning process is carried out in an effort to prepare skilled workers who have competencies according to their fields of expertise. In practice, the resulting output is not only evaluated from the results, but the process variable, namely the learning model.

Currently, the vocational learning model cannot be carried out normally due to the Covid-19 pandemic, which has forced the world of vocational education to change towards digital-based online learning through e-learning [6]. E-learning is an innovation that can be used in the learning process, not only in the delivery of learning material but also changes in the abilities of various competences of students. Through e-learning, students do not only listen to material descriptions from educators but also actively observe, do, demonstrate, and so on.

E-learning is a learning technology that plays an important role for students to access distance learning [7]. E-learning can be used as a very useful source of online information because e-learning does not have to be face-to-face [8]. E-learning is used as independent learning for students [9]. E-learning is very easy to use [10], provides benefits for both parties, both lecturers and students [11], has the level of effectiveness at least together with face-to-face learning [12]. On the other hand, full online learning is considered less able to accommodate all learning needs [13], one of which is the difference in learning styles of each student. The e-learning method will be more efficient when mixed with face-to-face learning [14]. To complement each other between e-learning and face-to-face learning, blended learning model can be used.

Blended learning is a learning approach that combines face-to-face learning in the classroom with online-based learning activities to increase the effectiveness and efficiency of the learning experience 15], [16]. Blended learning, combining the advantages of face-to-face learning models and digital-based learning models will have a good effect on the learning process [17], [18]. Blended learning is proven to be effective in improving the quality of learning outcomes: it has a positive impact on student academic achievement at Jordan [19], is effective in assisting students in learning English grammar [20]. has a positive impact on learning outcomes skills, and attitudes [21], and can improve students' understanding [22]. Blended learning can be a solution to overcome the weaknesses of e-learning pursuit [23]. Blended learning is considered to be the right step to respond to current conditions and can even become an educational innovation during the Corona-19 pandemic [24].

Learning mathematics, one of the components of education, contributes to the development of science and technology [25]. Applied mathematics is one of the compulsory subjects of vocational education. The learning process must be able to take place continuously without space and time limits. So it is very necessary to develop a blended learning model that is feasible, practical and effective to improve the quality of applied mathematics learning in vocational education. Although there have been quite a lot of studies that have been done by previous researchers on blended learning, further knowledge is still needed, especially on the requirements of a good learning model. A good learning model if it meets three requirements, namely valid, practical and effective. In line with Nieveen that the development of learning materials must consider the three aspects (validity, practicality and effectiveness) [26]. Plomp and Richey also argue that the development, learning model is said to be good when it meets the criteria of being valid, practical and effective [27],[28]. Measurement of effectiveness, validity and practicality is carried out with the intention of how the products developed can be used in learning. Whether the development is based on strong and consistent theoretical rationale (valid), does the user state that what has been developed can be applied (practical) and whether operationally it delivers results in line with expectations (effective). A learning model is said to be valid if the model is consistent, practical if the model is considered usable. Furthermore, it is said to be effective if it provides results according to the objectives that have been set [26]. Practicality refers to the user, considering whether the learning model can be used in the learning process [29].

Practicality can be measured by seeing whether the products produced can be used and are effective for learning. Meanwhile, according to effectiveness it refers to the level of experience and the results of the intended intended intervention. While the effectiveness of a learning model is seen from the quality of learning outcomes, attitudes, and motivation of students [29]. Plomp states that validity is carried out through expert judgment, practicality through expert and user assessments and effectiveness through field trials [27]. So, validation is carried out through expert considerations including validation of the components of the learning model, practicality can be assessed from users about the components of the learning model and effectiveness seen from the quality of learning outcomes, attitudes and motivation of students through trials. This research aims to determine: 1) the validity level of blended learning applied mathematics design for vocational education, and 2) the practicality level of applied mathematics blended learning design for vocational education.

2. METHODS

This research is a development research aimed at obtaining a design model of blended learning applied mathematics that is feasible, practical and effective for vocational education. Conducted in the field of Engineering at the Bali State Polytechnic, for 3 year stages. The subjects are Mathematics lecturers and students in the field of Engineering at the Bali State Polytechnic. The approach using the 4-D model includes the following stages: 1) Define, 2) Design, 3) Develop, and 4) Disseminate [30].

The define and design stage is the stage of development needs analysis. Define a needs analysis to determine goals and problems as a benchmark in the preparation of a learning model design. Perform analysis: beginning and end, student characteristics, concepts of teaching materials, assignments for students, availability of facilities and analyzing the indicators of learning outcomes. Furthermore, a prototype draft I is constructed for the design of blended learning mathematics and its tools. The tools include blended learning designs, semester lesson plans (SLP), teaching materials, and online learning classes using the Schoology application. Design prepares a prototype of the blended learning model based on the data at the define stage. At this stage online learning - face to face - online learning is designed. Classes and online learning content are class designs and content that can be used by lecturers to facilitate students learning online both independently and collaboratively. In online classes, there are several parts that can be used by lecturers to carry out learning, provide material, assignments and evaluate students.

Validity is divided into two, namely content validity and construct validity [26]. Content validity there is a need for the intervention and its design is based on state-of-the-art (scientific) knowledge [32]. Assessment of content validity in terms of several aspects of the assessment as follows, namely: 1) rational includes the need for model development; 2) theoretical support includes theoretical and empirical support; 3) State of the art; 4) Model description: model implementation and use of evaluation techniques; and 5) Learning Environment: the ability to model creates an active, effective and enjoyable learning environment. Construct validity is the intervention is logically designed [32]. The construct validity of the learning model is an arrangement, a framework that reflects a construction in the form of product components developed supported by certain theories, can measure aspects of thinking, such as cognitive, affective, psychomotor aspects. The measurement is focused on rational aspects and model components, namely: 1) supporting theory, 2) syntax. 3) social system, 4) reaction principle, 5) support system, 6) instructional impact and accompaniment impact; and evaluation. The validity of each aspect of the learning model is determined by referring to the criteria presented by Ratumanan and Laurens which are listed in Table 1 [33].

Table 1. Criteria for Assessing the Validity of the Blended Learning Applied Mathematics Model

No	Interval Score	Category	Information
1	$1.00 \leq$ Score < 1.75	Less Valid	Can be used with many revisions
2	$1.75 \leq$ Score < 2.50	Sufficiently Valid	Can be used with a fair amount of revision
3	$2.50 \leq$ Score < 3.25	Valid	Can be used with a little revision
4	$3.25 \leq$ Score ≤ 4.00	Very valid	Can be used without revision

The reliability of the results of the validation of the learning design is based on the level of reliability by the validator (expert) using the "Interobserver" with statistical analysis "Percentage of Agreement" which is as follows (Borich, 1994) [34]

$$R = \left(1 - \frac{A-B}{A+B}\right) x100\% \quad (1)$$

R is the reliability coefficient and A is the highest score by the validator and B is the lowest score by the validator. The results of the validation of the learning model can be said to be reliable, if the reliability value is obtained R ≥ 0.75 or R $\geq 75\%$ [34].

Practicality is the level of use and implementation of the learning model by lecturers and students. Van den Akker stated, Practicality refers to the degree that the user considers the intervention usable and preferable under normal conditions [29]. The measurement is done by seeing whether the resulting product can be used and is effective for learning. Measurement aspects include: ease of use, attractiveness of serving, and benefits [26], [[31].

The practicality of each aspect of the learning model is determined by referring to the criteria presented by Akbar. If $85.01\% < V \leq 100\%$ is very practical it can be used without revision; $70.01\% < V \leq 85.00\%$ practical, can be used but needs a small revision; $50.01\% < V \leq 70.00\%$ is less practical, can be used but needs major revision; and $0.01\% < V \leq 50.00\%$ is impractical, should not be used [35].

3. RESULTS AND DISCUSSION

This research is a development research using a 4-D development model, carried out multi years for 3 years. The first stage of this year (2019) has obtained a prototype product of draft I of blended learning applied mathematics, using the LMS schoology application. The components, 1) online learning, 2) face-to-face learning, 3) independent learning, 4) applications, 5) tutorials, 6) cooperation, and 7) evaluation. Its development is based on learning theories: Behaviorism, Humanism, Cognitivevism, Constructivism, and Conectivism [36], [37]. The design includes, 1) learning outcomes, 2) material organization map, 3) reference list, 4) teaching materials, 5)

synchronous and asynchronous learning activities, 6) asynchronous learning design, 7) synchronous learning design, and 8) synchronous learning flow. Composition between face-to-face learning and online learning 70/30 [38], [39], [40]. The combination in synchronous and asynchronous learning arrangements refers to the concept of 4 quadrants of learning arrangements [38], [41], [40]. Learning uses a problem-based learning approach.

Blended learning applied mathematics design is designed for one semester with a total of 2 credits, using the Learning Management System (LMS) schoology model application, can be visited on the page www.schoology.com. Display the main menu: Upgrade, Courses, Groups and Resources. Courses as a facility to create class subjects. Groups facility for creating groups. Meanwhile, Resources is a part of placing learning materials or resources. In the Coures menu, there is a material coures sub menu as a place to make various kinds of needs in the learning process and assessment of learning outcomes. Course material consists of: assignments, tests / quizzes, files and links external tools, discussions, pages, and Media albums. The draft I hypothetical framework is depicted in Figure 1.

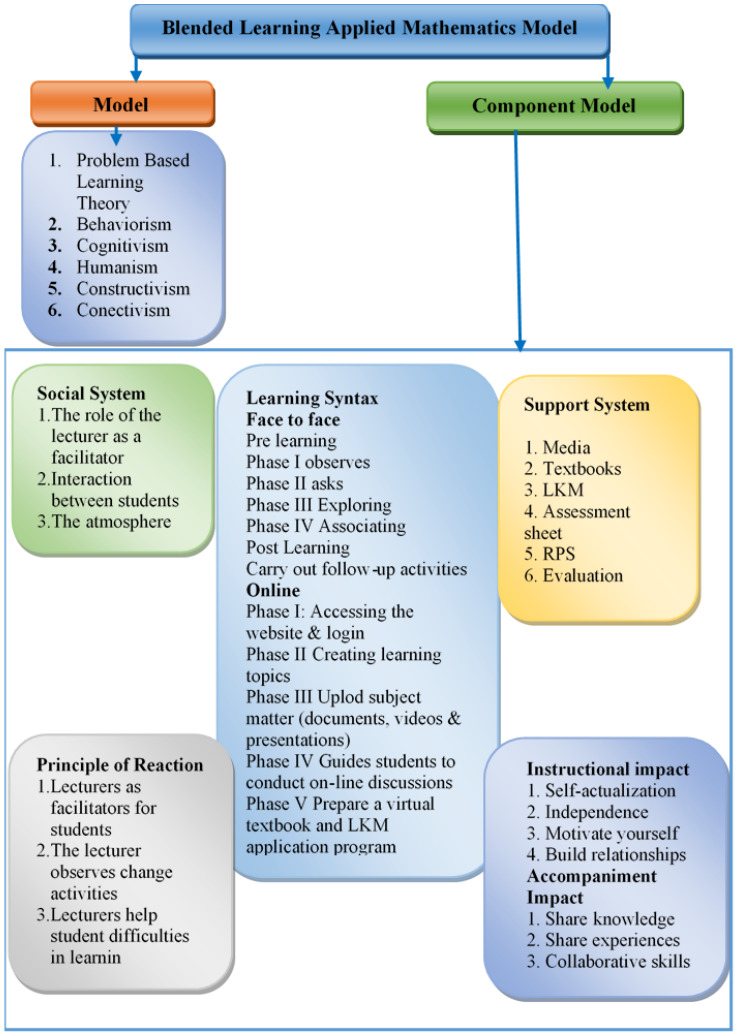

Figure 1. A Hypothetical Framework for the Design of Blended Learning in Applied Mathematics

The learning design as outlined in the hypothetical framework in Figure 1 as well as other supporting components, is outlined in the form of a blended lerning applied mathematics design book which is then validated by experts and practitioners. The goal is to determine the level of validity, practicality and reliability of the measurement results of each expert.

Currently in 2020 the second phase of development is being carried out including: expert validation and trial of draft I to get draft II. Validation includes content validation and design constructs, involving experts: learning (V_{ah1}), material content (V_{ah2}), media (V_{ah3}), design (V_{ah4}); and practitioners (Vpr) [26]. Practitioners from the teaching staff of senior mathematics teaching in the engineering field. The recapitulation of the results of the assessment by each validator is presented in table 1 and table 2 below.

Table 1. Recapitulation of Content Validity Results on Blended Learning Design of Applied Mathematics

Aspect	Validator					Average score	Category	Reliability (%)
	V_{ah1}	V_{ah2}	V_{ah3}	V_{ah4}	V_{pr}			
Rational	4	4	4	4	3	3,8	Very valid	85,7
Theory support	4	4	4	4	4	4	Very valid	100,0
State of the art kwoledge	3	3	3	4	4	3,4	Very valid	85,7
Model description	4	4	4	4	4	4	Very valid	85,7
Learning environment	4	3	4	4	3	3,6	Very valid	85,7
Average score	3,8	3,6	3,8	4	3,6	3,8	Very valid	88,6

Table 2. Recapitulation of Construct Validation Results on Blended Learning Design of Applied Mathematics.

Aspect	Validator					Average score	Category	Reliability (%)
	V_{ah1}	V_{ah2}	V_{ah3}	V_{ah4}	V_{pr}			
Rational	4	4	4	4	4	4	Very valid	100,0
Theory support	4	4	4	4	4	4	Very valid	100,0
Syntax	3	3	3	3	3	3	Valid, minor revisions	100,0
Social system.	3	3	3	4	4	3,4	Very valid	85,7
Reaction principle	3	3	4	4	4	3,6	Very valid	85,7
Support system	4	3	4	4	3	3,6	Very valid	85,7
Instructional and accompaniment impact	4	3	3	4	3	3,4	Very valid	85,7
Evaluation	3	4	3	4	4	3,6	Very valid	85,7
Average score	3,5	3,4	3,5	3,9	3,6	3,6	Very valid	91,1

Based on the data in Tables 1 and 2, it appears that the average measurement results by 5 experts on the content and construct validity are 3.8 and 3.6, both of which are categorized as very valid. While the reliability of the measurement results showed 88.6% and 91.1%, respectively, which were categorized as very reliable. Learning design has high content and construct validity [29], The blended learning design that has been developed has been supported by appropriate learning theory and in accordance with the curriculum, 2) learning components: syntax, social systems, reaction principles, support systems, instructional and accompanying impacts have been sequential and systematic.

The syntax of the Blended Learning Applied Mathematics model is designed in two phases, namely face-to-face and online by considering views, behavioristic, humanism, cognitive and constructivist. The social system is a synchronized interaction between lecturers and students. Interaction occurs when the lecturer advises students to access the learning website, so the students do or access the learning web. The principle of reaction is a guideline for lecturers to appreciate and respond to stimuli in the form of student behavior in the learning process, namely: (1) creating a conducive atmosphere for learning, (2) providing and managing learning resources; (3) convey information about e-learning; (4) guiding students to learn and guide solving problems; and (5) appreciating and directing all student activities during the learning process. Lecturers as facilitators, motivators, moderators and consultants [42]. Support system; computer units, networks, students' ability to access learning webs, semester learning plans, learning media and evaluation sheets. The learning web was developed using the LMS schoology model. Other supporting systems needed, namely: (2) teaching materials; (3) e-SAS and (5) assessment instruments, and (6) e-learning media [43]. The expected instructional impacts include: (a) mastery of applied mathematics textbook material; (b) a positive attitude towards textbooks, (c) the learning outcomes achieved, and (d) the ability to construct knowledge, seen from test answers and during face-to-face discussions and online

learning through online discussion activities. While the accompanying impact, namely: (a) independence in learning, (b) motivation to learn, and (c) increased learning activeness.

The learning steps for the offline and online phases, CPMK / SCPMK, training materials, and assessments in the RPS have been consistently linked to one another. This content is supported by Nieveen [26]. The validity aspect can be seen from: the curriculum or learning model developed and (2) the various components of learning tools are consistently related to one another.

The consistency of the assessment between experts is known through the results of the reliability test, both of which are above the terms of the inter observer agreement, which is 75% and are categorized as very reliable [34]. The results of measurements made by the five experts on the validity of the content and constructs were very reliable or very consistent. The building blocks of applied mathematics blended learning are very feasible to be used as a mathematics learning strategy in vocational education, but small revisions need to be made according to input from the validator, so that the content of the learning model becomes more meaningful and systematic.

Some of the input from the validator relates to rational and supporting theories, namely adding learning theory that underlies the development of the model so that the stages of the model really have a complete theoretical basis. In connection with the learning steps it needs to be adjusted to the Problem Base Learning syntax that is referred to, the exercises at the end of each chapter are more focused on practicing communication and problem solving skills. The support system is added with an explanation of the support system that must be present in implementing the model. Meanwhile, related to the purpose of developing the learning model, it needs to be more specified with the instructional impact.

Taking into account the suggestions given by each validator and practitioner, the prototype draft I was revised to become the prototype draft II, then a practicality test was carried out. Practicality is based on the responses of lecturers and students [26]. The responses of lecturers and students consist of several aspects: attractiveness, development process, ease of use, usefulness, and relevance. While the response from students consists of aspects: attractiveness, ease of use, and product benefits. The practicality test on students was carried out through small group, large group, and limited chili tests and was carried out in the engineering field of the Bali State Polytechnic. A summary of the practicality test results is presented in Tables 3 and 4 below.

Table 3. Recapitulation of the Results of the Blended Learning Design Practicality of Applied Mathematics by the Lecturer

Aspect	Lecturer					Average	Category
	L1	L2	L3	L4	L5		
Ease of use (%)	86,7	80,0	86,7	80,0	86,7	84,0	Practical, minor revisions
Attractiveness (%)	86,7	80,0	80,0	86,7	86,7	84,0	Practical, minor revisions
Benefit (%)	80,0	85,0	80,0	80,0	85,0	82,0	Practical, minor revisions
Relevance (%)	85,0	80,0	80,0	80,0	75,0	80,0	Practical, minor revisions
Percentage Average (%)	84,6	81,3	81,7	81,7	83,3	**82,5**	Practical, minor revisions

Information: L1, L2, L3 and L4 are lecturers of applied mathematics subject. L5 is another user outside the engineering field.

Table 4. Recapitulation of the Results of the Practicality of the Blended Learning Design of Applied Mathematics by Students

Aspect	Testing Group			Average	Category
	K_1	K_2	K_3		
Ease of use (%)	84,5	82,8	84,2	84,4	Practical, minor revisions
Attractiveness (%)	82,7	85,2	86,8	85,6	Very practical
Benefit (%)	83,3	78,5	80,5	80,5	Practical, minor revisions

Percentage Average (%)	83,5	82,2	83,8	83,5	Practical, minor revisions

Information: K_1 = small group; K_2 = large group; K_3 = Limited test

The practicality test was carried out by 5 prospective users, namely mathematics teaching lecturers and other potential users outside the engineering field of the Bali State Polytechnic. Aspects of practicality testing by lecturers include ease of use, attractiveness, utility and relevance. The average percentage of the test results reaches 82.5% which is categorized as very practical. The achievements for each aspect reached: ease of use 84.0% in the practical category, 84.0% attractiveness in the practical category, 82.0% in the practical category and 80.0% for the practical category. The results of practicality testing by students, the average percentage reached 83.2%, categorized as very practical. The achievements for each aspect reached: convenience 84.4% in the practical category, 85.6% attractiveness in the practical category, and 80.5% for the usefulness aspect in the practical category.

The test results by lecturers and other users on the design of blended learning obtained an average practicality value of 82.5% in the practical category with small revisions. The aspects of ease of use and attractiveness showed the highest percentage was 84.4%. In terms of ease of use, blended learning offers flexibility in terms of time, place, and more variations of learning methods compared to online and face-to-face methods. Blended learning: 1) can increase the level of learning interaction between students and lecturers, 2) can carry out learning interactions from anywhere and at any time, be able to reach students in a wider scope, and facilitate the improvement and storage of learning materials [44]. In addition, learning using blended learning is learning that is carried out online and face-to-face, so that it can complement each other, learning becomes more effective and efficient and can increase accessibility, so that students can easily access learning materials [45].

The attractiveness aspect reached the highest percentage of 84.4%. also occurs in the student response conditions. Blended learning is implemented using one of the LMS Schoology applications. Shoology is an LMS in the form of a social web that offers learning just like in the classroom for free and easy to use [46], [47]. In addition, Sholoology has several advantages, including, in Schoology, Attandance facilities are available that are used to check student attendance, as well as Analytic facilities to view all student activities on each course, assignment, discussion, and other activities that we prepare for students. With this media, the lecturers feel very motivated to improve the effectiveness of learning through blended learning. Students become very motivated in learning when learning using the blended learning model.

The design of applied mathematics blended learning that is being developed uses a problem-based learning approach, assisted by schoology applications. The learning process will be able to provide broad opportunities for students actively and constructively. The use of this model will be able to make students creative and critical in using technology in learning. Their insights become broader and the reference for solving problems becomes wider. This model can balance weaknesses by combining traditional learning methods and online learning [48]. Face-to-face learning allows for interactive learning whereas online learning can provide online material without time and space limits so that maximum learning can be achieved [49]. Giving problems during learning can encourage students to explore curiosity and detail on all problems and concepts in a given problem [50] . This can increase the level of learning interaction and learning activities between students and lecturers, in the end it can increase knowledge sharing / collaboration between students and lecturers, and increase the ability to solve problems. So that the effective application of the blended learning applied mathematics design will be able to encourage students to improve their academic abilities.

21st century vocational learning is learning the development of work competency capabilities of students who are ready to solve various problems in society and the world of work. The learning must include experiences in developing work capabilities and working habits in the 4.0 industrial revolution. The learning concept is based on the learning theory of behaviorism, cognitivism, constructivism, life-based learning, transformative, and social partnership learning [2]. Education is required to always be able to adapt to changing conditions, technology, and the demands of the world of work. Learning models and modes need to be flexible, applying face-to-face learning as well as those based on information technology.

The success in achieving learning goals in vocational education does not only depend on the quality of the curriculum that has been compiled [51], [52], but is also determined by the design of the learning process that is appropriate and in accordance with the characteristics. vocational education. Blended learning is developed based on the learning theory of Humanism, Beheviorism, Cognitiveism, Conectivism, and Constructiveism [53], [54], [39], is very much in accordance with the realm of vocational education and is right to be used as a learning strategy in vocational education in the industrial era 4.0. Blended learning helps students learn new concepts, information and acquire skills to complete their learning tasks more quickly [55]. Blended learning is very suitable for encouraging collaborative and constructive learning which places a strong emphasis on style and learning

environment today [56]. So that the blended learning design of applied mathematics that is being developed is very appropriate to be applied in an effort to improve the quality of learning in vocational education. The design of blended learning applied mathematics is very feasible. and is practically used as a learning model in vocational education.

During a limited trial, flaws and errors were found in online learning with the schoology application. These errors and shortcomings include user name errors, organizing materials, some layouts in web design that do not match the actual web design appearance for some laptops, student skills in writing mathematical expressions online, and file storage. In addition, it also obtained input from students, such as attractiveness of colors and types of questions available.

Based on the shortcomings and input obtained, the web schoology of applied mathematics was revised again so as to produce a web that was very valid and practical. The implication is that draft II of this design can be continued to the next stage of development, namely the effectiveness test and dissemination, but for optimization it is necessary to revise small receipts referring to the score of practicality test results.

4. CONCLUSION

Based on the data analysis of the results of the validation and practicality test by each expert and user: 1) the validity of the content and constructs of blended learning applied mathematics 3,8 and 3,6 are categorized as very valid with a reliability of 88.6% and 91.1% are categorized very reliable; and 2) the practicality level by lecturers and students was 83.5% and 83.5% respectively in the practical category. The implication is that draft II of this design is very feasible and practical to be used as a learning strategy in vocational education. Draft II can be continued to the next stage of development, namely testing the effectiveness, evaluation and dissemination, but for optimization it is necessary to revise a small receipt referring to the practicality test results.

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