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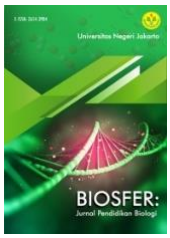

Increasing student's self-regulation in excretory system learning: A Development of through Moodle

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A B S T R A C T

In Biology learning, technology becomes a tool to facilitate 21st-century learning trends that are digitally oriented, distanced, internet-integrated learning materials, as well as being open and independent. This trend is a challenge because the results of a preliminary study at SMAN 37 Jakarta showed that 42.3% of students experienced a decline in their biology learning outcomes during the distance learning period, especially in the Excretory System chapter. Of these, 61.5% thought the decline was due to low self-regulation. This study aims to develop learning materials in the Excretory System through Moodle to increase students' self-regulation. The method used is research and development with the Borg and Gall development model using the Moodle platform. The development of learning materials was validated by 5 experts on aspects of the material, learning materials, and language. The result is the scope of the material aspect is 90.4%, the learning material aspect is 90.8%, and the language aspect is 88%, all of which meet the very feasible criteria. The learning materials were tested on 30 respondents and obtained pre-test and post-test scores on self-regulation. The results were tested using the paired sample t-test showed a significance value (p) = 0.001< 0.05. This result illustrated that the use of Excretory System learning materials can increase students' self-regulation.

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INTRODUCTION

Revolution 4.0 has an impact on the education sector, namely the challenge in the use of the internet actively in the learning process (Jung, 2019; Kayembe & Nel, 2019). The impact gives rise to 21st-century learning trends that are long-distance, open, and digitally oriented to improve students' competencies. The trends are valuable since they eliminate the dividing wall of space and time between students, teachers, and learning sources (Bozkurt, 2019). The covid-19 pandemic stimulates the implementation of distance learning that uses the internet in Indonesia. Nevertheless, distance learning creates some problems. Widiyono (2020) states that distance learning has not been effectively applied in Indonesia due to untrained students' self-regulation; hence, their learning independence is low.

Self-regulation could stimulate action in planning and adjusting the learning process to achieve goals (Boekart et al., 2005). Students with good self-regulation could control threats, pressures, and obstacles in learning; thus, they consciously try to achieve learning outcomes (Canabate et al., 2020). Through self-regulation, students can reduce or control learning problems that can affect their cognitive learning outcomes. Self-regulation in the cognitive process is oriented to a learning process that has an impact on students' cognitive learning outcomes. A preliminary study at SMAN 37 Jakarta indicates that 42.3% of 10th graders experienced a decline in cognitive learning outcomes during distance learning. Of the number, 61.5% opined that the decrease was due to low self-regulation. According to Nurrohmah (2020), self-regulation is directly proportional to students' cognitive learning outcomes. Based on interviews and observation, students, overall, were not familiar with online learning. This type of learning demands high self-regulation and awareness to achieve competencies and solve the accompanying obstacles (Carter et al., 2020). Learning control has so far been teacher-centered so students are seldom trained in their self-regulation.

Results of a study by Nuraeni & Habibi (2021) suggest that self-regulation can be trained by developing comprehensive learning materials used by students in the learning process. The learning materials contain methods, learning content, limitations, full figure of the competencies, and evaluation methods that are systematically designed. The developed learning materials should be digitally oriented since it follows trends in 21st-century learning and industrial revolution 4.0. Students in this era are incredibly familiar with the use of digital devices let alone spend their time with them. Digital learning materials will be easier to be studied and drive students' curiosity. Consequently, intrinsic motivation arises that encourages the learning quantity and quality of the students (Faisal et al., 2020).

Moodle is one of the platforms that can be used to develop digital learning materials. Moodle has been used by 234 countries with more than 120 languages. It has features that can distribute learning materials and support collaboration and interaction between students registered as a user (Kazanidis et al., 2018). Its advantages include large storage and a feature of learning outcome analysis that is equipped with a logging system facility (Fariha, 2014). The facility is capable of providing information in the form of student attendance, learning duration, last access to learning, and status of assignment completion in learning (Riza et al., 2016). Moodle is chosen based on the observation at SMAN 37 Jakarta indicating that 38.5% of the students required variation in learning media that contain learning materials that supported their distance learning. Moreover, 92.3% of the students did not know about Moodle nor used it in Biology learning.

All biology materials developed with Moodle are adjusted to their characteristics. Excretory system materials have a characteristic of explanation on how humans perform excretion of metabolic waste and body osmoregulation through the lungs, liver, kidney, and skin. The load of the excretory system materials has concepts, processes, and events related to everyday life that are difficult to comprehend using conventional learning materials (Ristanto, Rahayu, & Mutmainah, 2021). Djamahar et al. (2020) opine that learning in the excretory system should be student-center oriented materials with scientific approaches that stimulate observation, asking a question, trial, reasoning, and communication. These orientations are hard to achieve using conventional learning materials; however, they can be facilitated by Moodle. Moodle has various complete and integrated plugins that can be arranged independently by the teachers to support constructivist learning (Zelinsky, 2020).

Additionally, the finding of misconception is relatively high in the excretory system (Ritonga et al., 2017) and 61.5% of students in SMAN 37 Jakarta opined that excretory system materials are the hardest materials. Other studies have been conducted development to overcome the issue. The studies include Adi, Suratno, & Iqbal (2016) who developed virtual laboratories, Agushinta & Satria (2018) who developed 3D media, and Qumillaila, Susanti, & Zulfiani (2019) with the development of augmented reality. These development, however, are on one separate platform. Moodle, on the other hand, can be integrated into one platform — which is its advantage compared to previous studies — that simplifies learning for the students. The condition becomes a basis for the development of learning materials that are capable of facilitating students' self-regulation and become a solution in the application of blended learning in the transition from face-to-face learning to distance learning. The research aims to develop learning materials for the excretory system through Moodle to enhance the self-regulation of SMA students.

METHODS

Research Design

The research employed a research and development method. The development method was conducted by referring to Borg & Gall (1983) model that consisted of 10 development stages, namely, research and information collection, planning, develop a preliminary form of product, preliminary field testing, operational field testing, operational product revision, main field testing, main product revision, final product revision, dissemination, and implementation.

Population and Samples

The research population included all SMA students in Jakarta. Jakarta Selatan area was selected as the research sample through cluster random sampling. The reachable population was all students of SMAN 37 Jakarta. The determination of the research site was carried out using purposive sampling with a consideration that SMAN 37 Jakarta has been using LMS Moodle in its Economics learning but not in Biology learning, especially in the Excretory System. The determination of classes for trial employed a cluster random sampling method. Two classes were selected as the class sample and, using simple random sampling, 15 students were chosen for the initial test class and 30 students for the main test class as the research sample.

Instrument

The research instruments consisted of a preliminary study, expert validation instruments, and self-regulation instruments. The preliminary study included the measurement of difficulties in Biology learning for Grade 11 semester one, learning independence, learning motivation, and knowledge of the learning materials. The expert validation instruments comprised learning material validation instruments, language validation instruments, and material validation instruments that are modified from Ristanto et al. (2020). Experts involved in the product validation were Biology teachers and lecturers from academics and practitioners. The instrument grids of the expert validation can be seen in Table 1.

Table 1.
Instrument Grids of Expert Validation

Aspect	Indicator	Item	Total
Media	1. Composition and Layout	1	1
		2	1
	2. Image and video	3	1
		4	1
	3. Visual Communication	5	1
		6	1
	4. Text	7	1
	5. Pixel Quality	8	1
	6. Sound effect	9	1
	7. Accuracy of device by user	10	1
Language	1. Straightforward	1, 2	2
	2. Readability	3, 4	2
	3. Compatibility with Indonesian Language rules	5, 6	2
	4. Suitability for student's development level	7	1
	5. Consistency and Cohesiveness of mindset	8	1
	6. The utilization of terms, symbols, or icons	9, 10	2
Materials	1. Compatibility with basic competencies	1, 2, 3	3
	2. Accuracy of materials	4, 5	2
	3. Presentation techniques	6	1
	4. Learning presentation	7, 8	2
	5. Presentation completeness	9, 10	2
Total		**30**	

The self-regulation instruments tested the strength of students' self-regulation to participate in distance learning independently. Self-regulation skills include planning, initiation, effort, evaluation, and ability to overcome learning problems (Fadrikal, 2016). Instrument grids of self-regulation are presented in Table 2.

Table 2.

Instrument Grids of Self-regulation

No	Indicator	Statement		Total
		Positive	Negative	
1.	Learning initiative	5	5	10
2.	Formulating learning goals	3	3	6

No	Indicator	Statement		Total
		Positive	Negative	
3.	Efforts or interest	4	4	8
4.	Evaluation of learning process	3	3	6
5.	Discipline and responsibility	3.	3	6
6.	Interest or enjoyment	4	4	8
7.	Pressure or tension	3	3	6
	Total			**50**

Procedure

The procedures of the learning material development followed Borg and Gall's (1983) model which consisted of 10 development steps. The first step in the research was determining the schools to be tested (the method is explained in the sub-section of the population and sample section). Next, data collection as the preliminary study was conducted by distributing questionnaires to students and interviews with Biology teachers. The results of the questionnaires and interviews would be used as a basis for development to solve the occurring problems. The second step was planning and developing a preliminary form of the product that included concept design, material appearance system, illustration, visualization, and evaluation tools based on basic competencies. The third step was creating storyboards, learning media, and activity support plugins. The developed preliminary product of the learning materials comprised the presence of texts, study materials, quizzes, chats, learning reflection, and learning images, audio, and videos.

The fourth step was validation of the initial development results by experts or validators that consisted of material experts, learning material experts, and linguists with at least two revisions. The fifth step was a product trial that consisted of a small class trial on 15 students to find out their responses and input regarding the developed learning materials. In addition to the students, teachers were also involved to provide input for the learning materials. The input and suggestions would be used as materials for the sixth step, namely, revision, improvement, and enhancement of the learning materials to go through the final stages of the development.

The seventh step was a large class trial or main trial. The trial was conducted on 30 students to measure the research variable, namely, students' self-regulation in the excretory system. The utilization of Moodle in the trial was conducted in three meetings. The first meeting would have direction from the Biology teacher. In the last two meetings, the learning was conducted independently and guided by Moodle. The variable measurement was conducted using a pretest and posttest. The design of the large class trial for learning material development is illustrated in Figure 2.

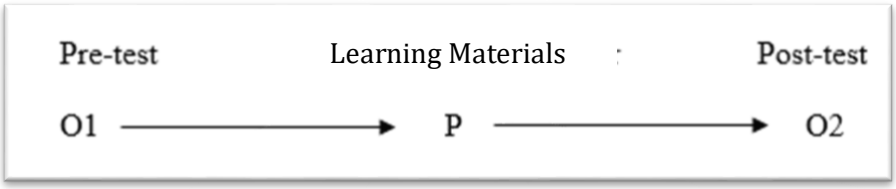


Figure 2. Main Trial Design of the Development Research

The eighth step was the main product revision based on results and input generated. The ninth step was product improvement followed by the final step, which was dissemination. The dissemination process was conducted by considering scientific processes that occurred; thus it was not public and open access.

Data Analysis Techniques

Data obtained from the expert validation processes in the categories were converted into feasibility percentage values using equation (i).

$$\text{Feasibility percentage} = \frac{\text{Total Score}}{\text{the Highest Score}} \times 100\% \quad \ldots\ldots\ldots \text{(i)}$$

The result interpretation consisted of very feasible, feasible, fairly feasible, not feasible, and unworthy (Riduwan, 2016). The paired sample t-test was conducted to identify differences between two means, namely during the pretest and posttest. Normality and homogeneity tests were carried out prior to the t-test as a prerequisite. The normality test employed the Kolmogorov-Smirnov test at a significance level of 0.05, whereas the homogeneity test used the homogeneity of variance test. Data were normally distributed and homogeneous if the value (p) > 0.05. The results of the normality and homogeneity tests are presented in Table 3.

Table 3.
Results of Normality and Homogeneity Tests

Variable	P Value	Normality Test		Homogeneity Test
		Pretest	Posttest	
Self-regulation Description	0,05	0,2 Normal	0,162 Normal	0,589 Homogeneous

RESULTS AND DISCUSSION

The research results will be discussed based on the development steps of the Borg and Gall (1983) model.

Data Collection

A preliminary study was conducted on 26 respondent students. The results suggest that 76.8% of the students stated that biology learning in Grade XI was in the difficult category. About 61.5% of the students opined that the excretory system content was the most difficult material. A diagram of the hardest biology material categories is illustrated in Figure 3.

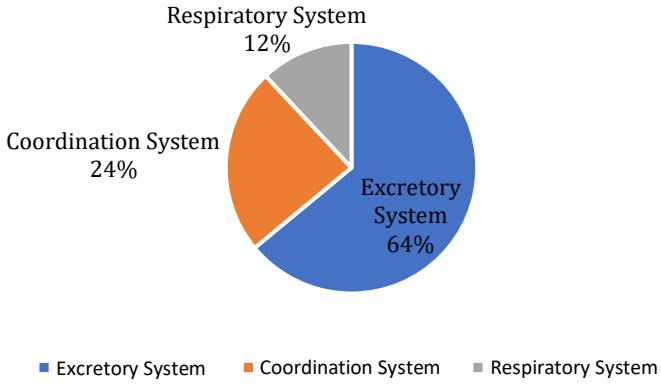


Figure 3. Diagram of the Hardest Biology Material Category

Students felt the complexities due to the long mechanisms in the material, more memorizing, difficulties in visualizing, and limited study time (Suparini, Rusdi, Ristanto, 2020). These difficulties were complicated by the distance learning system which triggered a decline in the respondents' learning motivation by 61.5%. They stated that learning material development is necessary that could train their self-regulation to restore their learning motivation. Two platforms have never been used by SMAN 37 Jakarta in biology learning, namely Moodle and Podcast (see Figure 4). Therefore, the development of the Moodle-based learning materials was conducted that included voice recording to improve students' self-regulation.

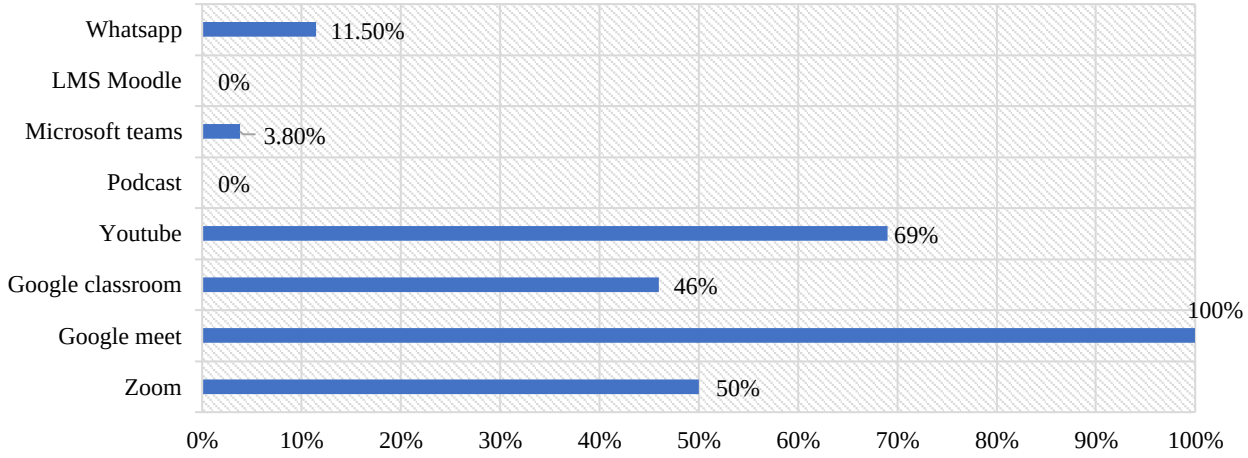


Figure 4. Results of Respondents' Knowledge of Distance Learning Platforms

Planning

The planning stage of the development through Moodle consisted of building hosting and domain, creating courses, creating a learning material plan, and uploading the learning materials (Syara et al., 2020). The first and second planning stages had been conducted from the preparation of Moodle-based learning materials based on the learning management system of the Department of Biology Education Universitas Negeri Jakarta. The creation of the course was adjusted to the material title, namely Human Excretory System.

The planning step was followed by creating a concept design of the learning materials using a storyline based on each page (Suhailah et al., 2021). The learning material planning referred to the basic competencies of Excretory System material. Each page contains a voice recording to provide instructions specific to using the learning materials (Firdaus & Wilujeng, 2018). This stage also included the selection of activity and resource features to design interactive learning. The storyline developed in the research is illustrated in Figure 5.

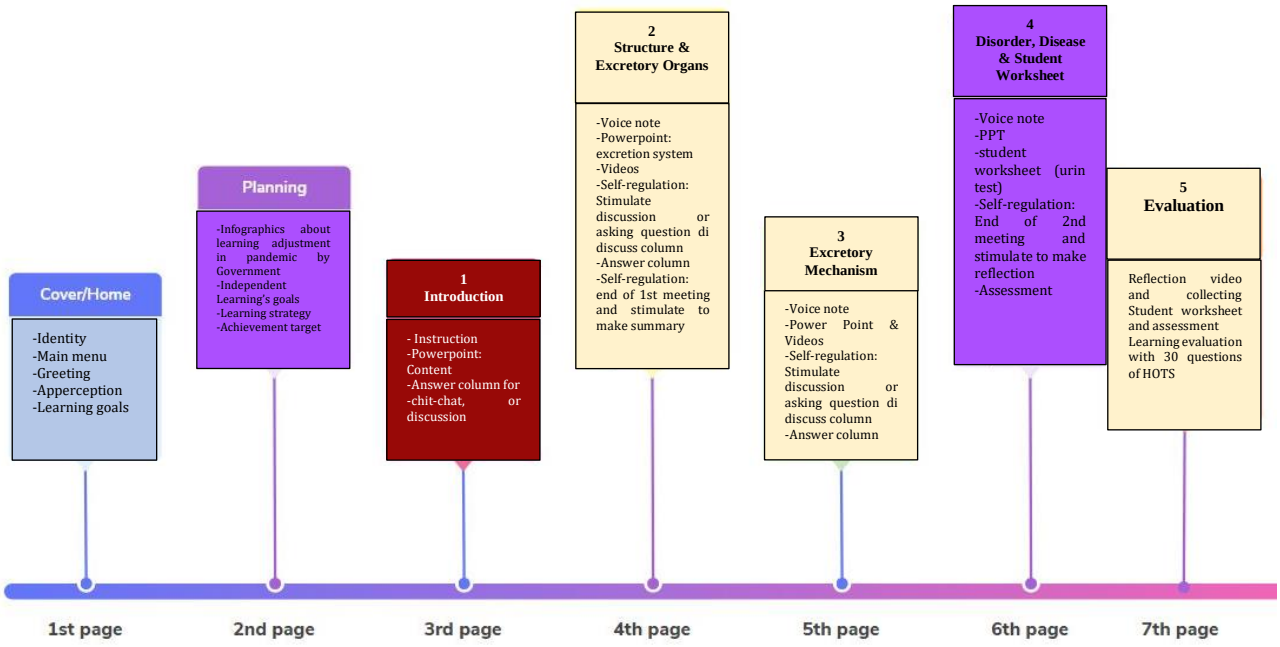


Figure 5. The storyline of Learning Material Planning

Development of Preliminary Form of the Product

The development was started by creating the learning material display such as its content, model images, animation videos, interactive audio, student worksheets, and quiz evaluations (Ristanto et al., 2020). Supporting media of the learning materials include PDF materials, images, and videos attached from Google and YouTube, and audio in the form of voice recording. All devices made were arranged according to the concept flow of the excretory system and ended with a quiz.

The development was conducted using a constructivist flow. The flow of the learning material developed contains question stimulus and findings, learning forums, and modeling through activities created. Moreover, assignment activities, quizzes, and synchronous are utilized to load reflection and authentic assessment. This follows the characteristics of learning material in the 21st century according to Oktaviani, Gunawan, & Sutrio (2017) that contain constructivist elements, stimulating questions, stimulating findings, learning community, reflection, and authentic assessment. The daily assessment was generated through a logging system record directly from Moodle. The summative and formative assessments were developed using student worksheets and learning evaluations.

Validation

The validation process of the learning materials was performed by conducting tests on the experts that consisted of biology lecturers and teachers. The validation process included three main aspects, namely the material aspect, learning material aspect, and language aspect. The material aspect validation referred to the basic competencies of the Excretory System, learning objectives, and learning indicators contained in the 2013 National Education Curriculum. The results of the validation assessment in the material aspect are presented in Table 4.

Table 4.
Validation Results of Material Aspect Experts

No	Indicator	Expert Validator				
		1	2	3	4	5
1	Platform compatibility with the basic competence of the Excretory System.	5.0	5.0	4.0	5.0	5.0
2	The product contains images of the structure of tissues that make up the excretory system organs.	3.0	4.0	4.0	5.0	5.0
3	The product presents material according to the thinking development of students at the high school level.	4.0	5.0	5.0	5.0	5.0
4	The product contains effective audio and	3.0	4.0	5.0	4.0	4.0

No	Indicator	Expert Validator				
		1	2	3	4	5
	visuals.					
5	The product contains a video of the bioprocess on one of the excretory organs.	4.0	4.0	5.0	4.0	5.0
6	The product contains examples of abnormalities in the various excretory systems.	4.0	5.0	4.0	5.0	5.0
7	The product contains student competency exercises to evaluate the learning process.	4.0	5.0	5.0	5.0	5.0
8	The product contains a variety of questions on students' competency exercises.	4.0	4.0	5.0	5.0	5.0
9	The product can help students grow an attitude of independence in learning.	4.0	5.0	5.0	4.0	4.0
10	The product can help students to plan learning.	4.0	5.0	5.0	5.0	4.0
Average		3.9	4.6	4.7	4.7	4.7
Percentage		78%	92%	94%	94%	94%
Criteria		**Valid**	**Very Valid**	**Very Valid**	**Very Valid**	**Very Valid**

Results of the expert validation in the material aspect had a total percentage of 90.4%. Riduwan (2016) suggested that the results were within the very valid criteria. Several input from the validator 1 and 5 included the need for consistency in language use in the learning materials whether to use Indonesian language, English, or Latin. Whereas, validator 2 highlighted the mechanisms of liquid regulation that was less completed since it only discussed Antidiuretic Hormone (ADH) and had not discussed the functions of Atrial Natriuretic Peptide (ANP). The second validation aspect measured was the learning materials aspect. The learning material validation referred to the platform display in supporting learning, including the quality of composition, features, and layout. The results of the validation assessment of the learning material aspect are presented in Table 5.

Table 5.
Results of Expert validation in Learning Material Aspect

No	Indicator	Expert Validator				
		1	2	3	4	5
1	The selected background and layout are general.	3.0	5.0	5.0	4.0	5.0
2	Appropriate color composition.	3.0	4.0	5.0	4.0	5.0
3	Various supporting images and illustrations.	4.0	5.0	5.0	5.0	5.0
4	Various supporting videos and illustrations.	4.0	5.0	5.0	4.0	5.0
5	Attractive presentation display.	3.0	5.0	5.0	4.0	5.0
6	Display supports the curiosity of students.	3.0	5.0	5.0	4.0	5.0
7	Clarity and legibility of font type and font size.	4.0	4.0	5.0	5.0	5.0
8	Image and video quality is not damaged when zoomed in or displayed.	4.0	5.0	5.0	4.0	5.0
9	Audio and video quality remain soft and stable during use.	4.0	5.0	5.0	5.0	5.0
10	Accuracy of links to other learning resources attached to the media.	3.0	5.0	5.0	5.0	5.0
Average		3.5	4.8	5.0	4.4	5.0
Percentage		70%	96%	100%	88%	100%
Criteria		Valid	Very Valid	Very Valid	Very Valid	Very Valid

Results of the validation in the learning material aspect had a total percentage of 90.8% indicating the valid criteria. Validator 3 suggested that the apperception on the first page of the learning materials needed to be re-discussed in the LKPD. Therefore, there will be a continuous learning flow from page to page. Students are required to thoroughly understand the developed learning materials without any broken information or

unconfirmed questions.

The last validation aspect measured was the language aspect. The language aspect referred to the use of symbols, sentences, grammar, and the writing of biological terms in the learning material developed. The results of the validation assessment in the language aspect are presented in Table 6.

Table 6.
Expert Validation in Language Aspect

No	Indicator	Expert Validator				
		1	2	3	4	5
1	Sentences do not contain bias.	5.0	4.0	5.0	4.0	5.0
2	There are various types of inductive and deductive paragraphs.	5.0	5.0	4.0	4.0	5.0
3	The font size is clearly legible on pictures and videos.	3.0	4.0	5.0	5.0	5.0
4	Use of colors that don't clash with the background.	4.0	5.0	5.0	5.0	5.0
5	Accuracy in structure and writing (No typo).	3.0	5.0	5.0	4.0	4.0
6	Correct use of biological terms in Indonesian	3.0	5.0	5.0	4.0	4.0
7	The use of sentences according to the level of thinking at the high school level.	4.0	5.0	5.0	4.0	5.0
8	Sentences are structured to produce an integrated mindset.	2.0	5.0	5.0	4.0	5.0
9	Consistent use of symbols and terms.	2.0	5.0	5.0	4.0	4.0
10	Use representative symbols and icons.	3.0	5.0	5.0	4.0	5.0
Average		3.4	4.8	4.9	4.2	4.7
Percentage		68%	96%	98%	84%	94%
Criteria		**Valid**	**Very Valid**	**Very Valid**	**Very Valid**	**Very Valid**

The validation results in the language aspect had a total percentage of 88% suggesting very valid criteria. Nevertheless, learning materials developed still contained misspelled sentences or terms (typos). According to validator 5, simple mistakes could be fatal if the learning materials are used fully in online learning since this will create a misconception. Validator 4 stated that the use of color and background should be in contrast so as not to interfere with students' comprehension.

Operational Trial

The operational trial stage was carried out on 15 respondents randomly selected by the Biology teachers of SMAN 37 Jakarta. The goal was to obtain perspectives from the development-target objects and the implementing subjects of the developed product (Borg & Gall, 2003). The majority of the respondent students did not give input or suggestions regarding the developed learning materials. The respondents, in general, stated that the developed product is good and easy to understand. Biology teachers in SMAN 37 Jakarta did not provide much feedback in the initial product development but recommended towards the main field trial. According to them, the developed learning materials had helped them to perform teaching and learning activities, especially in distance conditions.

Operational Product Revision

Prior to the main field test, the product needs to be revised according to the input from validators, students, and biology teachers. Inputs from the validators were used as a basis to perform the revision. Parts of the revision conducted are displayed in Table 7.

Table 7.
Initial Product Revision

No	Revision Content	Change
1	Inconsistency in biological terms	The terms are standardized to the Indonesian Language
2	The sound on the video in material 2 is less clear	Cleared sound and increased audio resolution
3	Concepts and their derivatives had not clearly conveyed	Concept development through statements and questions that bridge the concept through high-order thinking skills
4	The color of the letters and background is less	Combine contrast colors between letters and the

No	Revision Content	Change
	contrast	background
5	Less varied images	Add the number of explanatory images in the materials
6	Sentences have not conveyed information explicitly	Provide statements and questions that trigger high-order thinking and confirm the questions
7	Students can skip the activity page	Add restrict access feature in each activity

Main Trial

The main trial was conducted on Class XI MIPA 3 and XI MIPA 4. The implementation of the main trial was started by measuring the student's initial skill (pretest) in the self-regulation aspect. The main trial was carried out by the biology teacher of SMAN 37 Jakarta through blended learning where respondents had virtual learning and independent learning (Figure 6). The main field trial was conducted in 3 meetings. The first meeting consisted of acquaintanceship and introduction of materials followed by independent learning. The second meeting was total independent learning and the last meeting was learning evaluation. The first and second meetings were controlled by Moodle application that became a platform for learning material development. The third meeting was virtual face-to-face to evaluate excretory system learning to minimize fraud in working on the questions. The learning evaluation consisted of 30 multiple-choice questions to measure students' high-order thinking skills.

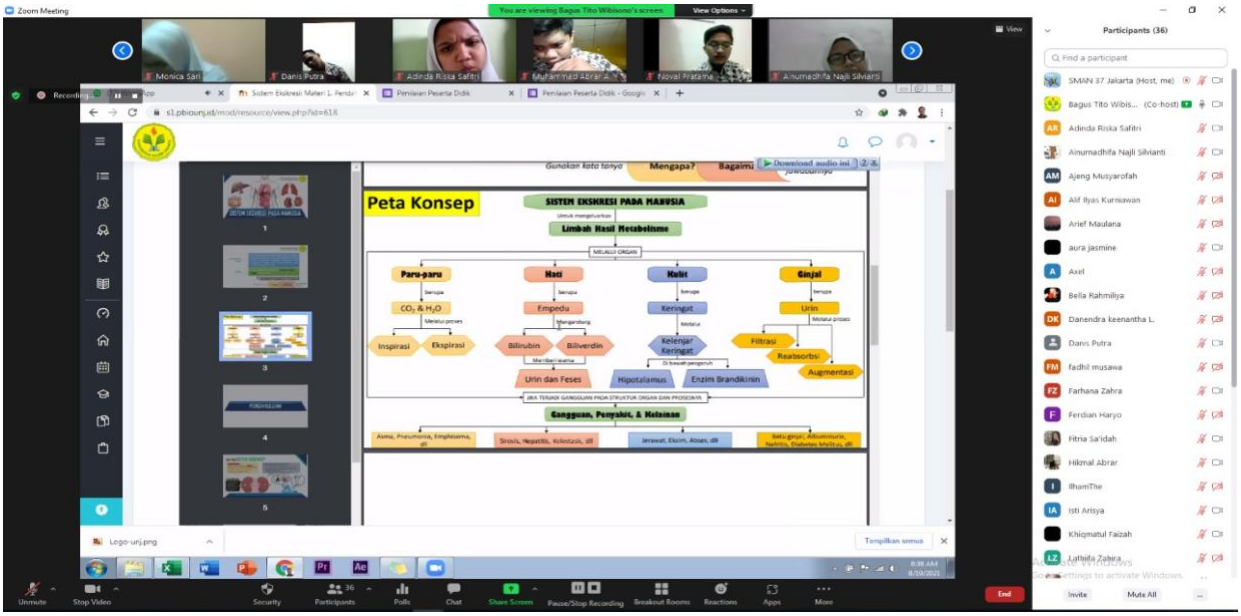
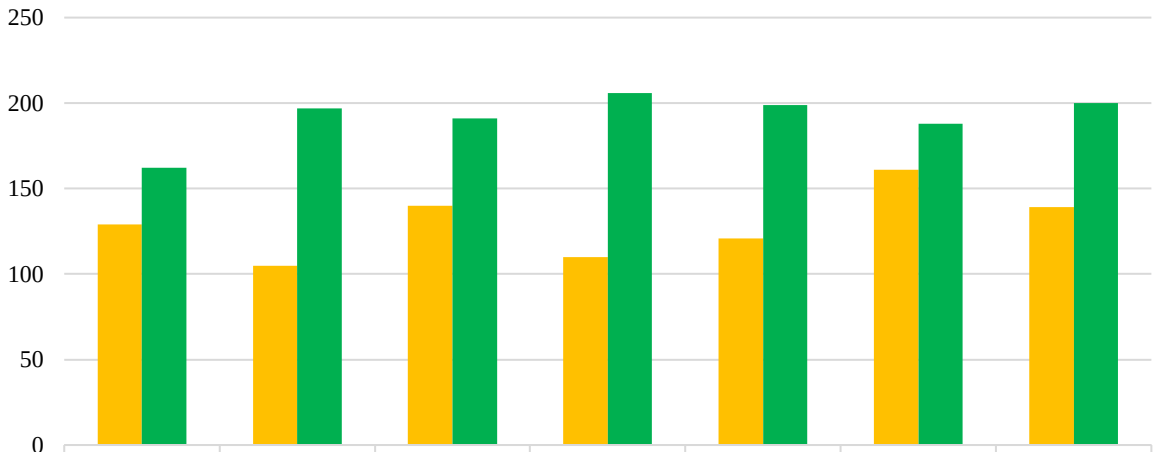


Figure 6. Trial Process of the Learning Materials in Virtual

Learning evaluation was prepared using the quiz feature that can load questions, correct answers, question discussion, and student scores. This aimed to confirm students' answers so the learning still occurred after the evaluation process. The feature, for teachers, can be used to validate question items so it simplifies them in analyzing questions. The results gained in the evaluation sheets became the after-treatment achievement data of students' high-order thinking skills (posttest). The means of the students' self-regulation scores in the pretest and posttest were 129.367 and 191.867, respectively. The paired sample t-test indicated a value (p) of 0.001 < 0.005. This suggests that there was a difference in the mean self-regulation score of students who used excretory system learning materials through Moodle and those who did not use it. The increase in the self-regulation score per indicator is presented in Figure 7.



	Learning Intiative	Formulating Learning Objectives	Effort in Learning	Evaluation of the Learning Process	Discipline and Responsibility	Interest in Learning	Managing Study Pressure
Pretest	129	105	140	110	121	161	139
Posttest	162	197	191	206	199	188	200

Figure 7. Chart of Self-regulation Enhancement per Indicator

All self-regulation indicators experienced an increase in score after the utilization of Excretory System learning material through Moodle. The indicator with the highest enhancement was learning process evaluation. This was due to the developed learning materials that have a reflection column at the end of every page and are presented in audiovisually. The reflection stimulates students to consciously comprehend and evaluate the learning process so that improvement can be found in the next process (Zimmerman & Martinez-Pons, 1986). The next indicator with the highest improvement was formulating learning goals. The developed learning materials contain lesson plan elements at the beginning of the meeting, including the determination of final achievement targets, learning schedules, reminders, and peer discussion. These components, according to Kazandis et al. (2018), are facilitated by the Moodle plugin as an effort to trigger students' learning awareness by setting goals in the initial activities.

The result of the student's assessment of the learning materials was 83.2 with an interpretation of very feasible. The utilization of the learning materials can stimulate students to formulate goals, implement learning strategies, and control and evaluate learning processes (Canabate et al., 2020). Students opined that the excretory system learning materials are capable of presenting coherent and easy-to-understand materials. This response is consistent with Zimmerman & Martinez-Ponz (1986) expressing that self-regulation could enhance if a student's learning path is systematic. Students also stated that the learning materials facilitate them to ask and give an answer to each other regarding difficulties in learning. The learning materials could replace the classroom and help teachers to create a pleasant learning climate. This is in line with a study by Carter, Rice, & Jackson (2020) that students who have good self-regulation will be able to control the learning process and create a conducive learning environment.

Main Product Revision

The assessment results of the excretory system learning materials suggested that all indicators were within the very feasible criteria. This stage only performed improvement in the background display and layout to be adjusted to the Moodle print. Boateng et al. (2016) stated that the development of learning materials using Moodle is an advanced and up-to-date study. This is due to Moodle which puts students not only as learning objects but also active subjects in learning. Moreover, Moodle also facilitates teachers to make a variation in learning since the platform can be used as a virtual class that is capable of uploading materials and as an evaluation tool.

Product Improvement

Regulation in the activity completion feature was added to regulate students who used the learning material systematically on each page. This is the form of teacher's control that is facilitated by the learning materials to make sure that students do not miss the learning content on each page (Hasan, 2018). This stage was also re-ensuring the display of the learning materials, re-arranging all components after the trial, and arranging the display of restricted access. The purpose is so that the developed learning materials are ready to be used by teachers to conduct Excretory System learning and train students' self-regulation.

Dissemination and Implementation

The last stage of the Borg and Gall development model is product dissemination for use by other parties. The researchers disseminated the research through various scientific publications both in the form of seminars or a publication articles published in several journals. The research, in particular, presented the original document

of the learning material development to the Biology teachers at SMAN 37 Jakarta as an appreciation of their willingness to become the product trial location.

The dissemination of the development product was limited according to the need of various schools. This was different from a study by Rohmaini et al. (2020) that disseminated their development product through social media. The researcher decided to have a closed dissemination process to respect the scientific process conducted. SMAN 37 Jakarta has been implemented the excretory system learning materials through Moodle to all Grade XI in the academic year of 2021/2022.

CONCLUSION

The excretory system learning materials developed through Moodle are feasible to be used to enhance students' self-regulation. The validation result in the learning material aspect was 90.4%, in the material aspect was 90.8%, and in the language aspect was 88%, all of which met the very valid criteria. The learning materials can become a solution to tackling low student's self-regulation by integrating various learning activities into one platform as suggestions from various studies by Adi, Suratno, & Iqbal (2016), Agushinta & Satria (2018), and Qumillaila, Susanti, & Zulfiani (2019). Moreover, the learning materials can facilitate teachers to control learning and present learning evaluation, attendance evaluation, discussion activities, and group cooperation.

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