



Blended Learning Integrated with Innovative Learning Strategy to Improve Self-Regulated Learning

Arsad Bahri

Dr., S.Pd, M.Pd, Universitas Negeri Makassar, Indonesia, arsad.bahri@unm.ac.id

Irma Suryani Idris

Dr., M.Kes., Sp.K.K., Universitas Negeri Makassar, Indonesia, irmaidris@unm.ac.id

Hasmunarti Muis

S.Pd, M.Pd, SMA Negeri 6 Maros, Indonesia, hasmunartimuis@gmail.com

Muh. Arifuddin

Graduate Student, Universitas Negeri Makassar, Indonesia,
arifuddinmuh432@gmail.com

Muh. Jibrannidhal Fikri

Graduate Student, Universitas Negeri Makassar, Indonesia,
muhjibrannidhal@gmail.com

Technological, Pedagogical, and Content Knowledge (TPACK) is a teaching framework to integrate technology in teaching. Integrating technology into the curriculum becomes an inseparable part of the best teaching practice. This study aims to produce learning tools on blended learning integrated with the PBLRQA strategy in the form of the lesson plan, evaluation sheets, and moodle-based e-learning media that are valid, practical, and effective in Animal Physiology courses. PBLRQA is an innovative learning strategy integrated between Problem-based Learning (PBL) with reading questioning answering (RQA). This study was Research and Development (R & D) using ADDIE development models (analyze, design, development, implementation, and evaluation). The validity of the product was measured using an expert validation sheet, the practicality of the product was measured using a lecturer and student response questionnaire, and the effectiveness of the product was measured using a student learning independence questionnaire. Based on the results of the study it could be concluded that the lesson plan, evaluation sheets, and moodle-based e-learning were valid, practical and effective in increasing the self-regulated learning of students. It proved that the lesson plan, evaluation sheets, and moodle-based e-learning media that integrate PBLRQA strategies are appropriate to use.

Keywords: blended learning, problem-based learning, reading questioning answering, flip classroom, self-regulated learning

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INTRODUCTION

Technological, Pedagogical, and Content Knowledge (TPACK) is a framework for designing new learning models by integrating technology in the learning process. There is a strong global trend towards utilizing learning management systems (LMS) in academic institutions as part of the education management system to enhance teaching and experience in the higher education (Aldiab, et. al. 2019). Integrating technology into the curriculum becomes an inseparable part of good teaching (Mills, 2006). One example of the application of technology in learning is the idea offered by NACOL (North American Council for Online Learning), which is a mixed learning model or blended learning. In this model, learning is not only focussed on face-to-face activities in the classroom, but also uses web-based technology (online learning) to support learning activities in the classroom. Blended learning combines conventional learning (face to face) with online learning (e-learning) that uses the internet in its application (Chaeruman, 2011; Sharma, 2010; Tao, et. al., 2011; Liu, et. al., 2016; Ghanem and Hamayil, 2011).

Blended learning has a basic framework of concept development based on constructivist learning perspectives that provide experience with investigations that ensure concepts are built and assimilated deeply and meaningfully (Garrison & Vaughan, 2008). The results of meta-analysis from several studies on blended learning (Vaughan, 2007; Kim & Bateman, 2010; Shroff, & Deneen, 2011; Rosenthal & Weitz, 2012; Kirna, 2013) have confirmed the effectiveness of this technology-assisted learning. Blended learning is more effective in improving learning outcomes than online and face-to-face learning that is done separately (Means, et al., 2014). At present and in the future blended learning can be an alternative solution and technology for use in the lecture process, including the Biological course i.e. Animal Physiology course.

The Animal Physiology course has various concepts relating to the processes that occur in the animal's body and the interrelationships between systems that form a unified system on animals. The scope of study material is complex, not supported by the number of effective hours of lectures which are only 100 minutes per meeting, during fourteen lectures in one semester causing the lecturers difficulty in explaining lecture material in detail to students. In addition to examining the characteristics of the subject matter material in Animal Physiology, to understand the physiology process is not only enough to get an explanation from the lecturer but also could be visualized through the media in the form of video. Students must also be active in finding information related to lecture material through reading activities. In addition, supporting facilities for the application of blended learning are very adequate, because most of students have already owned laptops or smartphones. To optimize the potential of blended learning in increasing learner learning independence, it is necessary to integrate appropriate learning strategies in both online and face-to-face lectures. One of the strategies that was considered appropriate to increase self-regulated learning of students is the PBLRQA (Problem-Based Learning and Reading, Questioning & Answering) strategy.

Bahri & Idris (2018) research results show that the PBLRQA strategy that integrates PBL and RQA complement each other and optimize the potential of both in empowering

the self-regulated learning of students. The PBL and RQA syntax in PBLRQA has the same goal of developing self-directed learning so that students can be responsible for organizing and controlling their learning process (self-regulated). Self-regulated learning was essential for academic success; therefore supporting, to improve and maintain self-regulated learning skills was important (Vanslambrouck, et al., 2019). Self-regulated learning was an important variable for success, especially in blended education (Vanslambrouck, et al., 2019). According to Corebima (2009), self-regulated learning could be empowered or trained through certain strategies or efforts.

METHODS

This study was a Research and Development (R&D) that aimed to produce learning tools in the form of the lesson plan, evaluation sheets, and *moodle* based e-learning media (<https://fiswanbiounm.com>) that are valid, practical, and effective in the Animal Physiology course. This development research procedure referred to the ADDIE development model (Grafinger, 1988) which includes the stages of analysis, design, development, implementation, and evaluation.

Sample and Sampling Technique

The population of this study were all the 4th-semester students majoring Biology Teaching in Biology Department, The Faculty of Mathematics and Natural Sciences, State University of Makassar, Indonesia who took Animal Physiology courses as many as 67 students. The samples in this study were 20 students. The sampling technique used in this study was randomized sampling for limited testing of products.

The Research Instrument, Validity, and Reliability

The instruments used in this research were observation sheets, interview sheets, validation assessment sheets, product practicality assessment sheets, and effectiveness tests. The observation was carried out on 67 students as the population of this research by using observation sheets. Observation sheets were used to find out the learning difficulties experienced by students in the lecture process and how their responses, interests and experiences in using interactive media such as laptops and smartphones. Interview sheets are used to obtain data on the needs of three Animal Physiology lecturers in the lecture process as well as problems that often occur in lecture activities. Validation assessment sheets were used to obtain product validity data according to two experts. The assessment sheet in the form of a product practicality questionnaire was used to obtain product practicality data according to 20 students and three lecturers of Animal Physiology course in the limited testing. The self-regulated learning questionnaire was adapted from MAI (Schraw & Dennison, 1994) and SEMLI-S (Thomas, et al, 2008) was used to obtain product effectiveness data in improving self-regulated learning of students. The indicators of this questionnaire were: 1) choose own learning activity, 2) effort to gain success, 3) initiative ability, 4) self-controlling, and 5) confidence. All instruments were valid and reliable before use. The original questionnaire was 34 items and the researches made change on the instruments by reducing as much as 4 items questionnaire to 30 valid and reliable items.

Research Procedure

The stages include: 1) needs analysis included student analysis, content analysis, structure analysis, and set development goals and learning objectives to align with the objectives to be achieved, 2) making a design of learning tools in the form of the lesson plan, evaluation sheets, moodle design for online learning, learning independence questionnaire, lecturer response questionnaire and student responses, and research instrument design in the form of validation instruments of the lesson plan, validation instruments of evaluation sheet, validation instruments of moodle-based e-learning, and validation instruments of the questionnaire, 3) developing the learning tools (lesson plan and evaluation sheets) and moodle-based e-learning, and research instruments, 4) implementing the validated products for practicality tests through lecturer and students responses, and 5) evaluating products to obtain conclusions or a process for revising the entire product of integrated blended learning with PBLRQA strategy in Animal Physiology course, which is carried out after seeing validity test results and practicality of products.

Data Analysis

The data were collected in the form of quantitative data, and analyzed descriptively, equipped with triangulation of methods and data sources. Data analysis included: 1) The validity data of the products produced are analyzed and adjusted to the validity category according to Hobri (2010), i.e. strongly valid (4.6 to 5), valid (3.6 to 4.5), less valid (2.6 to 3.5), invalid (1.6 to 2.5), and strongly invalid (less than 1.6). 2) Practicality data of the product produced in the form of questionnaire data responses of lecturers and students who were analyzed quantitatively (percentage). The analysis to calculate the percentage of lecturer and student responses positively was adapted from Arikunto (2009), which is very practical (84 %-100%), practical (68%-83%), quite practical (52%-67%), less practical (36%-51%), and impractical (less than 35%). Blended learning can be declared practical if the response of lecturers and students reached a minimum of 68% or is in the practical category. The data effectiveness of the product developed was analyzed by quantitative descriptive analysis using N-gain. The normalized gain rule (N-gain) was developed by (Hake, 1999) namely the N score gain ≤ 0.30 in the low increase category, $0.30 < \text{N gain} \leq 0.70$ in the medium increase category, and $0.70 < \text{N gain} \leq 1.00$ height increase category.

FINDINGS

Analysis

Researcher collected information in the field through initial observation, distribution of questionnaires and interviews with lecturers and distribution of questionnaires to students. The needs analysis was done to gather information related to the needs of students and the needs of lecturers in the lecture process.

Based on the observation, it was found that the current problems that often occur in the lecture process are students having difficulty in taking important ideas and remembering the material. It caused by the characteristics of Animal Physiology material are quite

complex and contain many abstract concepts and involves a variety of organ system work mechanisms that require high imagination and reasoning abilities. In fact, the restricted time allotment in the lecture process becomes an obstacle for lecturers to explain lecture material in detail to students so that they often provide additional homework at home to learn independently to enhance their understanding on the material. Therefore, a new innovation are needed in the lecture process to facilitate the students learning needs in Animal Physiology course so that the goals of lectures can be achieved.

Based on an analysis of the students' needs in Biology Department especially for 67 students of fourth semester who took Animal Physiology course, the aspects needed are presented in Table 1

Table 1
The result of needs analysis

Aspect	Number of Students	Percentage (%)
Need a variety of media and learning resources	60	89.55
Need an enrichment of lecture material at home	63	94.03
Need an innovation in learning	63	94.03
Want to try online learning	52	77.61

Analysis of students was done based on the results of interviews with lecturers and the questionnaires distributed to the students. The results of student analysis are presented in Table 2.

Table 2
The result of student analysis

Aspect	Number of Students	Percentage (%)
Students have <i>smartphone</i>	64	95.52
Students have a laptop	63	94.03
Students have wifi at home	22	32.84
Using data cellular	63	94.02
Adept at operating a laptop	53	79.10
Access internet to do the assignments	64	95.52
Access internet to browse the course material	60	89.55

Material content analysis was done by reviewing the material of Animal Physiology course. The result of content analysis in Animal Physiology courses consisted of Animal Physiology and Homeostasis Concept, Nervous System, Sensory System, Hormone System, Motion System, Respiration System, Excretion System, Digestive System, Reproduction System, Circulation System, Osmoregulation, and Thermoregulation.

The development of blended learning can ease the lecturers to carry out lectures and can optimize the learning process outside of face-to-face lecture so that students can learn without being limited by space and time while still connected to the internet connection.

Design

The design was used to guide the development implementation to be more structured can be seen in Table 3.

Table 3

Development Design

Development Design	
Name of Design	Blended Learning integrated with PBLRQA strategy in Animal Physiology courses
Design Sponsor	Indonesian Ministry of Research, Technology, and Higher Education
Customer Need	Innovative media and learning resource that can facilitates independent and collaborative learning
Reason of Design	The integration of blended learning with PBLRQA strategy has not been implemented in the Animal Physiology course.
Expected Result	Blended Learning integrated with PBLRQA strategy is valid, practical, and effective
Customer	The fourth semester students at Department of Biology, Faculty of mathematics and Natural Sciences, The State University of Makassar
Design Aim	Producing the valid, practical and effective lesson plan, evaluation sheet, and moodle-based e-learning as an innovative learning resource and media that giving a chance for students to learn independently and collaboratively.
Knowledge, skills, and abilities of customer	Students have knowledge, skills and abilities in operating computers so that students have no difficulty in using moodle when learning online.
Feedback	Lecturers can implement learning tools that support blended learning. Students can learn independently, collaboratively and effectively to build their own knowledge.
Time limit	3 months
Design benefit	Build students' independent learning abilities. In addition, the design results are made to develop existing learning resources to be more innovative. And make it easier for lecturers to implement blended learning that refers to the learning tools that have been made.

The form of the lesson plan used refers to the form of the lesson plan that were applied at the State University of Makassar including the components of identity, learning outcomes (knowledge, skills, and attitudes), expected end ability, learning material, learning activities, time allotment, students' learning experience, assessment criteria and indicators, and scoring and weighting criteria. The e-learning design format using moodle is shown in Table 4.

Table 4
A design of moodle-based *e-learning*

Component of E-learning	Sub component of E-learning
Homepage (log in page)	name of e-learning site, log in of account, & information of e-learning
Main page (Dashboard)	name of e-learning site, lesson plan, special summary, online visitors, setting, search, calendar, site home, site page, & course page
Site home	learning resources & learning activities
Site page	class member, blog sites, plan sites, notes, search, calender, & administration
Course page	online member, quiz, & score

Development

At this stage, the products developed are learning tools (lesson plan and evaluation sheets) and moodle-based e-learning. The moodle-based e-learning developed, can be accessed via <http://fiswanbiounm.com>. The results of developing moodle-based e-learning can be seen on (1) the front page (login page), (2) the main page (dashboard), and (3) the course page. The course feature provides 12 meetings in the learning process. Every moodle-based online learning meeting is provided with learning resources and learning activities. The forms of learning resources are available are in the form of *word* and *pdf document*. format. Also equipped with a video and url. Each meeting also features a discussion forum, chat, assignments and quizzes at the end of online learning. Learning activities in moodle-based e-learning in the form of multiple choice and essays questions that will be completed by students in accordance with the specified time. The features provided in e-learning are features that will be adjusted to fulfill the needs of lecturers and students in the learning process. Display e-learning can be accessed through <http://fiswanbiounm.com>.

The products developed were validated by an expert. Results of expert validation on learning tools and moodle-based e-learning. Validation was carried out by reviewing the product of development results in the form of the lesson plan, evaluation sheets, and moodle based e-learning and its validation instruments. The validity of the lesson plan was analyzed based on the results of the validation by two expert validators can be seen in Table 5. Table 5 shows the average score on all aspect of validation of the lesson plan were strongly valid.

Table 5

The result of validation of the lesson plan

Aspect	Average Score	Category
The identity of the lesson plan	5	strongly valid
Learning achievement competencies include attitudes, knowledge and skills	5	strongly valid
The final competency that is expected to be owned by students	5	strongly valid
Development of course material	4.70	strongly valid
Development of learning activities	4.63	strongly valid
Learning experiences for students are formulated in accordance with the characteristics of students and formulated in operational verbs that can be measured and observed as a reference for assessment	5	strongly valid
The assessment is based on certain criteria and indicators	5	strongly valid
Time Allocation	4.75	strongly valid
Can be used as a reference in the preparation of student worksheets and research instruments	5	strongly valid
Average	4.89	strongly valid

The assessment of moodle-based e-learning is carried out by two expert validators by filling in the assessment sheets. The results of the assessment of the two expert validators are described in Table 6. Table 6 shows that the average scores of validation of e-learning strongly valid.

Table 6

The result of validation of *e-learning*

Aspect	Average score	Category
Learning display	5	strongly valid
Content eligibility	4.25	valid
Concepts organization concepts	4.50	strongly valid
Design	4.30	valid
Steps of learning activities	4.75	strongly valid
The constructivist paradigm	4.60	strongly valid
Language	4.50	strongly valid
Average	4.56	strongly valid

Analysis of the results of the validation of the two expert validators on the evaluation sheet is shown in Table 7. Table 7 shows that the average scores of validations of the evaluation sheet is strongly valid.

Table 7
The result of validation of evaluation sheet

Aspect	Score	Category
Material content	4.75	strongly valid
Rubric	4.75	strongly valid
Construct	5	strongly valid
Language	4.5	strongly valid
Average	4.75	strongly valid

Analysis of the results of the validation of the two expert validators on the self-regulated learning questionnaire is shown in Table 8. Table 8 shows that the average scores of validation of self-regulated learning questionnaire is strongly valid.

Tabel 8
The result of validation of self-regulated learning questionnaire

Aspect	Score	Category
Instruction	5	strongly valid
Questionnaire component coverage	4.50	strongly valid
Language	4.50	strongly valid
Average	4.67	strongly valid

Implementation

The implementation process was carried out after the development process was completed. At this phase, includes practicality tests of products that have been previously validated at the development phase. Practicality test was conducted by 3 lecturers through lecturer response questionnaire. Furthermore, a practicality test was also conducted by analyzing the response data of 20 students through the questionnaire. The questionnaire for practicality testing consisting of lecturer responses and student responses were valid and reliable. The practicality test results of moodle-based e-learning were assessed by the lecturer and can be seen in Table 9.

Table 9
The result of lecturer responses toward *e-learning*

Aspect	Responses Percentage (%)	Practical Category
Learning display	91.11	very practical
Content feasibility	78.09	practical
Display	88.89	very practical
Operation	90.67	very practical
Language	86.67	very practical
Software engineering	91.67	very practical
Average	87.85	very practical

The results of practicality test of the moodle-based e-learning conducted by fourth semester students who took Animal Physiology course in Biology Department, Faculty of Mathematics and Natural Sciences, the State University of Makassar are shown in Table 10.

Table 10

The result of students responses toward *e-learning*

Aspect	Responses Percentage (%)	Practical Category
Material relevance	89.20	very practical
Display	88.00	very practical
Operation	68.80	practical
Constructivistic paradigm	81.80	practical
Language	86.67	very practical
Average	82.89	practical

Based on the analysis of the lecturers' responses and the students' responses, it shows that the moodle-based e-learning product developed for blended learning is very practical and did not need to be revised.

Evaluation

This stage was a limited testing phase of using product development to test the effectiveness of the product. The research instruments were the self-regulated learning questionnaire. The results of the effectiveness test can be seen in Table 11.

Table 11

The result of the effectiveness of product

N-gain category	Percentage
Height increase	65%
Medium increase	25%
Low increase	10 %
Total	100 %

DISCUSSION

This developmental research had produced a product in the form of learning tools (lesson plan and evaluation sheets), moodle-based e-learning to support blended learning, and self-regulated learning questionnaire that have met the validity criteria. If all aspects of the assessment have reached the validity criteria, then the media developed was declared suitable for use (Hala, 2015).

The development of learning tools was carried out by integrating the PBLRQA strategy adopted in this study and producing blended learning with teaching activities that are more structured and systematic. The PBLRQA strategy adopted in this study has a syntax that aimed to develop self-directed learning so that students can be responsible for organizing and controlling their learning process. In addition, this strategy helps students to become independent and self-regulated learners.

The PBLRQA learning syntax that was developed shows that student activity begins with reading several resources, then students think about the problems found and then write them in the list of questions. Furthermore, students will discuss the tasks that have been made to clarify the answers or solutions that are unclear. The end of learning was self-assessing made by each student to monitor the thought process and learning outcomes (Bahri, 2017). During PBLRQA, students are trained to learn independently,

filter out irrelevant information while focusing on more important things, teamwork, solving and learning to apply the concept of a problem. This helps students gain more information and make them responsible for their learning.

E-learning developed for online learning is a moodle-based e-learning that can be accessed through <http://fiswanbiounm.com>. In the e-learning there is a combination of text, images, videos, animations, as a learning resource for students in Animal Physiology course and various activities such as quizzes, chat, glossary and discussion forums that can motivate the students to be more active. The diversity of learning resources and activities undertaken by students can help the learning process running innovatively. In line with the results of research conducted by Chou & Chou (2011) that innovative learning could be created through three images of learning namely, face-to-face learning, online learning (e-learning), and mixed learning (blended learning).

The results of the questionnaire showed that the lecturers and students gave a positive response to the learning tools and e-learning. According to Nedeva (2005), a very good response mean that students or lecturers support its use, and the students were motivated to attend lectures using e-learning.

The data also showed that some students feel free to choose their own learning activities and could increase their self-controlling by using blended learning. This is in line with the finding of Strambi & Bauvet (2003) and Schraw (2007) found that students could control learning activities independently. Students assumed that they could control their learning by themselves through direct feedback from the e-learning and also feedback from the lecturer on the face to face learning. Students had more opportunities to interact, get direct feedback so that they could improve their learning and performance independently. Blended learning also promote collaborative activities and interactions between students through assignments inside or outside the classroom (Tan et al, 2005), and increase interdisciplinary or independence students can interact actively in the learning process. Blended learning represents clear advantages for creating learning experiences that provide the right learning at the right time for each student. Stacey & Gerbic (2008) stated that it could make students be more communicative.

The results of the students' questionnaire in this study also showed that by using blended learning, the students had some effort to succeed in their learning and it could make students more motivated in learning. Study of Schmidt (2007), and Bart & Baurke (2010) supported this statement that students could increase their motivation and success in learning. It means that students' learning outcomes were higher than conventional learning. Alsalhi et al., (2019) stated that blended learning as a new learning strategy that combines traditional learning in various forms and e-learning in various models, it could increase student motivation and learning achievement. Adult students in a blended learning environment tend to be efficient enough to organize their own learning (Vanslambrouck, et al., 2019). Andragogic principles of self-directed learning, life-oriented that were more relevant to each other's experiences, and intrinsic motivation to learn something that was personally relevant was greatly facilitated through the blended learning (Cocquyt, et. Al. 2019). Blended learning has the potential to enhance learning, but there are also challenges especially in responding to the complexity of the two

learning environments. Further research is needed to identify several factors that can determine the success of blended learning.

Integrating the PBLRQA strategy in this blended learning environment can improve learning independence not apart from the PBL stages in the PBLRQA strategy. Through the PBL phase, students are confronted with an ill-structured real-world problem, so students try to make the problem become well-structured. Students will formulate several possible hypotheses and solve them based on information from reading various literature. Learner activities in PBL involved training in self-directed learning (Downing, et al., 2009; and Corebima, 2010). The activities of students in PBL steps were the benchmark if there is metacognition in PBL. In addition, PBL enhanced self-regulation and facilitated the thinking and learning processes. Sungur & Tekkaya (2006) mentioned that through PBL, students were proficient in process skills and problem-solving skills as well as independent learning skills.

Optimization the empowerment of the self-regulated of students in the PBLRQA strategy is also inseparable from the RQA stage. This is in line with the results of Hasanuddin (2013) that the RQA capable to enhance self-regulated learning of students. Corebima (2010) stated that at RQA strategy, students must first carefully read the material and then arrange questions that contain problems. From reading activities, students can do self-assessing, where students will understand what is known from the reading activities that have been carried out. Sumampouw (2019) argued that making questions had two stages, the accepting stage and the challenging stage. When reading information about the situation, at that time a metacognitive step will be carried out, that is the process of receiving, while the challenging stage is indicated when gathering questions. The reception process makes it possible to place information on a network of metacognitive structures while a challenging process can allow existing networks to have stronger relationships.

The stages of raising problems in the form of questions in the PBLRQA strategy are part of empowering self-regulated learning of students. Questions are triggers for students' thought processes. Corebima (2010) explained that an alternative to improve students' thinking skills was to ask questions that can spur thought processes. Schraw & Moshman (1995) and Slavin (2000) found that the questioning strategy had an effect to empower self-regulated learning of students. The interaction between strategy and academic achievement influences metacognitive skills. This is due to the PBLRQA stage where the process of discussing and debating with each other, as a result student become accustomed to thinking (Bahri, et al. 2019).

The last step of the PBLRQA strategy is making summarize the results of reading and discussion. This kind of learning activity shows a self-regulated learning pattern. This is in line with the statement that summarizing was one of the learning strategies that could empower learners' metacognitive skills (Corebima, 2010). The self-regulated learning patterns will be reflected when students have discussions to get clarification. From the discussion activities students can find out the learning and what they have not known yet. With this activity, students would be able to develop into independent learners

(Bahri, et al., 2019). This potential is believed to be even greater because the summarizing task is carried out at the end of PBLRQA learning.

PBLRQA learning that shows the pattern of training on self-regulated learning has been proven. The findings of this study are consistent with the results of Kuiper's (2002) study that used metacognitive self-regulated learning strategies to help students improve their metacognitive skills. Thus, the PBLRQA stage helps students to develop thinking skills and make students self-regulated learners. Self-regulated learning contributed to the development of metacognitive insights and strengthens the application of metacognition in the context of clinical reasoning (Chen, et al. 2019). In line with the research of Bahri, et al. (2019) that PBLRQA aimed to develop independent learning. With independent learning, students can be responsible for organizing their own learning. In addition, this strategy helped students to become independent learners. Bahri & Corebima (2015) suggested that through the development of students' learning independence, retention and cognitive learning outcomes could be improved.

CONCLUSION

This research produced the learning tools on blended learning integrated with the PBLRQA strategy in the form of lesson plan, evaluation sheets and e-learning media based on moodle in Animal Physiology courses. Based on the results of research, it can be concluded that the products declared were valid, practical and effective. The valid and practical blended learning has proven effective to empower self-regulated learning of students. It is expected that this work contributes to the overall field of study by implementing blended learning more widely by considering the characteristics of students and also learning material.

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