

Blended Learning Method Integrated with Bloom–Rederker–Guerra (B–R–G): Model to Enhance Self-Regulated Learner

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Abstract—The development of science and technology can be utilized to improve the quality of the learning process. Therefore, the teachers need to have a good understanding and ability to improve Technology, Pedagogy, Content, Knowledge (TPCK) to develop their professional skills. The effort to enhance the quality of learning can be conducted by combining conventional learning (face to face) with online learning (e-learning) which is currently known as Blended Learning (BL). Many types of research showed that BL is an effective learning innovation to improve the quality of learning. This study aimed to develop blended learning which is integrated with Bloom-Rederker-Guerra (B-R-G) mapping model on a valid and practical biology learning. The Bloom-Rederker-Guerra (B-R-G) mapping is used to represent learning objectives, classify learning activities, and propose alternative technologies that can be used in the implementation of blended learning. This development research was carried out by adopting the ADDIE model. The resulting product is a learning tool consisting of learning syllabus, lesson plans, student activity sheets, and a learning management system (LMS) which use Moodle as a tool. The result showed that the developed blended learning is valid. The teachers and learners also show a positive response to blended learning, as they believe that developed blended learning is practical. Thus, it is feasible to be implemented in the learning system as it can help to enhance self-regulated learner.

Keywords—self-regulated learner, blended learning, online learning, Bloom-Rederker-Guerra (B-R-G) mapping, moodle

I. INTRODUCTION

The success of learning is influenced by the ability of teachers in mastering learning materials, managing the learning activities, and integrating technology to support the learning process. Therefore, teachers should have an appropriate understanding of technological knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK) [1][2].

The ability of teachers in using appropriate media and learning resources is crucial to the success of the learning process. In addition to the knowledge of concepts, theories, ideas, and the framework as the knowledge of learning content, teachers also need pedagogical knowledge related to the way and the process of teaching, in this case, is the knowledge of managing classroom, task, learning planning,

and students' learning. Furthermore, the development of science and technology can be a way to improve the quality of learning. A good understanding needs to behave by the teacher of TPCK in order to develop their professional skills. Khoeler & Mishra [1] assume that teachers need to have the knowledge of technology, pedagogy, content, and knowledge (TPACK) to successfully integrate the use of technology in the teaching and learning process.

When teachers use strategies and methods to integrate technology in learning, the Internet can be a powerful tool in motivating learners to learn in order to create a good teaching process [3]. Research conducted by Zaid & Bahri [4] shows that high school students access the internet to seek information and complete tasks during the learning process. It is in line with a survey conducted in 2014, showing that the internet user is dominated by high school students, which means that the internet can support the education system. The utilization of the internet in distance learning is an example of how the internet can be used to support education [5].

Biology learning in high school has many difficulties due to the characteristics of the subject matter itself [6]. The main reasons of students' difficulties in learning biology are the nature of the topics, teachers' teaching styles, students' learning habits, negative feelings and attitudes toward the topics as well as the lack of resources [7]. Moreover, Zaid & Bahri [4] also found that high school students today do not have the ability to learn independently. Consequently, their intellectual competence is not developed. Student ability to learn independently should be developed in order to enhance their understanding as well as to make them more engaged during the learning process. Students can perform self-regulated learner not only when they are at school, but also when they are at home. Therefore, teachers also need to control the students' activities when they already at home. In this case, electronic learning (e-learning) can be used for this purpose. E-learning has been widely utilized in distance learning through the use of computer technology or the Internet, which connects teachers with students, but without the requirement to be online at the same time [8][9].

Blended learning is learning that combines conventional learning (face to face) with online learning (e-learning) so that the learning becomes more innovative. Blended learning combines conventional learning (face to face) with online learning (e-learning) which uses internet network in its application [10][11][12][13][5][14]. In line with the

results of research conducted by Chou & Chou [15], innovative learning can be created through three learning illustrations namely, face to face learning, online learning (e-learning), and blended learning. Fleck [16] explained that blended learning is learning in which the conventional teaching (face to face) is combined with online supporting activities.

Virtual learning environment (VLE) which is often used in the form of a learning management system (LMS) or course management system (CMS) is an effective and innovative media. Hodhod et al. [17] explained that the VLE in the form of LMS is a software package designed to help educators to create and deliver online subjects. Given the progress of technology, information, and communication, it shows the importance of technology integration in education. LMS that can be used to run online learning is moodled. Moodle was chosen because it can be used freely (open source). Furthermore, the use of social constructivism and problem-based learning during its development, as well as its support for collaborative learning environment has made moodle a convenient media to be used in implementing online learning [18].

El-Ghalayini and El-Khalili [19] designed the Bloom-Rederker-Guerra mapping (B-R-G) to develop blended learning from the objectives to the content of learning materials. Bloom's Taxonomy is used to represent the purpose of learning. Redeker taxonomy is used to classify components of learning activities, namely receptive dimensions, interactive dimensions, and collaborative dimensions. Meanwhile, the Guerra scale is used to classify media and learning technologies. The receptive dimension places learners as recipients of information conveyed through the burning medium. Interactive dimensions internally integrate learners in interaction with computers, which is known as computer-based technology (CBT) with the activities framework through simulation. Dimensions of cooperative learning require the learners' communicative activities such as brainstorming, debate, or problem-solving among group members [20][21][22][23].

This research will develop blended learning which utilizes LMS using Moodle to support online learning. The development is integrated with Bloom-Rederker-Guerra (B-R-G) mapping model which classify Bloom and Rederker taxonomy, then adjusted with the appropriate technology to be implemented in learning based on the Guerra Scale. The product of the development is a learning tool that consists of learning syllabus, lesson plan, student worksheet and moodle to support blended learning. Blended learning can improve the activity and self-regulated learner, can direct learners in developing their knowledge by providing various types of sources and learning media that can be used, and also can provide evaluation for the learners. Thus, it can promote student-centered learning.

II. RESEARCH METHOD

This study is a Research and Development (R and D) which is a development of Blended Learning methods integrated with Bloom-Rederker-Guerra (B-R-G) mapping model on human digestive system subject for Grade IX senior high school students by adopting development model of analyse, design, development, implementation, and evaluation (ADDIE). The development is conducted to test the validity and practicality level of blended learning. The

resulting product is a learning tool consisting of the syllabus, lesson plan, student worksheet, and LMS using Moodle. The product validity was tested by using a validation instrument which is rated by two experts.

Practicality test was conducted on a group of the sample which consists of a teacher and 38 students at Senior High School 3 Makassar, South Sulawesi, Indonesia. The data on product practicality was collected by using a teacher and students' response questionnaires which had been validated by the experts. The questionnaires were then distributed manually to the respondents. As the questionnaires used are a Likert scale questionnaire, the respondents need to put a checklist on the criteria of practicality that has been specified. The data then analyzed by using descriptive statistic analysis.

III. RESULT AND DISCUSSION

A. Result

The researchers conducted the initial data collection activities to find out the problems in the teaching and learning process that occurred in school. The steps in the analysis phase include: (1) performing needs analysis, (2) analyzing learners, (3) analyzing the content, (4) undertaking structural analysis, and (5) establishing the development goals as well as the learning objectives to be in accordance with the goals to be achieved.

1) Need Analysis

The analysis of high school students needs assessment showed that the students need to repeat their own lessons at home in order to develop a better understanding of the concepts that have been learned on the school. They need assessment an effective media and learning resources such as online learning which is currently acclaimed by the students. New innovations in the online learning process can help them to grow their self-regulated learning.

2) Analysis of Learners

Based on the analysis of need assessment, it is understood that the learners need to access the internet taking the task and look for the learning materials. The students prefer to search for lesson material over the internet compared to the book. However, the sources of reference from which they obtain information were irrelevant and unreliable.

3) Analysis of Content

Content analysis was conducted through a review of the material used in the development of blended learning which is integrated with the Bloom-Rederker-Guerra (B-R-G) mapping model on human digestive system subject concepts for the Grade XI high school students. The learning materials used refers to the 2013 Indonesian curriculum. Content analysis is conducted by examining existing materials which can be used to develop products, such as through the National Certification Bound package book, existing materials, survey results, as well as drawings, and then be adapted to the basic competencies of the implemented curriculum.

4) Analysis of Structure

Analysis of structure was aimed to analyze the structure of learning materials that will be included in the syllabus, lesson plan, student worksheet, and moodle tools in order to

implement blended learning. The analysis of structure was performed on the human digestive system concepts for the first semester of Grade XI senior high school students based on the 2013 Indonesian Curriculum.

5) Analysis of Objective

The objective analysis is the formulation of learning objectives based on Basic Competencies and Indicators. This analysis is the last stage of analysis and the main focus for achieving the development goals. This analysis includes an assessment of core competencies, basic competencies, learning indicators, and learning objectives.

6) Design Phase

The design stage is the arrangement of blended learning which is integrated with the researcher needs to make a good and detailed design plan to develop blended learning. At this stage, the product to be developed is designed carefully; then the product could be developed based on the previously made design.

7) Development Phase

The development stage was aimed to realize all the stages that have previously been conducted and to produce the blended learning as the end product. The developed Blended learning meet several criteria, namely: (1) meet the quality standards of learning components based on 2013 Indonesian curriculum, (2) contains a discussion which is based on the basic competence of human digestive system subjects concepts for Grade XI Senior High School students, including the function of human digestive system, human digestive organs, the structure of human digestive systems, human digestive processes, impaired function in human digestive system, dietary substances, and dietary tests based on 2013 curriculum, (3) produced as the result of literature review from university books, scientific books, high school biology books, research results and journals, internet and other reliable sources of knowledge, (4) equipped with available activities in Moodle, including forums, glossaries, wikis, assignments, quizzes, chat, and learning resources in the form of word files, PDFs, images, podcasts videos, and powerpoints.

The developed product is in the form of learning tools which consists of the syllabus, lesson plan, student worksheet, LMS in the form of moodle, as well as student and teacher response questionnaire which have been validated by experts. The result of data analysis on the learning tools validity is provided in Table 1.

TABLE I. VALIDATORS ASSESSMENT ON LEARNING TOOLS AND MOODLE

No.	Assessed Aspects	Average (V_a)	Validity Criteria
1.	Syllabus	4.23	Valid
2.	Lesson Plan	4.41	Highly Valid
3.	Students Work Sheet	4.3	Valid
4.	<i>Moodle</i>	4.27	Valid

The criteria set that the learning tools and Moodle have a good level of validity if the minimum validity level achieved is $3.5 \leq V_a \leq 4.5$.

Table 1 shows the mean validity values of the learning tools and Moodle, in which the syllabus is 4.23; lesson plan is 4.41; students worksheet is 4.3; dan *Moodle* is 4.27. The validity value obtained is in accordance with the validity

criteria of $3.5 \leq V_a \leq 4.5$, which means that the learning tools and Moodle are valid.

8) Implementation Phase

Implementation stage is a real step to apply valid blended learning integrated with B-R-G mapping. A product practicality test was conducted by the teachers as a practitioner validator by using a teacher response questionnaire and also a student response questionnaire. In this research, there is no effective test because the result of practicality test analysis of the teacher's and the students' response is enough to prove that the blended learning developed can be applied in the school.

TABLE II. TEACHER'S ASSESSMENT ON LEARNING TOOLS AND MOODLE PRACTICALITY

No.	Assessed Aspect	Total (x_i)	Percentage (%)	Practicality Criteria
1.	Syllabus	48	80	Very Practical
2.	Lesson Plan	52	80	Very Practical
3.	Student Work Sheet	21	84	Very Practical
4.	<i>Moodle</i>	160	80	Very Practical

Table 2 shows that the practicality percentage of the learning tools and Moodle which were developed for blended learning. The practicality percentage of the syllabus, lesson plan, student worksheet, and the model is 80%, 80%, 84%, and 80%, respectively. The practicality criteria of 80% - 100% mean that the developed learning tools and model are very practical. Thus, the products were not subjected to revision.

TABLE III. LEARNER'S ASSESSMENT ON LEARNING TOOLS AND MOODLE PRACTICALITY

Assessed Aspect	Total (x_i)	Percentage (%)	Practicality Criteria
<i>Moodle</i>	3437	75.37	Practical

Table 3 shows that the practicality percentage of which was developed for blended learning as assessed by the students. The obtained practicality percentage of moodle is 75.37%. The practicality criteria of 60% - 79% mean that the developed learning tools and model are practical.

9) Evaluation Phase

The evaluation is conducted to revise the developed product comprehensively, which is conducted after obtaining the result of validity, practicality, and effectiveness test of the product. However, the researchers have not carried out this evaluation phase due to time constraint.

B. Discussion

Characteristics of Bloom-Rederker-Guerra (B-R-G) as well as synchronous and asynchronous learning activities are illustrated in the developed learning objectives. This mapping was chosen because Bloom's taxonomy, the Rederker taxonomy, and the Guerra scale were specifically designed to develop blended learning so that teaching and learning activities could be more structured and systematic. The adopted Bloom's taxonomy in this study is Bloom's taxonomy revised by Anderson & Krathwohl [24], including

remember, understand, apply, analyze, evaluate, and create. Bloom's Taxonomy will classify the learning objectives for the achievement of basic competencies in the human digestive system concepts. Redeker Taxonomy [20] classify the activities of learners in their learning activities, such as receptive activities, in which learners consume information; interactive activities, in which learners interact with the learning object, in this case, are learning sources and learning media; and collaborative activities, in which learners do communicative activities with their peers. Guerra scale is outlining various activities, media and online learning resources that can be used in order that the developed blended learning can enhance the quality of teaching and learning process.

In line with the results of research conducted by El-Ghalayini and El-Khalili [19], adopting e-learning does not guarantee the improvement in learning. This is because the mixing of technology and content does not always result in effective learning. The systematic design process for developing blended learning for all levels of education is based on instructional design theories and utilizing Bloom's taxonomy, Redeker taxonomy and the Guerra scale. A mapping model is proposed and embedded in the designing process to develop blended learning starting from the objectives and the content of the subjects. Through the analysis and design phase, could be produced an initial product design which is suitable with the needs of teachers and learners in the expected learning.

The learning tools and moodle were designed and developed based on constructivist learning principals who are a characteristic of blended learning. Learners can construct their own knowledge and skills, either through individual or group working. Online learning (e-learning) that is run by using Moodle requires learners to do activities to complete their own tasks as well as group tasks. In line with a study result conducted by Kubiack [25], learners working in a cooperative learning situation will be encouraged to work together on a joint task, and they must coordinate their efforts to complete the task, learners will also depend on each other to achieve a common appreciation

Learning management system (LMS) which is used for online learning is a modular object-oriented dynamic learning environment (Moodle). The moodle which is developed in this research can be used as a source of learning from which the learners can have access to download the learning materials as well as the learning media. Thus, allowing learners to conduct independent learning anytime and anywhere. The positive advantages of various media are needed to achieve optimal learning [26].

Moodle is used as a media which provides various learning resources and features that enable online learning activities (e-learning). Moodle was chosen in this study because it can be used freely (open source), it used the constructivist and problem-based learning approach during its development, and it supports the collaborative learning environment. According to Dougiamas [18], moodle is based on social constructionism philosophy, which is an efficient way to enable all learning activities to occur between large groups. A teacher with expertise in using Moodle can create an extraordinarily rich and interesting learning environment by utilizing all the technological, information, and communication facilities.

The moodle which was developed for online learning to support the application of blended learning is practical. The practicality of the learning tools and moodle means that the developed blended learning can be applied in the learning system. In line with the research conducted by Margolis et al. [27], the practicality of blended learning provides benefits, such as providing the learners with guidance in problem-solving activities, ensuring all learners are at the same level of knowledge before starting the learning activities, reviewing the subject matter at an increasing frequency (i.e., reviewing the material in unspecified days), providing course material in various ways and formats, applying material to practical and real-world situations, and increasing the flexibility of learners with their schedules. In addition, the self-regulated learners to learn is higher than before. This is demonstrated by the enthusiasm and curiosity of learners through online learning. The utilization of the Internet as a medium of learning encouraged the learners to learn independently.

Learners recognize that online learning helps them in the learning process and in obtaining more effective information. Research conducted by Eryilmaz [28] showed a significant difference between the views of 110 learners in relation to blended learning, online learning, and face-to-face learning environment, in which they can learn more effectively in a blended learning environment. Vernadakis et al. [29] conducted a study to determine the impact of face to face and blended learning on students' learning achievement. The results showed a statistically significant difference in students' achievement. Based on these findings, blended learning emerged as alternative teaching that should be applied by teachers to help students improve their performance.

Learners are motivated and very enthusiastic about receiving learning materials in the classroom. When utilizing online learning, they feel facilitated with ease of access in the implementation of blended learning. Tao et al. [13] stated that learners support the learning through blended learning. A study conducted by Wright [30] on 112 learners generally showed more learners were engaged in a classroom learning environment with higher motivation and interest, as they could better understand the learning materials, and could appreciate the interaction between teachers and their classmates. The learners choose online lessons because of the speed, convenience of learning, and the flexibility of time and place. The implementation of effective online learning can improve the quality of the learning process, but should not reduce the value of face-to-face instruction with teachers.

Students activities in learning show a positive attitude. The results of research conducted by Ajide & Tik [31] showed that learners were more active in the blended learning process, as they have a good perception of concepts. This means that blended learning is very effective in achieving learning objectives. The group of students who learned through blended learning felt increased of comprehension far greater than when accepting learning in the classroom [32]. Research conducted by Yapici & Akbayin [5], showed a very positive view of the learners during the learning process through blended learning. Learners viewed blended learning could provide various opportunities to prepare before receiving lessons, to review the lessons as many times as desired, to achieve a subject

related material without depending on time and place, to do self-assessment, and to communicate with teachers and other learners.

Blended learning is not only about matching the learning content with the most appropriate media, but also about using the learning objectives and assessment techniques in determining the best method for each goal, using a model for guidance / learning in order to provide an opportunity for learners to master learning objectives using a particular technology. In addition, the learning activities can become more collaborative with blended learning [33].

This research is in line with the results of research conducted by Koehler & Mishra [1], it is asserted that the development of technology, pedagogy, and content knowledge by teachers is essential for effective teaching. In this case, the content, pedagogical, and technological knowledge are equally important. Thus, the teachers should have an appropriate ability of technology, pedagogy, and content knowledge (TPCK).

IV. CONCLUSION

The development of blended-learning integrated with Bloom-Rederker-Guerra (B-R-G) mapping model on human digestive system concepts for Grade XI senior high school students is valid and practical. The data analysis on the validity score of learning tools, including syllabus, lesson plan, and student worksheet, as well as moodle showed an average validity value of $3.5 \leq V_a < 4.5$, which is categorized as "valid." The data analysis on the average practicality score based on teacher's responses questionnaire showed that the developed products have an 80% - 100% practicality degree, which is categorized as "very practical." The analysis of the average data of practicality score from the students' response questionnaire showed that the developed products have a 66% - 79% practicality degree, which is categorized as "practical."

It is expected that the learning tools produced in the form of a syllabus, lesson plan, and students worksheet, can be used as one of the learning supports in school, especially in the human digestive system concepts of biology subject. The developed moodle can also be used as one of the learning resources and as an independent learning media for learners that can be used anywhere and anytime to support the learning process through blended learning. The results of this study can be applied in teaching and learning process at school. Furthermore, the development of blended learning which is integrated with Bloom-Rederker-Guerra (B-R-G) mapping model can also be conducted on different learning materials.

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