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The Development of Blended Learning Model in Applied Mathematics by Using LMS Schoology (Requirement analysis stage)

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Abstract

This research aims to obtain a draft model of applied blended learning mathematics based on LMS Schoology. The development used 4-D model Thiagarajan, and Semmel in 1974 with several modifications, namely: 1) Define, 2) Design, 3) Develop, and 4) Disseminate. Nowadays, the development of stages 1 and 2 are being carried out and part of stage 3. It is being implemented in the Engineering field of the Bali State Polytechnic (BSP). The data were collected using survey methods, documents and questionnaires, then analyzed using descriptive statistics. The results of the analysis are: 1) students' attitudes toward mathematics are very positive, moderate student learning interest, 2) high student motivation, 3) high student learning independence, 4) characteristics of applied blended learning mathematics: based on Behaviorism learning theory, Cognitivism, Humanism, and Constructivism. The format of implementation: synchronized blended learning, with a problem-based learning approach supported by LMS schoology models, multimedia such as video and audio learning media. The variations in the amount of time face to face and online in the semester, 50% face to face and 50% through e-learning. The evaluation is a process and the outcome with a performance assessment approach based on portfolio and self-assessment. An expert assessment of the draft model with an average of 36.8 (valid) is appropriate to use with a few minor revisions.

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1 Introduction

Learning is a process of interaction between students and teachers and learning resources in a learning environment. The 21st century has changed the paradigm of national education. The Ministry of Education and Culture formulates that the learning paradigm in the 21st century emphasizes the ability of students to find out from various sources, formulate problems, think analytically and collaboratively and collaborate in solving problems (Litbang Kemdikbud, 2013). Learning must be designed effectively and innovatively so that it fits with the learning framework in the 21st century.

One element of the learning framework in the 21st century is information literacy and Information Communication Technology (ICT) (Partnership for 21st-century skills, 2007). Information literacy skills and ICT student literacy really need to be developed. One of the effective ways to develop it is by integrating ICT in learning with the internet as a mean in the learning process (Yilmaz & Orhan, 2010).

Learning in the 21st century requires students to be directly involved in the learning process that utilized internet facilities, not only limited to finding information, however, they also carried out learning online. ICT literacy skills and student information literacy can be explored and developed. However, it is still found among lecturers that they have not utilized the internet facilities as one of the learning aids to the fullest in reality. This condition clearly contradicts the demands of learning in the 21st century. Therefore, lecturers must be able to design learning systems that are able to motivate and enhance students' ICT skills.

Likewise with mathematics learning, learning models designed by lecturers must be able to increase ICT motivation and literacy. The design must also be able to encourage increased interest, communication skills and mathematical problem-solving. One learning model that can be applied is the problem based learning (PBL) model.

PBL is one of the innovative learning models that makes problems the basis or basis for students to learn (Barrows, 1996). However, PBL has several weaknesses, one of which requires a relatively long time (Sanjaya, 2007).

To overcome the lack of time in implementing PBL, it can be implemented by combining face-to-face learning and online learning. These learning models hereinafter referred to as blended learning. The combination of two main elements, namely classroom learning face to face with online learning, is called blended learning (Mosa, 2006). One of the types that can be used is online typeface to face online.

Blended learning integrates traditional face-to-face learning and computer-based learning (Dwiyogo, 2013; Ginaya *et al.*, 2018). The advantages: 1) flexibility, 2) participation, 3) learning has more learning time (Marsh, 2012). The goal is to provide opportunities for various characteristics of students to make learning independent, sustainable, and develop throughout life, the learning process will be effective, more efficient and more interesting (Rooney, 2003).

Blended learning, requires an application that is a learning management system (LMS). LMS is an application or software that is used to manage online learning, covering several aspects, namely material, placement, management, and assessment (Mahnegar, 2012). Several types of LMS that can be utilized in the learning process, namely: Schoology, Learnboos, Edmodo, Moodle, Blackboard, WebCT and others (Dwiyogo, 2018). Schoology is one of the social web-shaped LMS that offers the same learning as in the classroom for free and easy to use as Facebook. Schoology becomes one of the e-learning platforms that are interesting and fun in learning. The advantages compared to other LMS, among others, use the terms that we usually used on the social network Facebook, module, and Edmodo such as recent activity, messages, courses, resources, groups, assignments, and attendance (Amiroh, 2013). Schoology has facilities that are not owned by Edmodo and Moodle. Other advantages, attendances is available. Every student activity will also be monitored through analytical facilities at setian courses, assessments, discussions, and other activities. Sicat showed that Schoology is effectively used to implement blended learning (Sicat, 2015). Many interesting features that can be accessed by students will make them motivated to engage in learning. Joshua proved there was an increase in the high category for the motivational aspects of students who were taught using Schoology (Joshua *et al.*, 2016; Widana *et al.*, 2018).

Blended learning is proven effective in increasing the quality of learning outcomes. A meta-analysis conducted by Means on the effectiveness of blended learning publications published in the period of 1996-2003 and 2004-2008, the average learning outcomes of students in online learning were better than those who received face-to-face learning (Means *et al.*, 2013; Karma *et al.*, 2019). In learning science, it gives a positive impact on the results of learning skills, attitudes and learning outcomes can reach the highest level (Almasaeid, 2014).

Based on the above considerations, blended learning applied mathematics based on LMS type Schoology with the PBL approach. Hopefully with the application of these models in the process of learning mathematics will be able to

occur increasing communication skills and problem-solving. Information literacy skills and ICT literacy in students are increasing. To get a design model that suits your needs, a need analysis has to be done. The aim is to get a draft model of applied mathematics blended learning.

2 Materials and Methods

This research was carried out in 3 stages a year. In the first year using a type of descriptive research conducted by survey methods. The aim is to obtain data that supports the design specifications of the blended learning model in the learning of applied mathematics at the BSP.

This research is a development study using the 4-D model of Thiagarajan and Semmel in 1974 with several modifications. The development phase consists of stages: 1) Define, 2) Design, 3) Develop, and 4) Disseminate (Thiagarajan *et al.*, 1974). Stages 1 and 2 and part of phase 3 were conducted in the first year (2019) and the other parts are in the second year (2020) and stage 4 is in the third year (2021). The implementation in the field of engineering of the BSP, with as many as 588 people distributed in 3 majors and 6 study programs. Samples were taken using a purposive sample of 251 students and 20 lecturers of basic science.

The procedure, the first stage (2019) was carried out to define, design and develop. The Define includes five main steps, namely: front-end analysis, student analysis (learner analysis), task analysis, concept analysis and the formulation of learning objectives (specifying instructional objectives). Design, including four steps, namely: 1) preparation of standard tests (criterion-test construction), 2) selection of media in accordance with the characteristics of students, selection of web application programs, 3) selection of formats, namely reviewing the formats and determining the format of the material, 4) and make an initial design according to the application model and format chose.

The define and design stage is the stage of development needs analysis. At this stage, a field survey and literature study are conducted. The field survey was conducted for students and lecturers in BSP engineering, namely regarding the availability of internet facilities, the characteristics of students in learning applied mathematics, and students' perceptions about learning applied mathematics nowadays. Then, a draft of the model of Blended Learning Mathematics and its devices were constructed. The tools compiled include blended learning designs, Semester Learning Plans (SLP), teaching materials and online learning classes using the Schoology application. The intended blended learning design involves mixed learning designs using PBL applications, which parts are carried out online and which parts are carried out face-to-face, and how is the division of time. The design specifications are online learning - face to face - online learning. While online learning classes and content are class designs and content that can be utilized by lecturers to facilitate students learning online both independently and collaboratively. In the online class, there are several parts that can be used by lecturers to carry out learning, provide material, assignments and evaluate students.

The develop phase, to get a validated blended learning design. This stage is carried out through 1) expert appraisal, 2) revision, 3) developmental testing. Phase 2 and 3 will be carried out in the second year. Currently, validation testing is done through an expert appraisal. The assessment was done by filling out a validation questionnaire for aspects of the design model being developed.

Research variables, including student characteristics, included: school origin, attitudes, interests, motivation, independence, mathematical understanding, and mathematics learning styles, and the need for blended learning model design. These needs include internet network conditions, teaching materials used, internet usage, devices used to access the internet, lecturer knowledge about blended learning and the need for problem-based blended learning in applied mathematics learning.

The data were collected using methods: survey, documentation, observation, and interview. The instruments were compiled by the researcher 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 trends were classified into five categories with ideal normal curves, as follows (Mardapi, 2016).

Mi + 1.5 SDi $<x\leq$ Mi + 3SDi = Very High/very positive
Mi + 0.5 SDi $<x\leq$Mi +1.5 SDi = High/positive
Mi - 0.5 SDi $<x\leq$Mi + 0.5 SDi = Medium/neutral
Mi - 1.5 SDi $<x\leq$Mi - 0.5 SDi = Low/negative
Mi - 3 SDi $<x\leq$ Mi - 1.5 SDi = Very Low/very negative

Notes:
Mi = ½ (maximum score + minimum score)
SDi = 1/6 (maximum score - minimum score)
While the validation of the learning model uses the criteria as in table 1 below (Akbar, 2013).

Table 1
Criteria for the validity of learning models

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

3 Results and Discussions

The characteristics of students seen from the origin of schools, 37.5% of high schools and 62.5% of vocational schools. The majority were (72.5%) aged 18 years. Learning outcomes achieved on average 3.85 or 93.3% (very good). This condition identifies that students' abilities vary greatly both in terms of academics and talents. Therefore, it is necessary to develop a learning strategy model that is able to accommodate this diversity.

One of the factors that influence mathematics learning outcomes is the internal factors of students, namely: attitudes, interests, motivation, and independence of learning (Sudjana, 2009; Rusman, 2013; Syah, 2013).

The survey results obtained a student attitude toward mathematics 73.0% (very positive). This condition identifies that students already have good potential to take part in mathematics lectures. The attitude is the tendency of individual behavior patterns to do things in a certain way towards people, objects or ideas. Its influence is very dominant in mathematics learning activities and mathematics learning achievement (Sudjana, 2009). If students are negative towards mathematics, the students will avoid, make a distance and even hate mathematics. Feeling lazy and saturated will cling to him during the learning process.

The survey results related to learning independence, showing an average of 50.6% (low). This condition is an obstacle in mathematics studies that need to be resolved so that student learning outcomes in mathematics can be improved. Learning independence does not mean that students learn on their own; however, students can solve problems and responsibilities so that the results obtained are optimal as expected. Student learning independence affects 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 own abilities.

The survey results related to mathematics interest get an average of 47.05 or 62.73% (high) from the highest score of 75. This condition identified that students have good potential in following the mathematical recovery. Interest is one of the internal factors that determine student learning success (Nawawi & Susanto, 2007). Interest in its influence is very large on learning because if the study material learned is not in accordance with 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. Conversely, a material that attracts students' interests will be more easily conveyed. Students who have a high interest in learning will eventually achieve satisfying learning outcomes.

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

The survey results related to how to learn mathematics get: 50.6% by recording lecturer explanations, 10.4% memorizing formulas according to the topic and 35.1% understand the user of each formula. This condition is identified, the way to learn mathematics in students is not right, tends to be memorized. Studying mathematics is different from learning the others. Learning mathematics regarding ideas or concepts. In mathematics, there are

many formulas that must be mastered, starting from the formula of the flat wake, space building, 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. Although you can memorize formulas, however, you do not understand they are used, they certainly will not be able to solve a mathematical problem. Therefore, understanding formulas and they are used are more important than just memorizing formulas according to the topic.

The results of the survey related to the users of the internet to students in the week category are very high (97.2%), and only 2.0% of students have never used the internet. The duration of its used, 86.9% more than 5 days per week, and 52.2% more than 5 hours per day. Students using the internet for learning tend to sometimes 41.0% when there are assignments from lecturers and used them every day 25.9%. The most commonly used devices, namely: 95.2% use mobile phones, and 4.8% use other devices such as laptops, PCs, and tablets. Most 78.6% have personal laptops and the rest have PCs. This condition is sufficient capital to be able to carry out internet-based learning. Learning is online, requires quality internet networks and experience using the internet.

Besides experience and internet tools, online-based learning also requires a fairly good quality internet network service. Student assessment of e-learning services in BSP is likely to be unsatisfactory (49.0%) and very unsatisfactory 14.7%. The condition of BSP internet services supports online-based learning, although e-learning is not satisfactory.

The survey results relate to lecturers, most (98%), lecturers have a mobile phone as a means of communication, although the mobile phone has not functioned as a learning tool, however, this is a good start to move towards m-learning (mobile learning). Likewise, laptop ownership is sufficient, at 90% of lecturers having laptops. The range of tenure (96.6%) has a working period of 15-25 years. This condition is capital for online-based learning and can access and upload more diverse learning resources via the internet.

Other 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. Today's learning tends to lead to a combination of face-to-face learning, offline learning (interactive computer) and online learning (internet). Traditional learning based on face-to-face learning has now moved towards offline and online learning, as well as online learning initially also began to move towards face-to-face combination (Dwiyogo, 2018). Therefore, the ability of lecturers to manage to learn must also lead to blended.

Blended learning is present and future learning needs to be mastered by the teaching staff. Blended learning of applied mathematics is very much needed in current and future learning. Therefore, it is necessary to develop learning activities related to the content of mathematics learning and blended learning models. Most lecturers (97%) agreed that a blended learning based mathematics learning model was developed, the rest only 3% disagreed, some of the reasons were because the model needed reliable internet network services, while the facilities for learning needs in the BSP environment were considered to be very unsatisfactory.

Other results also showed that the obstacle faced by lecturers in implementing PBL is the limited time allocation to transform all concepts in detail to students. Another obstacle is the ability to choose interesting and fun learning strategy models to support the mathematics learning process. Therefore, the LMS-based blended learning model with the Schoology application needs to be developed in mathematics learning. Besides making learning easier and more enjoyable, it can also reduce the negative impact of using the internet. With blended learning, students no longer have to be fully in the same classroom as the lecturer, they can access learning anywhere and anytime.

Blended learning as a combination of face to face learning and online learning (Cheung & Hew, 2011). Blended learning-based learning is learning that combines learning delivery strategies using face-to-face activities, computer-based learning (offline), and online computers (internet and mobile learning). The composition that is often used, which is 50/50, means that from the allocated time provided 50% for face-to-face learning activities and 50% is done online learning. Some used the composition 75/25, or 25/75. Which composition is used, depends on the results of competency analysis to be produced, learning outcomes, student characteristics, face-to-face interactions, online learning strategies or combinations, characteristics of student location, characteristics and abilities of instructors, and available resources (Dwiyogo, 2018; Chaeruman, 2017).

Blended learning has aimed to (1) help learners to develop better, in accordance with learning styles and preferences in learning, (2) provide realistic practical opportunities for educators and learning participants to learn independently, be useful, and continue to develop, (3) increase scheduling flexibility for students, by combining the best aspects of face-to-face and online instruction, and 4) address learning problems that require resolution through the use of varied learning methods (Prayitno, 2016).

The components of blended learning, namely: 1) online learning, 2) face-to-face learning, 3) independent learning, 4) application, 5) tutorials, 6) collaboration and 7) evaluation. Therefore, blended learning is based on learning theory: Behaviorism from Gagne & Berliner, Humanism from C. Roger & Arthur Comb, Cognitivevism from Piaget, Bruner, Gagne & Blooms, and Constructivism from Piaget (Richey *et al.*, 2011).

Behaviorism learning theory (stimulus and response, S-R), stated Pavlov, Skinner, Watson, Hull, Guthrie, and Thorndike summarized Gredler (2011), assume that learning experiences will occur when students are given a stimulus through various online-based learning media. Stimulus-stimulus (S) from the media helps and encourages students to respond (S) so that they are accustomed to learning. In the design of blended learning how to design learning that provides stimuli through learning components to improve student responses. The cognitive constructivist views put forward by Piaget, and Bruner summarized Gredler (2011) states that learners have potential that can be developed, so that to shape learning experiences is done by increasing their insight. The application in the design of blended learning systems is how to design learning systems that can develop students' cognition to improve their understanding. The Humanism view put forward by A. H. Maslow, A. Comb and, C. R. Rogers, views that learning emphasizes individual freedom when and where learning occurs and students tend to think inductively to achieve self-actualization (Syah, 2000; Sukmadinata, 2003; Baharuddin, 2009). The application in the design of blended learning is how to design learning systems that can develop students' self-actualization to improve their understanding of the material being studied. They can learn at any time according to their respective learning styles. Learning is not limited to taking place in the classroom face-to-face, however, it can also be carried out outside the classroom online using android-based smartphone learning media.

From the viewpoint of Behaviorism learning theory, cognitive cognition and humanism, the learning experienced through interaction can be improved through learning activities. If in Behaviorism learning activities by providing stimuli to students, then in Cognitivism learning activities by giving them the opportunity to explore for themselves the knowledge they need. While Humanism learning activities can be done anywhere by giving individual freedom in accordance with their respective learning styles. These three things in the design of a blended learning system are not contradictory things, however complementary. This means that by increasing the resonance of the application of the three different learning theory views, it can optimize the learning experience itself. These three views can optimize blended learning, for example, assignments through online learning and discussion and discussion at face-to-face meetings. This is behaviorism practice, the assignment is a stimulus and written assignment is a response. While the discussion is a cognitive process because during the process the meaning process takes place. Learning activities carried out anywhere are not limited to just inside the classroom, but also outside the classroom using smartphone media through web schoology. For example, providing stimulus in blended learning through learning websites that are specifically designed for learning with teaching material content that has been arranged in such a way, and then by means of a school website for school students learning can explore various other knowledge relevant to the learning objectives. This is the practice of Humanism. Blended learning, with the freedom and variety of media choices, can increase student interaction to give them more contextual learning experienced. Blended learning is based on three theories of learning Behaviorism, Constructivism, and Humanism that complement each other.

Blended learning applications can be done through problem-based learning (Dwiyogo (2018). PBL, is one of the innovative learning models that makes problems the basis for students to learn, based on constructivism learning theory promoted by Piaget and Vygotsky The characteristics are: 1) the learning process is student-centered, 2) the problem presented is a learning stimulus, 3) new information is obtained from independent learning (self-directed learning), and 4) the problem is a vehicle for developing skills problem solving (Barrows, 1996). The syntax includes the stages: problem orientation, organizing students, guiding individual and group investigations, and developing and presenting the work. Through PBL, students will learn based on the problem that must be solved, then trace the concepts, principles, and procedures that must be accessed to solve the problem. Likewise, the evaluation must be based on process and results, carried out through portfolio-based performance assessments. Assessment is not based on teacher authority, however, there needs to be self-assessment by students and other students' assessment (Dwiyogo, 2018).

Learning settings in the blended learning design model, taking the essence of e-learning (Riyanto & Mumtahana, 2018). Generally, e-learning learning is asynchronous, where the lecturer and students as the learners do not meet at the same time. There are four classifications of e-learning, namely: 1) e-learning without the presence and without communication, 2) e-learning without presence however with communication, 3) e-learning combined with occasional attendance, and 4) e-learning is used as classroom teaching tools (Ranganathan *et al.*, 2007). Based on this classification six concepts of blended learning are developed as follows.

Type I Face to face learning, learning is carried out in the presence of the physical presence of the teacher through physical presentations however without electronic communication. Type II independent learning, learning is carried out without the presentation and physical presence of the instructor and however without electronic communication. Type III learning is out of sync, learning is done without the physical presence of the teacher however does not synchronize electronic communication. Type IV, synchronized blended learning, virtual learning, and synchronous electronic communication. This format is called synchronous, because teachers and students are present in real-time, though not accompanied by physical presence. Type V blended learning is out of sync, learning is carried out in the presence of occasional instructors and combined or mixed electronic communication. This format is a blended or hybrid e-learning format with occasional teacher attendance. Type VI synchronous blended learning, learning is done in the presence of instructors with electronic communication. Electronic communication is packaged in asynchronous and synchronous formats. The presence of teachers can be alternated between physical and virtual. Some class meetings are carried out with physical presenced, namely face to face in class such as traditional learning, other meetings are held in virtual (synchronous) (Dwiyogo, 2018; Dwiyogo, 2014; Chaeruman, 2017).

Blended learning needs to be supported by an LMS application that is used to manage online learning. One of them, the Schoology application program. Schoology is one of the web pages in the form of the social web, offering to learn just like in the classroom for free and easy to use as Facebook and is one of the e-learning platforms that are interesting and fun in learning. Offering facilities to lecturers through figures available to contain various forms of learning activities, as well as learning materials needed by students in their recovery. Availability of attendance figures by choosing to attend, permit, be late, or not attend. Every student activity will also be monitored through analytical facilities in the section course, assessment, discussion and other activities prepared for students. Schoology learning becomes very easy.

As seen to the characteristics of students and lecturers, the available facilities and infrastructures, as well as the study of the blended learning theory above, can be constructed of a draft model of applied blended learning mathematics. The model was developed based on Behaviorism, Constructivism, and Humanism learning theories, with synchronous blended learning format, applying PBL, using LMS model schoology, supported by multi-media learning media such as video and audio. Variation in the amount of time face to face and online in the semester, 50% face to face and 50% through online learning. Evaluation of results is a process and results with the performance assessment approach based on fortune and self-assessment. This design model is expected to increase students' understanding of the material which in turn will be able to improve communication skills and mathematical problem-solving. In general the contents of this blended learning mathematics design model include: 1) learning achievements, 2) material organization maps, 3) reference lists, 4) teaching materials, 5) synchronous and asynchronous learning activities, asynchronous learning designs, 6) learning designs Synchronous, 7) Synchronous learning design, and 8) Synchronous learning flow. Each learning activity, divided into three main activities, namely: online-face-to-face online, illustrated as the following picture 1.

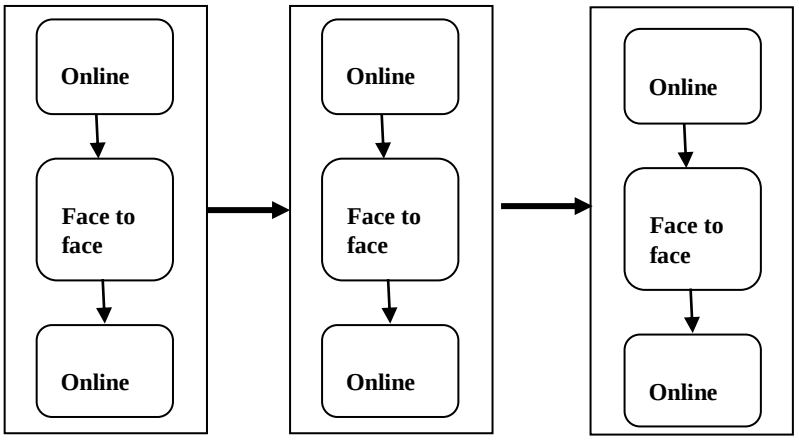

Figure 1. Blended learning design in applied mathematics

For each activity listed in Figure 1, there are stages of problem-based learning. Pre-face-to-face online activities

contain problem orientation activities, namely: explaining learning objectives, explaining the logistics needed, proposing phenomena or demonstrations or stories to bring up problems, motivating students to get involved in solving selected problems. In the face-to-face session, there are activities for organizing students and guiding group and individual investigations.

Then in the final stage, post-face-to-face online, develop and present the work and analyze and evaluate the problem-solving process. The stages of problem-based learning can be seen in Figure 2.

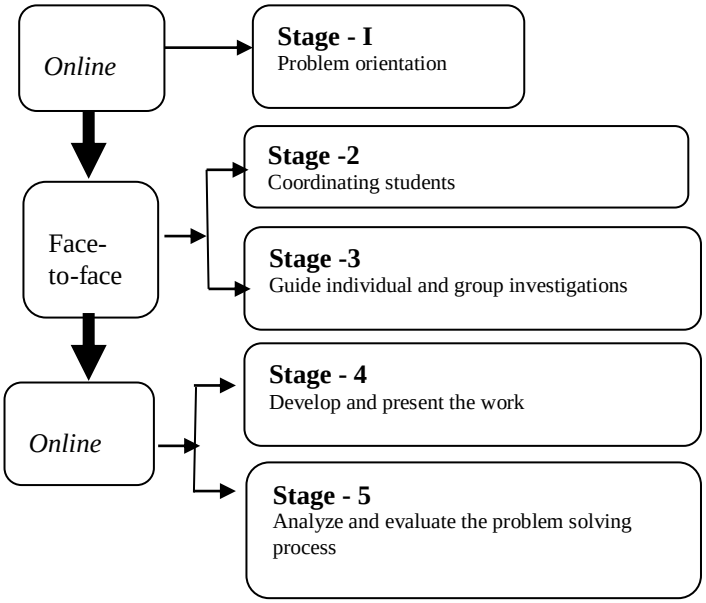

Figure 2. PBL stages in blended learning applied mathematics

If Blended Learning like Figure 2 is implemented well, the learning model will make a positive contribution to learning. One of them is saving time. Because, with the implementation of Blended Learning students will be able to complete the learning tasks in a short time (McCarthy & Murphy, 2010). However, in the process of implementing blended learning, there are several aspects that are considered, namely the characteristics of learning objectives to be achieved, relevant learning activities and choosing and determining which activities are relevant to conventional conventions and which activities are relevant for online learning (Prayitno, 2013). Other considerations are related to learning tools, such as textbooks, student worksheets, practice questions or assessment of learning outcomes and online classes.

The textbook contains material as a starting stock for students in the learning process. Furthermore, the exercise questions that contain contextual problems are made with the aim that students practice questions related to the learning activities that have been carried out. Finally, an online class was developed, used as a forum for conducting face-to-face and post-face-to-face activities.

In the online class, there are Student Worksheets, handouts and practice questions that can be accessed by students anytime and anywhere. Online class design or structure of online class content can be seen in Figure 3.

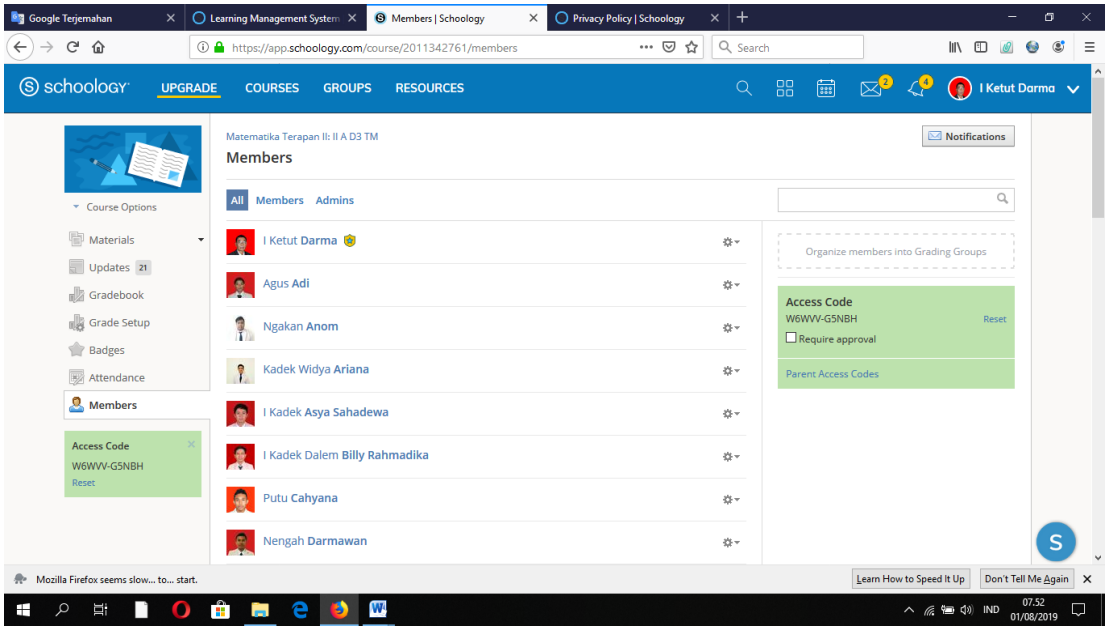

Figure 3. Structure of online class content

The results of the validation of the draft of the blended learning model begin with the development stage of designing the blended learning model in the form of a draft guide containing the background, concepts and characteristics of the learning model consisting of syntax, social system, reaction principles, support systems, and instructional impacts (Akbar, 2013). The learning model is declared valid if the elements of validation have been declared valid. The elements of validation consist of 1) validation of experts or experts in the field of learning; 2) user validation by three practitioners (professional teachers); 3) audience validation by students by giving scores on student response questionnaires (Akbar, 2013). In this research, the validation elements included 5 validator logistics, namely learning experts, mathematics learning content experts, learning media experts, and two practitioners (applied mathematics teaching lecturers). The results of the validation carried out by the five logical validators can be seen in the following Table 2.

Table 2
The results of the logical validation of blended learning models

Rating Indicator	Validator					Average
	I	II	III	IV	V	
Supporting Theory of learning models	4	4	4	4	4	4,0
Background to developing learning models	3	3	2	3	3	2,67
The purpose of developing a learning model	4	3	3	4	4	3,33
Description of the learning model	3	4	4	4	4	3,67
Syntactic learning model	4	3	4	4	3	3,67
The social system of learning models	3	3	3	3	3	3,00
Learning model support system	4	3	3	4	4	3,33
Use of learning approaches	3	3	4	3	4	3,33
Learning steps	2	3	3	3	3	2,67
Evaluation and assessment	4	4	3	4	4	3,67
Desired Learning Outcomes	4	4	3	4	4	3,67
Amount	38	36	36	38	36	
Overall Item / Validator	Valid	Valid	Valid	Valid	Valid	
Average	36,8					Valid

Rating Indicator	Validator					Average
	I	II	III	IV	V	
Percentage	83,64%					

Scores from the five validators decided that the draft Blended learning model can be used in applied mathematics learning with a few minor revisions. The revision specifically in the statement item which explained the background of the model and the steps of learning was considered to be less valid because an average of 2.67 was obtained. Besides, in the background, there is also the addition of learning theory that underlies the learning model so that the stages of the model really have a basic theory that will be applied. The learning steps are adjusted to the PBL syntax referred to. The support system was also revised by adding an explanation of the support system that must exist in applying the model. The aim of developing a learning model is also more specific with instructional impact. Input from the validator is based on the revision for the feasibility of the learning model. Further revisions will be carried out at the next stage before field testing.

4 Conclusion

Blended learning Applied Mathematical Design Model was developed based on Behaviorism, Constructivism, and Humanism learning theories, with synchronous blended learning format, applying PBL, using LMS model schoology, supported by multi-media learning media such as video and audio. Variations in the amount of time face to face and online in the semester, 50% face to face and 50% through e-learning. Evaluation of learning outcomes is a process and results with a performance assessment approach based on portfolio and self-assessment. The specifications of the components of the design model of applied mathematics blended learning, include: 1) learning achievements, 2) material organization maps, 3) reference list, 4) teaching materials, 5) synchronous and asynchronous learning activities, Asynchronous learning design, 6) learning designs Synchronous, 7) Synchronous learning design, and 8) Synchronous learning flow. The draft model is declared valid and is suitable for use with minor revisions.

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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