The Design of Adaptive Learning Model to Support the Application of Blended Learning

RISWAN*

Abstract

The adaptive e-learning model is a learning model that developed in blended learning in the Information Systems Project Management (ISPM) course. The development was to improve the quality of the school teachers of Informatics and Computer Management (STMIK) Nurdin Hamzah. The initial study results on the instructors by using the question lattice instrument were in four categories. They were (1) learning organizing strategies, (2) learning delivery strategies, (3) learning management strategies, and (4) learning evaluation in conventional teaching. These showed that the teaching position was in enough category. It needs to increase the teachers' category by developing a teaching model based on adaptive e-learning to create sustainable learning. This model was expected to increase the teachers' category and the students' ability to understand the ISPM course. A study on this model used a descriptive methodology to get students' responses to the developed adaptive e-learning model. The implementation of this model showed that the students' responses were very good, and the teachers' category had also changed from enough to good. It is expected educational institutions can develop this model as a solution during the pandemic.

* Lecturer, Universitas Nurdin Hamzah, Indonesia; ris_wone@yahoo.com

Introduction

The development of adaptive e-learning model is one of the solutions offered to students with different regional backgrounds and different absorption abilities in receiving material by lecturers. This model can ensure the teaching and learning sustainability process that will run like it used to be, so the students can access the material based on their level of understanding and ability in communicating and discussing with their lecturers and friends wherever and whenever. Somehow, those who have lack understanding regarding the material during the implementation of adaptive e-learning might face the lecturers and discuss with their friends. Moreover, this model could encourage lecturers to intensify their creativity in preparing teaching materials. These will be in line with the assessment enhancement through the lecturers' performance as categorized good based on four assessment factors that have been fulfilled. Furthermore, as a blended learning model, the adaptive e-learning model can be a solution for the implementation of education during this Covid-19 pandemic. That is why collaborating face-to-face learning with Information and Communication Technology (ICT) is an appropriate part of the limitations of educational facilities.

At this point, the advances of information and communication technology (ICT) have encouraged several universities to take advantage of ICT in the teaching process, either in or as complementary. This implementation is influenced by the respective state universities, infrastructure, available human resources, students from different regions, and varied capabilities become the spotted part of an adaptive e-learning model implementation. This limitation encourages the researchers to consider the model of *web-centric course* adoption, which combines e-learning with face-to-face. In addition, this model is one of three models proposed by Haughey, Anderson, and Anderson (1998). There are three forms of learning systems through the Internet, considered a basis for a learning system development by utilizing internet items, such as web course, web-centric course, and web-enhanced course (Haughey et al., 1998).

Furthermore, the model designed in this website considers various needs of the students in the field of the material and content that will be discussed and shared with their friends and lecturers. The availability of this content will optimize the teaching activity since the web is designed regarding the students' needs. Surjono (2015) noted that the adaptive e-learning model had been proven effective in increasing the students' learning outcomes in the Education Department of Electronics Engineering FT UNY.

The design of the adaptive e-learning model based on the students' needs will change the conventional teaching model applied. It has also become part of the slogan of STMIK Nurdin Hamzah. The balance between vision and mission and the motto of the activities done are implemented as it is in the college statutes. In addition, the students' need for e-learning as a lectures medium is supported by early studies of the needs analysis of the Project Management Information Systems (MPSI) course. According to Riswan (2014), the teaching position needs to be in enough category with the mean value is from 35.41 to 44.42, and 39.91 to 4-dimensional data distribution of the lattice instruments processed. As a future lecturer, the researcher wants this category increased to be better.

Literature Review

E-learning

E-learning has been used as a complementary by some lecturers for conventional teaching in the classroom. Nowadays, distance learning has made full use of e-learning or has combined the e-learning model with the face-to-face class known as the blended learning model. In this study, the researchers used the blended learning model in teaching the MPSI course. The component was designed in the form of adaptive e-learning and chosen based on the diversity of respondents from different abilities. To understand the presented material, all respondents need different approaches. The description of e-learning, blended learning and adaptive e-learning can provide readers with an understanding of the function of each of these components.

According to Shute and Towle (2003), e-learning is learning done using a computer connected to the Internet. Adaptive e-learning is generally perceived from the instruction point of view and comprises CBLEs that can interact with a student to provide the most appropriate instruction. Thus, it means that the instructions provided by the system adapt and not the students' learning. Adaptive e-learning is currently applied to improve the instructions given to heterogeneous student groups (Brusilovsky, Karagiannidis & Sampson, 2004; Van Seters, Ossevoort, Tramper & Goedhart, 2012).

Moreover, according to Groenendijk and Markus (2010), e-learning is a learning process created by interaction with digitally delivered content, network-based services, and tutoring support. This definition focuses on the revolutionary impact of network-enabled technology. In addition, e-learning is some technologically mediated learning using computers, whether from a distance or in a face-to-face classroom setting (computer-assisted learning). It is a shift from traditional education or training to ICT-based personalized, flexible, individual, self-organized, collaborative e-learning based on a community of learners, teachers, facilitators, experts. Therefore, e-learning indicates learning done using digital media with a computer connected to the network internet. Somehow, not all the material can be in e-learning. Sinofsky (2014) stated that as the number of tools and options for e-learning expands, companies now realize that online learning is not for everything and everyone. It is the same as e-commerce which does not replace the needs for bricks and mortar retail stores, so e-learning does not replace the need for instructor-led training, coaching, expert support, labs, and collaborative experiences.

Blended learning and adaptive e-learning

Garrison and Vaughan (2008) state that blended learning is the combining ideas from the experience of face-to-face learning and online learning. The basic principle is direct face-to-face communication and online written communication. This model seems simple, but actually, the implementation is more complex. The primary assumption of the blended learning design is a thought to combine face-to-face and online learning, the fundamental

thinking about the course design to optimize student engagement, restructure and reorganize the traditional lecture.

In addition, Watson (2008) defined blended learning as the integration of face-to-face and online learning to improve the learning experience in the classroom and expand the knowledge through information and communication technology. This strategy will increase student engagement in learning through activities online and the effectiveness and efficiency of college. He also defined blended learning as learning that combines online and face-to-face. The content delivered online usually uses discussions, online and face-to-face meetings. "The Sloan Consortium" defined the blended program carried out between 30 per cent and 79 per cent of the content delivered online, the rest of the learning content by teachers or lecturers through face-to-face or a method based non-web, such as textbooks. It can be achieved through the resources "blended" the virtual and the physical source.

Adaptive e-learning has been investigated by multiple disciplines, including educational psychology and computer science, and each uses its terminology to label similar concepts (Van Seters et al., 2012). It consists of multiple components that enable instruction adjusted to the students' needs. According to the terms in educational psychology, the names of the components are the content models (domain models), the learner models (manual models), the instruction models (interface models), and the adaptive engine (Brusilovsky, 2001; Shute & Towle, 2003).

Methodology

Research design, site, and participants

This study was quantitative research on students who took ISPM/MPSI courses as the respondents. It needs an analysis of the student's needs for the adaptive e-learning model. In designing this learning, the researcher is guided by the waterfall model with some stages, such as problem identification, system design, implementation, testing, and spreading the system to the object of the study.

At the problem identification stage, the researcher saw that the STMIK Nurdin Hamzah institution as an IT-based high school had not implemented digital-based learning yet as an alternative or support for face-to-face learning by lecturers. The researcher also found that student assessments of lecturers in ISPM/MPSI courses were in enough category. Hence, it needs some efforts from the institution or lecturers to provide alternative online learning models to support offline learning. From this identification, the researcher tried to design an adaptive blended learning system using a website-based programming application. This design used a data flow diagram, depicted context diagrams, zero diagrams, and detailed diagrams of the system built, involving all components, both students, lecturers, BAU, and BAAK. These components were interconnected with each other. There were several designs such as input, output, process, and connecting facilities that can be used by lecturers and students as well as face-to-face lectures.

After the design stage has completed, the researcher proceeded to the system implementation stage. This stage is the stage of translating into a programming language. The researcher used PHP, MySQL, and several tools. Then testing was carried out at the

student level and the lecturer level. The results of this test were to determine how this application will be ready to use by users whether there is still an error that is then corrected so that later it can be disseminated to users.

The data of this study were from students who took the Information System Project Management (ISPM/MPSI) course. So far, lectures are carried out manually in the class. Meanwhile, STMIK Nurdin Hamzah, as a technology-based university, of course, needs to develop e-learning based learning media, so that students can attend lectures anytime and anywhere. E-learning media developed by an adaptive model according to student conditions.

In general, students of STMIK Nurdin Hamzah come from various regions in Jambi Province, with different high school education backgrounds, both public and private. These diverse backgrounds will affect the lecturers in the teaching and learning process. It is impossible to do it with the same approach because it will affect the absorption capacity of each student. The lecturers need to take various approaches in the teaching process to make the students understand the material. Adaptive e-learning applications designed for MPSI courses can help lecturers meet the students' needs in understanding material with systematic concepts. This application is a supporting part of lecturers in the carried out face-to-face teaching process. The students' sustainability in the learning process continues from what they have learned on the campus. They can repeat to learn at home, and vice versa doubts about the understanding they have learned on the website. They can discuss adaptive e-learning during offline lecture meetings.

There will be interactive communication in understanding the lecture material taught for both lecturers and students. There are tiered solutions that students will go through and experience with teaching materials, starting from pre-lecture content, where students can understand the materials uploaded by the lecturer on the application before it starts. All materials in the pre-lecture will be studied independently and can be communicated through discussion facilities by students. Furthermore, the researchers have designed discussion facilities in this application, both communication between students and lecturers. The discussion will later be resumed offline in class with lecturers and friends so that you can understand the material properly. This process is the researchers' goal for a sustainable learning process experienced by students.

Evaluation of the course material understanding designed structured through a semester learning plan (RPS), in the form of quizzes, midterm exams, and semester exams in the form of various and graded questions by the prepared RPS to achieve the predetermined syllabus. The evaluation was carried out in two forms. They were offline, conducted during lecture meetings in class, and online. The results were given to students. Furthermore, at the next meeting, the evaluation questions were discussed so that students understood their answers to the discussion.

Data collection and analysis

Project Management Information Systems (ISPM/MPSI) was the object under study. These objects were students in the fifth semester at the STMIK Nurdin Hamzah. The teaching of this course is manually done face to face in class. The evaluation of the lecturer

toward this object was a sufficiency rating. As a teaching staff, of course, they are motivated to increase the assessment evaluation to be good or very good. The efforts made by the teacher to change this assessment are by developing the manual teaching model to a model based on e-learning. The development also supports the higher education's motto as Truly IT School. In developing this e-learning model, 12 questions had to be answered by 70 students who were taking the MPSI course. The results of the SPSS processing on this questionnaire illustrated the analysis of students' needs for the e-learning model. It needs analysis data used as a guide for the researcher to develop an adaptive e-learning model. Afterward, the researchers used the waterfall-type System Development Life Cycle (SDLC) model to develop an e-learning model. In addition, five stages must be passed in the waterfall, consisting of planning, analysis, design, implementation, and maintenance. The resulting e-learning application was tested on students to determine their response toward this application and assessment from the teacher.

This adaptive e-learning application is very beneficial for lecturers and students in the learning process. So far, lecturers have other alternatives besides the model they have applied in the teaching process. These models look separate from each other but connected in a unified system. This system will divide the percentage of lecture meetings between offline and online. This lecture meeting percentage distribution must be reflected in the semester learning plan (RPS). It is very beneficial for lecturers in preparing teaching materials to achieve the desired output.

Ethical considerations

This study was conducted on MPSI course students at STMIK Nurdin Hamzah. The head of the study program allowed the researcher to conduct a study toward MPSI teaching to change the position of the lecturer in teaching to be a good or better category. The changes category of student assessment toward lecturers from enough to good or better in the teaching process can provide lecturer's satisfaction. It will influence the teaching process and the students in understanding the teaching materials. This change, of course, must be fundamental from changes in teaching materials developed by lecturers. The teaching process is carried out conditionally where students cannot continue learning if they have not been able to understand the learning. This understanding was done by testing students through a list of questions tested on the lecture material.

Findings

This study found a needed analysis for e-learning design and website design for adaptive e-learning systems. It involved 70 students who were taking the ISPM/MPSI course. The results showed the following ten questions. Below are the results of the processed data on the e-learning needs analysis.

Table 1. *List of questions and answers*

| No	Questions	Answer YES	NO
1	Do you agree if STMIK Nurdin Hamzah provides an e-learning Website?	64	6
2	Do you agree if there are courses in the Information Systems department using e-learning?	67	3
3	Do you have any experience with e-learning?	16	54
4	Would you be happy to learn only to use textbooks and modules to understand the subjects?	18	52
5	Is the internet connection on your campus good??	23	47
6	Do you have a computer?	61	9
7	Is your computer quality adequate for learning via e-learning?	50	20
8	Do you follow learning training through e-learning?	67	3
9	Do you agree if the lecture on F2F is partially replaced with e-learning?	51	19
10	Do you need guidance to use an e-learning class?	68	2

Table 1 shows that students strongly agree that STMIK Nurdin Hamzah provides an e-learning website to complement the manual learning carried out by lecturers. It certainly supports the university motto as a university with the Truly IT School concept. The students also strongly agree that the information systems study program at STMIK Nurdin Hamzah uses the e-learning model. The students' desire to be able to undergo lectures through e-learning is based on their strong desire to experience this e-learning. It can be seen from the students' low experience in the e-learning process. Students should have had this experience because they studied at an IT-based university. Their disapproval with questions on learning based on textbooks and modules is also high because they cannot understand them well. In this case, there is an operational problem encountered to develop e-learning, such as the slow internet connection on campus. They must be immediately addressed by the institution so that their strong desire for the existence of a campus website and e-learning can be realized.

In terms of computers ownership, there are no high obstacles for students because generally, they have computers that can be connected to the Internet. Of course, it is an advantage for the campus to use the students' computers without creating a laboratory. With the computers they have, they can study everywhere and everytime since they do not have to be on campus. Lecturers are also greatly helped by the owner of the computer. They may soon be able to upload lecture materials that students can later access. The students' computers to support e-learning are also very supportive. Almost all students have high enough computer specifications to support e-learning.

The success of e-learning implementation is to complete the manual learning expected by students and training on the use of the created system. The students' interest to participate in this training is very high because they have never participated in e-learning training. It helps students participate in e-learning in effectiveness and efficiency later. Their desire to change the teaching from manual to online is very high. It must be responded to lecturers or institutions to provide facilities and infrastructure and facilitate lecturers to gain skills to

develop online learning content. In general, students also need a companion in online learning. It contradicts the principle of online learning itself, which is whenever and wherever. It shows that the independence of students for independent learning is still low. It is the biggest challenge for lecturers and institutions to motivate students to be able to learn more independently. From table 1, the graph of the analysis of e-learning needs for students on MPSI lecture is as follows:

Figure 1. *E-learning needs analysis*
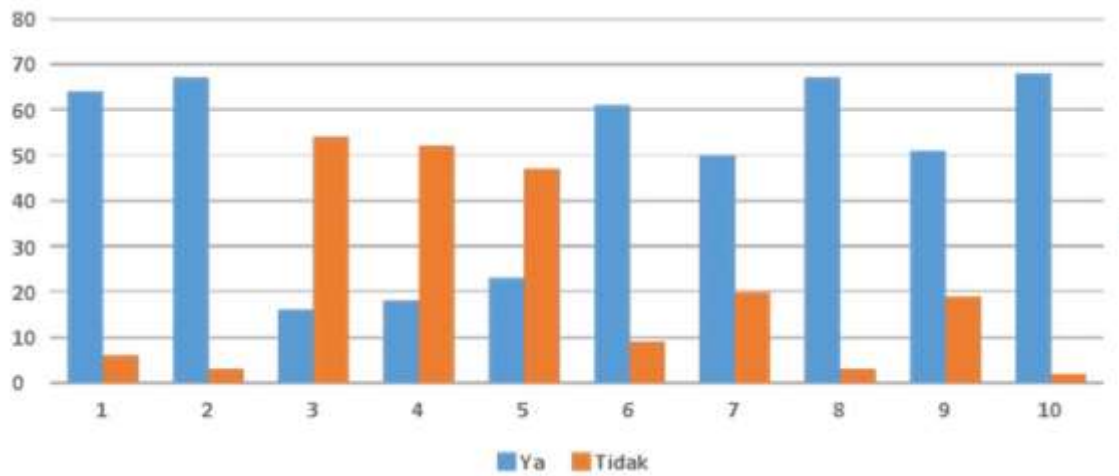
Note: "*Ya*" means "Yes" and "*Tidak*" means "No"

Figure 2. *Main course*

The dashboard of the e-learning website application designed shows the availability of homepage facilities, the MPSI materials submenu that contains materials for the students and can be downloaded, and a class-enhancing material submenu that consists of materials for the students to improve their understanding. This sub-menu contains student notes on lecture material that have not been understood yet, and this becomes the basis for lecturers to discuss the material in face-to-face meetings. The main menu is illustrated with a pre-class materials sub-menu containing material that will be discussed later in online lectures. Students can learn more about this material before entering the online class.

This e-learning application can also be accessed using an e-mobile/cellphone owned by students. The advantage of this application is students can access lectures whenever and wherever. To maintain the application sustainability, so it can always be accessed, it is necessary to have an admin role in maintaining and managing the website content, as shown in Figure 3. The responsibility of this website is really in the hands of an admin. In its operation, the admin has a username and password to access rights to the website. Only the admin can access the application to update information and lecture materials. The same applies to users of this application which is students who take MPSI courses, as shown in Figure 3. Students will get usernames and passwords to access rights to enter the application. It is also part of the protection from students who do not take the courses to access it. If the username and password are wrong, the students cannot enter the system. Then, if they can enter the system, they will be approved in advance by the course lecturer. If the course lecturer does not approve it, the student cannot follow the lecture.

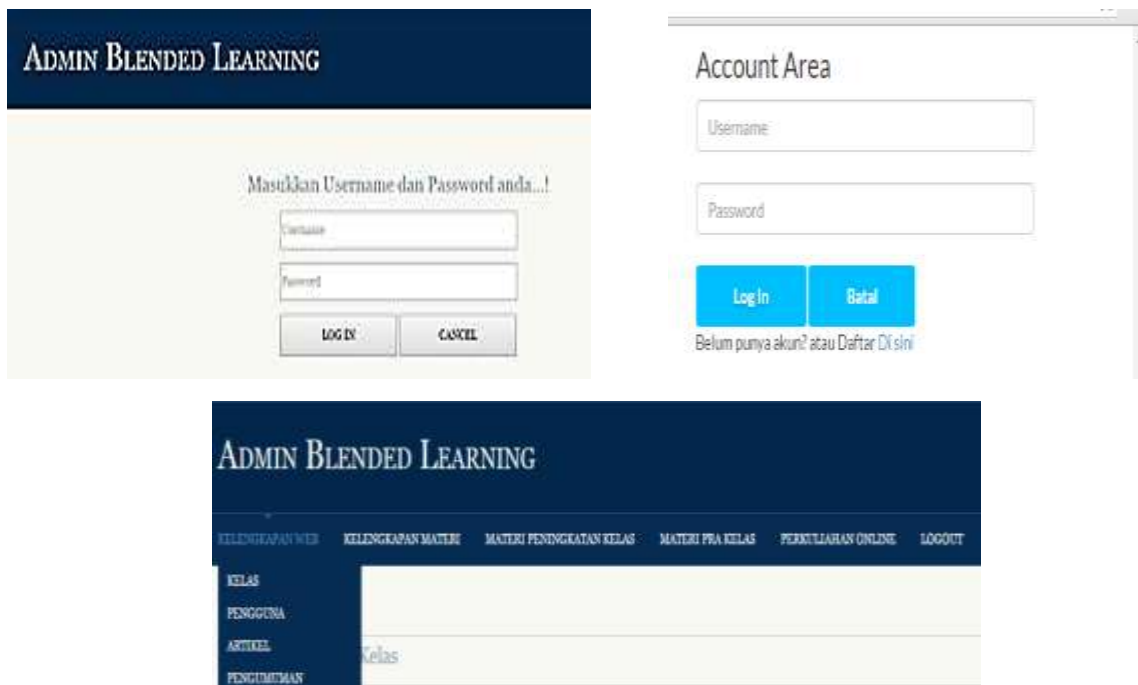**Figure 3**. *Admin, student, and content menu*

Figure 3 also shows the management that an admin will carry out. The task section of the back end is responsible for filling out the content materials. If it is not managed properly, it will result in invalid data obtained by the user. Therefore, a website will be frequently visited and used by users if the content on the website can provide the latest information. An admin does not have to be a lecturer. The most important thing is that he can operate a computer and understand the system. An admin is very crucial in a website. He becomes an essential person in the success of a website. An admin must always maintain the stability of a website, and it is his responsibility. Furthermore, he should not ignore even the slightest of the website is his responsibility.

Figure 4. *Interactive test menu (sample)*

In Figure 4, there is a submenu containing test content on the material taught by lecturers. If the students cannot answer the test, they cannot follow the following material. It is part of controlling the lecture material taught. The course lecturer will evaluate the students' results. The evaluation can be in answering questions by lecturers, both in essays and multiple choices.

### Test results of adaptive e-learning web practicalities

This learning website has been tested on students who took the MPSI course in a class. This test produces students' perceptions through the use of the e-learning website of the lecture, and the result of this perception data processed shown in Table 2 and Figure 5 as follows.

Table 2. *Students' practicalities value*

Statistics

		RESPONDEN	TX
N	Valid	30	30
	Missing	0	0
Mean		15,50	114,97
Median		15,50	116,50
Mode		1ª	105
Std. Deviation		8,803	11,288
Variance		77,500	127,413
Minimum		1	89
Maximum		30	137
Sum		465	3449

a. Multiple modes exist. The smallest value is shown

Figure 5. *The frequency distribution test data of responded practicalities*
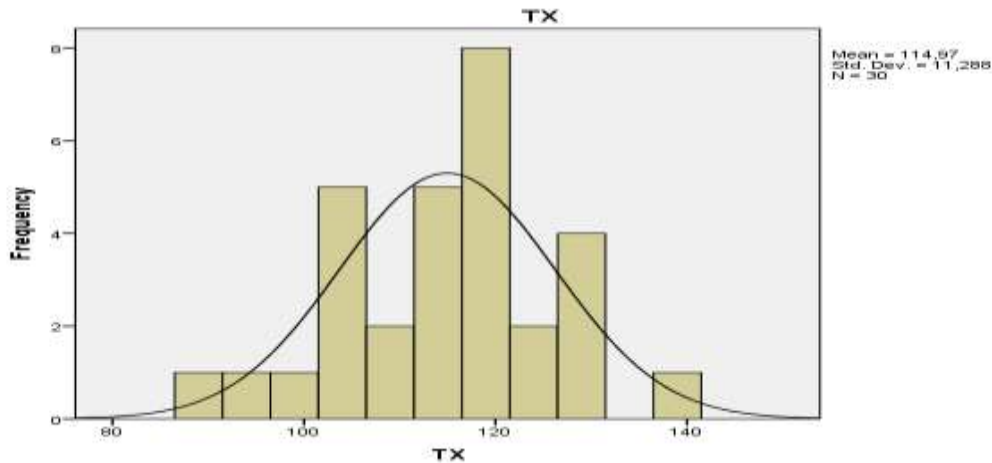
This trial shows that the response of the students to the adaptive e-learning can be seen through the degree of achievement as follows:

$$DP = \frac{\sum X}{n \; x \; \sum item \; x \; the \; highest \; scale} \; x \; 100\%$$

$$DP = (3449) \, / \, (4200) \; x \; 100$$

$$= 82.1\%$$

where:
DP = Degrees Achievement; Σx = Total score measurement results; π = number of samples / respondents; Σitem = Number of items instrument

Discussion

The graph of e-learning needs analysis above showed students desperately needed a model of e-learning as part of the conventional lectures conducted. The researcher in this study showed multiple design views as part of the design of the adaptive e-learning model. The learning model was tested on the students who took the MPSI course during the class. This test produced students' perceptions of e-learning websites in the lecture. The value of the practicalities and the testing distribution frequency showed this adaptive e-learning on the MPSI course obtained 137 as the highest value and 89 as the lowest value, with an average of 114.97.

Finally, it showed a mean value of 114.97, a median of 116.50, a standard deviation of 11.288, a minimum value of 89, a maximum value of 137, and the average value of 114.97, with the achievement of respondents to the implementation of *Blended Learning Model Web-Centric* on the MPSI course is 82.1% and categorized as good.

The adaptive e-learning application in the MPSI course as complementary to teaching is part of the blended learning model application. The results showed a significant change in students' responses to lecturers in the MPSI course. Students' assessment of lecturers in MPSI lectures done manually in the moderate category changes to good category. Of course, it could impact changes to another course. In addition, it showed a significant change from the face-to-face learning model that was carried out before by the lecturers. It is better if the positive response by the students to the adaptive e-learning teaching model developed must be socialized to other lecturers. Academics must be the facilitators of this change, so the vision and mission of the STMIK Nurdin Hamzah institution to become a university with the motto Truly IT School can be realized well.

Conclusion and Recommendations/Implications

To improve the quality of the learning process, it has produced a web of adaptive e-learning for the MPSI course, with the domain name BL-STMIKNH.COM. E-learning application designed to use applications, such as PHP, HTML, MySQL, Wondershare Quiz Creator. Meanwhile, the e-learning web is a learning model expected by students. As shown in the needs analysis, 91.4% agreed that the institutions provide e-learning websites for the lecture. Institutions are expected to provide adequate internet facilities to support the implementation of digital-based learning. Providing this large bandwidth capacity is the main thing in implementing e-learning. If the system is developed for all courses connected to the academic system, it will require high bandwidth. Other lecturers are also very responsive to what the researcher has done to MPSI lectures with this adaptive e-learning. They also want this application applied to the courses they teach. The application of this adaptive e-learning model can also become a project in the blended learning model development. This model can be a solution to the problems of the world of education today regarding the impact of the COVID-19 pandemic on the learning process from elementary school to university. The primary basis for this model application is the facilities and infrastructure, both the tools used and the adequate internet network facilities, as illustrated by the STMIK Nurdin Hamzah, which is less supportive in terms of bandwidth. Now, it has been resolved. During this pandemic, the institution has undergone online-based lectures.

Moreover, the students feel the practicality of the adaptive e-learning model designed that has met the expectations of students in the learning process. This model's success is due to carefully considering what has been suggested by some experts. The result of the achievement degree of the practicalities test showed the number ranged from 82,1%. It meant that BLWCC models had been able to meet the expectations of students towards MPSI learning, both in terms of constructivism, interactivity, *problem-based learning,* and learning styles in a good category. The results of this study had been submitted to the academic manager of STMIK Nurdin Hamzah before. This institution now has changed to Nurdin Hamzah University. This name is a merger of two institutions under the Dewi Nurdin Hamzah Foundation (YDNH), namely STMIK Nurdin Hamzah and STISIP Nurdin Hamzah. This merger occurred at the end of 2020 when STMIK Nurdin Hamzah became the Faculty of Computer Science (Filkom) with three study programs, namely Information Systems, Computer Engineering, and Information Technology. Meanwhile, STISIP Nurdin

Hamzah became the Faculty of Social and Political Sciences (Fisipol) with two study programs, namely the Government Science Study Program and the Government Communication Study Program. The results of this study have been conveyed to the academic side. Furthermore, the concept of this study has been adopted by Nurdin Hamzah University in developing online-based lectures to overcome the problems that happened during the Covid-19 pandemic. The adoption of the study concept has resulted in a learning media website that all lecturers can use. This application is now in its second year during the Covid-19 pandemic.

Disclosure statement

No potential conflict of interest was reported by the author.

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Biographical Note

DR. RISWAN is a lecturer at the Universitas Nurdin Hamzah, Jambi, Indonesia.