Needs Analysis Development of Applied Mathematical Blended Learning Models Using Schoology LMS.

I Ketut Darma¹, I Gede Made Karma², I Made Anom Santiana³

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

Abstract. The purpose of this study to describe the need for developing LMS-based blended learning models of applied mathematics using Schoology, and 2) to obtain a draft LMS-based blended learning model using Schoology. The development used the Thiagarajan 4-D model, and Semmel in 1974 with several modifications, namely: 1) Define, 2) Design, 3) Develop, and 4) Disseminate. Currently the development stages 1 and 2 and part of stage 3 are being implemented. The implementation is in the engineering of the Bali State Polytechnic (BSP). Data was collected using survey methods, and questionnaires and analyzed using descriptive statistics. The results of the analysis get: 1) student attitudes toward mathematics are very positive, learning interests are moderate, 2) learning motivation is high; 4) learning independence is high. Characteristics of the blended learning model: based on constructivism learning theory, using synchronous blended learning format, applying problem-based learning (PBL), using LMS schoology, supported by multi-media learning media such as video and audio learning media. Variation in the number of face-to-face and online time in semester, 50% face-to-face and 50% through e-learning. The evaluation is process and results with a performance assessment approach based on a portofolio and self assessment. An average expert assessment of 36.8 (valid) is feasible to use with several minor revisions.

1. Introduction

Facing the increasingly rapid development of the 21st Century, learning must be designed to achieve 21st Century competency. One of the six elements of 21st century learning is information literacy and Information Communication Technology (ICT)³. Students' literacy skills in information and ICT literacy really need to be developed. One effective way to develop it is through integrating ICT in learning with the internet as a tool in the learning process². 21st Century Competence also requires that students be directly involved in the learning process that utilizes internet facilities, not just limited to seeking information, but they also carry out online learning. ICT literacy skills and student information literacy will be explored and developed. But in reality, still found among lecturers, they have not utilized the internet facilities as one of the maximum learning aids, mathematical problem solving. One learning model that can be applied is a PBL.

Based on the above considerations, the researchers tried to provide an alternative learning system that could be applied by lecturers by developing a blended learning based on LMS type Schoology with PBL models in mathematics courses. The hope with the implementation of the model in the learning process will be able to increase communication and problem solving skills, as well as information literacy skills and ICT literacy in students. In order to produce a model design that suits the needs of lecturers and students, it is necessary to analyze the need to develop a blended learning design model. The aim is to get: 1) blended learning applied mathematics learning design model, 2) analysis of the need for blended learning design, 3) finding components of the blended learning design model.

2. Research Method

The procedure, the first stage (2019), is to define, design and develop This research was carried out in 3 stages of the year. In the first year using descriptive research conducted by the survey method. The aim is to obtain data that supports the desired model design specifications and is suitable for use in applied mathematics learning systems at the BSP. This research was a research development using the Thiagarajan 4-D model, and Semmel in 1974 with some modifications. The stages of development consist of 4 stages, namely: 1) Define, 2) Design, 3) Develop, and 4) Disseminate¹⁸. Stage 1 and 2 and part of stage 3 are carried out in the first year (2019) and some are done in the second year (2020) and phase 4 is carried out in the third year (2021). Implemented in the engineering scope of the Bali State Polytechnic. The population is 588 people distributed in 3 department and 6 study programs.
Samples were taken using proportional sampling as many as 251 students and 20 basic science lecturers.

The develop stage, to get a validated blended learning design. This stage is carried out through: 1) expert appraisal, 2) revisions, 3) developmental testing. Phase 2 and 3 are conducted in the second year. Currently validation tests are carried out through expert judgment. Assessment was carried out by filling out a questionnaire test validating aspects of the design model developed.

Research variables, including the characteristics of students include: school origin, pathways of acceptance, GPA, attitudes, interests, motivation, independence, mathematical understanding, and mathematics learning styles, and the design needs of the Blended Learning model. These needs include: internet network conditions, teaching materials used, internet usage, devices used to access the internet, lecturers’ knowledge about blended learning and the need for blended learning in applied mathematics learning.

Data collected using methods: survey, documentation, observation and interview. The instrument is prepared by the researcher itself based on the variables described in the research indicators and the validity and reliability have been tested through empirical tests. Then analyzed using descriptive statistics. Data from each variable is compared with the average reality. Furthermore, the trends are classified into five categories with the norms of the ideal normal theoretical framework, as follows:\[19\].

\[
\begin{align*}
M_i + 1.5 SD_i < x & \leq M_i + 3SD_i = \text{Very High / very positive} \\
M_i + 0.5 SD_i < x & \leq M_i + 1.5 SD_i = \text{High / positive} \\
M_i - 0.5 SD_i < x & \leq M_i + 0.5 SD_i = \text{Medium / neutral} \\
M_i - 1.5 SD_i < x & \leq M_i - 0.5 SD_i = \text{Low / negative} \\
M_i - 3 SD_i < x & \leq M_i - 1.5 SD_i = \text{Very Low / very negative}
\end{align*}
\]

\[\text{Notify: } M_i = \frac{1}{2} (\text{maximum score} + \text{minimum score}); \text{SD}_i = \frac{1}{6} (\text{maximum score} - \text{minimum score})\]

3. Results and Discussion

Characteristics of students are seen from school origin, 37.5% from Senior High Schools and 62.5% from Vocational High Schools. Viewed from the pathway accepted as a student at BSP, 39.8% through PMDK, 37.1% UMPN, and 23.1% through UMPN independent. The age of the majority (72.5%) is 18 years old. The learning outcomes that have been achieved are an average of 3.85 or 93.3% (very good). This condition identifies that the ability of students is very diverse both in terms of academic and talent. So it is very necessary to develop a learning strategy model that is able to accommodate that diversity.

Motivation is a force that can encourage someone to do something, including learning\[27\] (Uno, 2012: 27). Its function is to encourage learning efforts and achieve better learning outcomes\[28\] (Ratumanan, 2004: 87). The greater the learning motivation a person has, the greater his success in learning. Conversely, those whose motivation is weak, seem indifferent and easily discouraged, as a result many experience learning difficulties. The survey results on students use an average learning motivation of 48.33 or 64.44% (very high) from the highest score of 75. This condition indicates that students have very high strength in learning mathematics.

Although they can memorize formulas, but don’t understand their use, they certainly won’t be able to solve a mathematical problem. For this reason, understanding the formula and its use is more important than just memorizing the formula according to the topic. The survey results of students obtained, how to study mathematics 50.6% by recording lecturers’ explanations, 10.4% memorizing formulas according to the topic and 35.1% understanding the use of each formula. This condition identifies, how to learn mathematics in students is not appropriate, tends to be rote. Learning is online, requires internet network quality and internet usage experience. The survey results showed that internet usage in categorized weekly students was very high (97.2%), and only 2.0% of students never used the internet. The duration of use, 86.9% more than 5 days per week, and 52.2% more than 5 hours per day. In detail the general duration of internet usage for students is presented in Table 1 below.
Table 1. Duration of Internet Usage Per Week Students of Engineering in the BSP

| Duration per week | Frequency | Percent (%) |
|-------------------|-----------|-------------|
| Never             | 5         | 2.0         |
| 1-3 days          | 9         | 3.6         |
| 4-5 days          | 19        | 7.6         |
| more than 5 days  | 218       | 86.9        |
| Total             | 251       | 100.0       |

Table 2. Duration of Use of the Internet Per Day Students in the Engineering of the BSP

| Duration per day | Frequency | Percent (%) |
|------------------|-----------|-------------|
| Less than 1 hour | 15        | 6.0         |
| 1-3 hour         | 46        | 18.3        |
| 4-5 hour         | 59        | 23.5        |
| More than 5 hour | 131       | 52.2        |
| Total            | 251       | 100.0       |

While the average internet usage for learning is presented in table 3 as follows

Table 3. Duration of Internet Usage for Learning from Engineering Students of the Bali State Polytechnic

| Duration      | Frequency | Percent (%) |
|---------------|-----------|-------------|
| Never         | 5         | 2.0         |
| Sometimes     | 103       | 41.0        |
| 1-3 times     | 48        | 19.1        |
| 4-6 times     | 30        | 12.0        |
| Every day     | 65        | 25.9        |
| Total         | 251       | 100.0       |

Students using the internet for learning tend to sometimes 41.0% if there are assignments from lecturers, and use them every day 25.9%. The devices that are used most often, namely: 95.2% use HP, 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 enable the implementation of internet-based learning. Besides internet experience and devices, online-based learning also requires good quality internet network services. Respondents’ assessment of internet services and e-learning in BSP are presented in Table 4 and Table 5 below.

Table 4. Student Satisfaction Levels on Internet Network Services in BSP

| Quality                  | Frequency | Percent (%) |
|--------------------------|-----------|-------------|
| Very unsatisfactory      | 45        | 17.9        |
| less satisfactory         | 89        | 35.5        |
| Satisfying enough        | 75        | 29.9        |
| Very satisfactory        | 34        | 13.5        |
| Very very satisfactory   | 8         | 3.2         |
| Total                    | 251       | 100         |

3
Table 5. Student Satisfaction Levels for BSP E-Learning Services

| Quality                | Frequency | Percent(%) |
|------------------------|-----------|------------|
| Very unsatisfactory    | 37        | 14.7       |
| Less satisfactory      | 123       | 49.0       |
| Satisfying enough      | 61        | 24.3       |
| Very satisfactory      | 26        | 10.4       |
| Very very satisfactory | 5         | 1.6        |
| Total                  | 251       | 100.0      |

Students' assessment of e-learning services in BSP is likely to be less satisfactory (49.0%) and very very unsatisfactory 14.7%. BSP internet service conditions support online-based learning, although e-learning is not satisfactory. The survey results of the respondents of basic science lecturers, namely: the level of education of most Magisters (S2) 18 (90%) people, and Doctoral 2 (10%) people. The working period of the majority (96.6%) has a working period of 15-25 years, while only 3.4% has a working period of more than 25 years. The majority (97.7%) are between 41 - 50 years old and 2.3% are between 51 - 60 years old. Most or almost all lecturers prepare SLP in carrying out learning activities. There were 98.9% of lecturers stating that they compiled SLP and 2.1% did not compile SPL because had been prepared by previous teachers, they were substitute lecturers between times (abandoned study assignments). Conditions show that lecturers have teaching teaching and become capital to be able to innovate learning. Learning material is an important learning resource for students, the majority (87.8%) of respondents include dictates / teaching books / hand outs in the learning design. While teaching materials in audio and audio visual formats have not become an important part of their learning. However, some teachers have used computers (92.6% and internet (65.8%). Most 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 solving mathematical problems, this condition is a good capital for the implementation of computer and internet based learning.

Figure 1. Blended learning design of Applied Mathematics

In each activity listed in Figure 1 the stages of problem-based learning are carried out. Pre-face-to-face online activities contain problem-oriented activities, namely: explaining learning objectives, explaining the logistics needed, submitting phenomena or demonstrations or stories to raise problems, motivating students to be involved in solving selected problems. In face-to-face activities there are activities to organize students and guide group and individual investigations. Then in the final stage, online post-face-to-face development and presenting the work and analyzing and evaluating the problem solving process. The stages of problem-based learning can be seen in Figure 2.
If Blended Learning in Figure 2 is well implemented, the learning model will contribute positively 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[33]. But in the process of implementing blended learning there are several aspects that are taken into consideration, namely the characteristics of the learning objectives we want to achieve, relevant learning activities and choosing and determining which activities are conventionally relevant and which activities are relevant for online learning[34]. Another consideration is related to learning tools, such as textbooks, practice questions or learning outcomes tests and online classes. Textbooks contain materials as the initial provision of students in the learning process. Furthermore, the practice questions that contain contextual problems are made with the aim that students practice the questions related to the learning activities that have been carried out. The last one to be developed is an online class, used as a forum when conducting advance and post face-to-face activities. In online classes, there are StudentWorksheets, handouts and practice questions that can be accessed by students anytime and anywhere. Online class design or online class content structure can be seen in Figure 3.

The results of the draft validation of the blended learning model begin with the development stage, namely designing a 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 principle, support system, instructional impact, and accompaniment impact. The learning model is declared valid if the validation elements have been declared valid. The validation element consists 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. In this study the element of validation includes 5 logical validators, namely learning experts, mathematical learning content experts, learning media experts, and two practitioners (applied mathematics instructors). The validation criteria are as shown in Table 5.

| Score | Validation category | Information                           |
|-------|---------------------|---------------------------------------|
| 40-48 | Very Valid          | Very good to use                      |
| 31-39 | Valid               | May be used with minor revisions      |
| 22-30 | Valid enough        | May be used with major revisions      |
| 12-21 | Invalid             | Cannot be used                        |

Table 5. Criteria for validity of learning models

The results of the validation carried out by the five logical validators can be seen in Table 6 below.

Table 6. Results of logical validation of the Blended Learning learning model.

| Indicator                                      | Validator | Average |
|------------------------------------------------|-----------|---------|
| Supporting Theory of learning models          | I         | II      | III     | IV      | V        | 4.0     |
| Background to the development of learning models | 3         | 3       | 2       | 3       | 4        | 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    |
| Syntagmatic learning model                    | 4         | 3       | 4       | 4       | 3        | 3.67    |
| Social system learning model                  | 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    |
| total                                         | **38**    | **36**  | **36**  | **38**  | **36**   |
| Overall Item / Validator                      | Valid     | Valid   | Valid   | Valid   | Valid    |         |
| Average                                       | **36.8**  |         |         |         |         |
| Percentage                                    | **83.64%**|         |         |         |         |

The score of the assessment results from the five validators, decided that the draft Blended learning model could be used in applied mathematics learning with several minor revisions. The revision is especially in the statement that explains the background of the model and the learning steps are considered to be less valid because it obtained an average of 2.67. In addition to the background there are also additional learning theories that underlie the learning model so that in the model stage it really has a theoretical basis to be applied. The learning steps are adjusted to the PBL syntax referenced. The support system was also revised by adding an explanation of the support system that must exist in applying the model. The purpose of developing the learning model is also more specific to the instructional impact. Input from the validator is the basis for revising the feasibility of the learning model. Subsequent revisions will be carried out at the next stage before field tests are conducted.

4. Conclusion
The Blended learning design model of applied mathematics was developed based on constructivism learning theory, with synchronous blended learning format, applying PBL, using LMS application schoology, supported by multi-media learning media such as video and audio. Variation in the number of face-to-face and online time in 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 blended learning design of applied mathematics is needed for current and future learning. The specifications of the components of the blended learning design model of applied mathematics include: 1) learning outcomes, 2) material organization maps, 3) reference lists, 4) teaching materials / materials, 5) synchronous and asynchronous learning activities, Asynchronous learning designs, 6) Synchronous learning design, 7) Sync learning design, and 8) Synchronous learning flow. The draft model is declared valid and feasible to use with minor revisions.

5. Acknowledgement
The author would like to thank Directorate Research and Social Service, Ministry of Research, Technology, and Higher Education for their financial support that this research was successfully undertaken.

6. Reference
[1] Partnership for 21st Century Skills. (2007). Beyond the Three Rs: Voter Attitudes Toward 21st Century Skills. Tucson, AZ: Author.
[2] Yilmaz, M. B., & Orhan, F. (2010). High School Students Educational Usage of Internet and Their Learning Approaches. World Journal on Education Technology, 2(2), 100-112.
[3] Barrows, H. (1996). Problem-Based Learning in Medicine and Beyond: a Brief Overview. New Direction for Teaching and Learning. Jossey: Bass Publisher.
[4] Sanjaya, W. (2007). Strategi Pembelajaran Berorientasi Standar Proses Pendidikan. Jakarta : Kencana Prenada Media Group.
[5] Mosa, E. (2006). Puntoedu: A Blended E-Learning Model. Current Developments in Technology-Asisted Education, 6 (4), 1744-1749.
[6] Suana, W., Maharta, N., dan Nyeneng, I., D., P. (2017). Design And Implementation of Schoology Based Blended Learning Media For Basic Physic I Course. Journal Pendidikan IPA Indonesia Al-BiRuNi, 6(1), 1770-178..
[7] Dwiyogo, W. (2014). Analisis Kebutuhan Pengembangan Model Rancangan Pembelajaran Berbasis Blended Learning (PBBL) Untuk Meningkatkan Hasil Belajar Pemecahan Masalah. Jurnal Pendidikan dan Pembelajaran, 21(1), 71-78.
[8] Graham, C. R. (2006). Blended learning systems: Definition, current trends, and future directions. Dalam C. J. Bonk & C. R. Graham (Eds), The Handbook of blended learning: Global perspectives, local designs (pp. 3-21). San Francisco, CA: John Wiley & Sons, Inc.
[9] Marsh, D. (2012). Blended learning: Creating Learning Opportunities for Language Learners. New York: Cambridge University Press.
[10] Rooney, J. E. (2003). Blended learning opportunities to enhance educational programming and meetings. Association Management, 55(5), 26-32.
[11] Mahnegar, F. (2012). Learning Management System. International Journal of Business and Social Science, 3(12), 144-150.
[12] Dwiyogo, D. (2018). Pembelajaran Berbasis Blended Learning. Depok: Rajawali Pers.
[13] Amiroh. (2013). Antara Schoologi, Moodle dan Edmodo. Retrieved from http://amiroh.web.id/antara-moodle-edmodo-dan-schoology/. Diunduh 20 Januari 2018.
[14] Sicat, A. S., & Ed, M. A. (2015). Enhancing College Students’ Proficiency in Business Writing Via Schoology. International Journal of Education and Research, 3(1), 159–178.
[15] Joshua, J.,W., N, 1), I Putu Agus Swastika, I.P.A dan Estiyanti, N. M. (2015). The Effectiveness of E-Learning Implementation using Social Learning Network Schoology on Motivation & Learning Achievement in STMIK Primakara Bali. Prosiding Seminar Nasional Pendidikan Teknik Informatika (SENAPATI 2015) Singaraja – Bali, -, 96-106.
[16] Means, B., Toyoma, Y., Murphy, R & Baki, M. (2013). The Effectiveness of Online and Blended Learning: A Meta-Analysis of the Empirical Literature. *Teachers College Record*, 115(030303), 1-47.

[17] Almasaeid, T., F. (2014). The Effect of Using Blended Learning Strategy on Achievement and Attitude in Teaching Science Among 9th Grade Student. *European Scientific Journal*, 10(31), 133-145.

[18] Thiagarajan, S., Semmel, D. S & Semmel, M. I. (1974). *Instructional Development for Training Teachers of Exceptional Children*. Minneapolis, Minnesota: Leadership Training Institute/Special Education, University of Minnesota.

[19] Mardapi, D. (2016). *Pengukuran Penilaian & Evaluasi Pendidikan*. Yogyakarta: Nuha Medika.

[20] Sudjana, N. (2014). *Penilaian Hasil Proses Belajar Mengajar*. Bandung: PT. Remaja Rosdakarya.

[21] Rusman. (2013). *Faktor-faktor yang mempengaruhi hasil belajar*. Jakarta: PT. Bumi Aksara.

[22] Syah, Muhibbin (2013). *Psikologi Belajar*. Jakarta: Rajawali Pers.

[23] Siregar, A. R. (2006). Motivasi Berprestasi Mahasiswa Ditinjau dari Pola Asuh. Jakarta: Gramedia Pustaka.

[24] Suhendri, H. (2012). Pengaruh Kecerdasan Matematika-Logika, Rasa Percaya Diri, dan Kemandirian Belajar terhadap Hasil Belajar Matematika. *Jurnal Formatif Universitas Indraprasta PGRI*, 1(1), 30-44.

[25] Nawawi dan Susanto, (2007: 39) Teori belajar & Pembelajaran, Jakarta, Prenada. Media Grup.

[26] Loekmondo, J.T Lobby. (1994). *Belajar Bagaimana Belajar*. Salatiga: BPT Gunung Mulia.

[27] Uno, B., H. (2012). *Teori Motivasi dan Pengukurannya*. Jakarta: PT. Bumi Aksara.

[28] Ratumanan, T.G. (2004). *Belajar dan Pembelajar*. Surabaya: UNESA University.

[29] Cheung, W. S. & Hew, K., F. (2011). Design and Evaluation of Two Blended Learning Approaches: Lesson Learned. *Australasian Journal of Educational Technology*, 8(27), 1319-1337.

[30] Riyanto, S. dan Mumthahana, H., A. (2018). *Desain Pembelajaran Blended Learning Untuk Mata Kuliah Statistik*. Yogyakarta: Leutikaprio.

[31] Ranganathan, S., Negash, S. & Wilcox, M.V. (2007). Hybrid Learning: Balancing Face-to-Face and Online Class Sessions, *Proceedings of the Tenth Annual Conference of the Southern Association for Information Systems* Jacksonville, Florida.

[32] Uwes, A., C. (2017). *PEDATI Model Desain Sistem Pembelajaran Blended*. Direktorat Pembelajaran Direktoral Jenderal Pembelajaran dan Kemahasiswaan Kementerian Riset, Teknologi dan Pendidikan Tinggi.

[33] McCarthy, M. A., & Murphy, E. A. 2010. Blended learning: Beyond initial uses to helping to solve real-world academic problems. *Journal of College Education & Learning*, 7(6), 67-70.

[34] Prayitno, W. (2013). Implementasi Blended Learning Dalam Pembelajaran Pada Pendidikan Dasar dan Menengah. [http://lpmpjogja.kemdikbud.go.id/](http://lpmpjogja.kemdikbud.go.id/), diunduh 15 Maret 2017.

[35] Akbar, S. 2013. *Instrumen Perangkat Pembelajaran*. Bandung: Remaja Rosdakarya Offset.
