Available online at: http://journal.uny.ac.id/index.php/jipi

Jurnal Inovasi Pendidikan IPA, 8 (1), 2022, 99-111

Developing multimedia learning on concept Arthropoda to increase students self-regulation and motivation

Wahyu Maulana Endris[1] *, Suhartini[2]

[1] Department of Biology, Faculty of Science and Technology, Universitas Nahdlatul Ulama Purwokerto, Purwokerto, Indonesia.

[2] Department of Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.

* Corresponding Author. E-mail: wahyu.maulana2015@student.uny.ac.id

Received: 25 February 2022; Revised: 11 April 2022; Accepted: 22 April 2022

Abstract: This study aims to: (1) produce learning multimedia, (2) determine the feasibility of learning multimedia, and (3) determine the effectiveness of multimedia learning in increasing independence, motivation, and learning outcomes of biology subjects. This development research uses the ADDIE model, namely the analysis, design, development, implementation, and evaluation stages. Data collection techniques in the study used observation sheets, interview guides, learning style questionnaires, cognitive tests, learning independence questionnaires, learning motivation questionnaires, and experience questionnaires using media. Quantitative data on learning outcomes were obtained and then analyzed using paired t-tests. The results showed that: (1) the product was learning multimedia valid and reliable, (2) multimedia learning on Arthropod material is suitable for use in biology learning; and (3) learning using multimedia is effective in increasing the independence, motivation, and learning outcomes of biology students.

Keywords: Learning independence, Learning motivation, and multimedia learning media.

How to Cite: Endris, W. M. & Suhartini, S. (2022). Developing multimedia learning on concept Arthropoda to increase students self-regulation and motivation. *Jurnal Inovasi Pendidikan IPA, 8*(1), 99-111. doi: https://doi.org/10.21831/jipi.v8i1.45860

INTRODUCTION

The development of science and technology in all fields has an influence directly and indirectly, including in education. Access to information is getting easier and faster, increasing the need for education and indicating the need for innovation and new formulations to improve education quality (Rusdiana, 2014). Education is a need and a significant aspect of human life. One of the activities to obtain an education is learning activities. The process of learning activities is an important activity that various things can influence, one of which is independence and learning motivation (Uno, 2021). Both of these things require special attention for educational practitioners. Neglect of independence and motivation to learn can result in students' learning difficulties. Furthermore, this will also impact the low learning outcomes of students if it is not addressed immediately.

Independent learning becomes essential in the learning process. Bandura (1991) states that the concept of learning independence is strongly influenced by the process, not only as an external influence. Self-study is also suitable for all age levels. In other words, independent learning is suitable for all middle and elementary school levels to improve students' achievement and ability. Students who have learning independence can analyze complex problems, work individually or in collaboration with groups, dare to express ideas, and have motivation (Hamalik, 2014).

In contrast to independent learning, motivation is essential in carrying out activities and an active driving force to achieve a goal in learning. Therefore learning is a business activity or motivation for students to acquire knowledge and skills. Motivation change energy in a person, characterized by the emergence of feelings and response to existence. This understanding contains three main elements/characteristics in that motivation, namely motivation that initiates a change in energy, characterized by feelings, and stimulus because of a purpose.

https://doi.org/10.21831/jipi.v8i1.48211

The point is that motivation is a psychological condition that drives someone to do something. Motivation in learning activities can be said to be the overall driving force within students that creates, ensures continuity, and provides direction for learning activities so that it is hoped that the goals can be achieved (Hamalik, 2014). Motivation in learning activities is essential because someone who does not have motivation in learning will not be able to carry out learning activities. The importance of the role of motivation in the learning process needs to be understood by educators so that they can take various forms of action or assistance to students. Motivation is formulated as an encouragement caused by students' internal and external factors to achieve specific goals to meet or satisfy a need. In the context of learning, these needs are related to the need to learn.

Based on the results of interviews and initial observations at one of the senior high schools in Bantul district, Yogyakarta, Indonesia, information was obtained that the school has complete facilities, including the availability of internet and computer networks. Before the 2013 Curriculum was implemented, the internet and computer network facilities were used to benefit computer subjects. However, after the 2013 Curriculum was implemented, computer subjects became non-existent. Hence the internet and computer network facilities were only used at certain times, for example, during computer-based national exams. In addition, learning other subjects, especially biology, has not utilized the internet and computer networks provided by the school. This is very sad because the already adequate facilities are not appropriately optimized during the learning process. Therefore, researchers consider being able to take advantage of these facilities in the learning process through the development of web-based learning media.

The development of web-based learning media is also motivated by data on student learning styles and students' experiences in using learning media. Based on the results of interviews about learning styles, most students have a visual learning style, and on average, students can use various learning media, so web-based learning media is suitable to be applied to the school. On the other hand, related to the need to increase independence and learning motivation, it is necessary to make efforts to make the material presented in learning enjoyable. One of them is by designing and making learning media that is expected to increase the independence and motivation of students to learn.

Web-based learning multimedia is a media that is designed and developed by combining various types of media, has a flexible nature, and can be used whenever and wherever students are because this multimedia can be accessed online (Rusman, 2012). Web-based biology learning multimedia will be developed to facilitate teachers to maximize the delivery of information or message ideas to students in biology learning, so that information or message ideas are conveyed and can be well received by students. Therefore, the researcher aims to develop learning multimedia using web-based learning.

Biology learning packaged in an interactive web that displays many visual images, accompanied by videos, can attract students' attention to study well, allow students to more easily understand the subject matter presented, and motivate students to learn. Related to the learning objectives to be achieved, learning using multimedia needs to be designed so that its quality is tested so that the developed multimedia can clarify the understanding of concepts and theories in learning.

Biology is part of science, so learning biology follows the nature of learning science. The essence of learning science is learning to carry out the discovery process by involving various skills and activities so that students must be involved in the learning process to have the motivation to learn biology. Sujatmiko & Nurlaili (2003) stated that learning activities allow students to socialize by respecting differences (opinions, attitudes, achievement abilities) and work together to communicate ideas, creations, and findings to teachers and other students, so students need to have independent learning.

One of the basic concepts learned in high school biology learning is Animalia. This concept discusses the characteristics of living things which are classified into vertebrates and invertebrates. The Arthropoda sub-concept is an invertebrate material in the Animalia material. Because the Arthropoda sub-concept discusses a wide range of material, the arthropod material will be developed and presented in web-based biology learning multimedia.

The description illustrates that teaching and learning biology activities require the development of multimedia learning following the needs of students. One of the efforts is to develop a web-based biology learning multimedia designed to increase independence and motivation to learn biology. The development and use of web-based biology learning multimedia in classroom learning are expected to increase independence and motivation to learn biology. In addition, multimedia learning biology also

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

facilitates teachers to maximize the delivery of information or message ideas to students in biology learning so that they can be conveyed and received well by students. Based on these considerations, developing products that can be applied in the biology learning process is necessary. The product developed is the development of web-based biology learning multimedia to increase students' independence and learning motivation.

METHOD

This research is development research or known as Research and Development (R&D). In this study, researchers focused on developing product-oriented web-based biology learning media. This multimedia product is intended for class X high school students in the form of web-based learning, in which it contains biology learning materials that discuss the subject of Animalia, the Arthropoda sub-concept.

The development model used is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The product developed in this study is web-based biology learning multimedia on the material Animalia, the Arthropoda sub-concept, to increase the independence and motivation of students to learn biology. This web-based biology learning multimedia contains components that support learning, including teaching materials in text, images, animations, and videos.

Multimedia products are intended for high school students in class X. A total of 6 students participated in small group trials, and 30 participated in large-scale trials (field). In large-scale testing, a comparison design of the control class was used in which 34 students participated in the control class. The products used in the small and large group trial classes have gone through the validation stage. Validation is carried out by two experts, namely media experts and material experts, to maintain product development quality. After the product was declared valid by the expert and revised, the product was then used and tested by two biology education students, the purpose of which was to assess the feasibility of the product developed.

The product was tested using web-based biology learning multimedia in the classroom learning process. The trial was conducted using a quasi-experimental method using the Nonequivalent Control-Group Pre-test & Post-test design presented in Table 1.

Table 1. Desain Nonequivalent Control-Group Pre-test & Post-test

Group	Pre-Test	Treatment	Post-Test
Experiment	Y_{11}	X_1	Y_{12}
Control	Y_{21}	X_2	Y_{22}

Explanation: Y_{11} is learning independence and motivation at the beginning of experiment class, Y_{12} is learning independence and motivation at the end of experiment class, Y_{21} is learning independence and learning motivation at the beginning of control class, Y_{22} is learning independence and motivation at the end of control class, X_1 is learning using web-based multimedia, and X_2 is learning without using web-based multimedia.

Data, Instruments, and Data collection technique

This research produces quantitative data, which is then converted into qualitative data. The qualitative data was obtained from media and material experts' validation results, small group tests, field trials, and student test results. The data types obtained in this study are (a) assessment and validation of multimedia learning biology from media experts and material concepts obtained from material experts, and (b) effectiveness of web-based biology learning multimedia to increase students' independence and motivation to learn biology. From the questionnaire given to students, and (c) the effectiveness of web-based biology learning multimedia on improving student learning outcomes obtained from the pre-test and compared to the post-test.

Data collection techniques carried out in this study used non-test and test techniques. Non-test techniques include interviewing and giving questionnaires, while test techniques include giving pre-test and post-test questions. Interviews were used to collect information related to research to be carried out regarding the availability of resources and school needs related to web-based biology learning multimedia. The interview subjects in this study were the principal, biology teacher, and students at one of the public high schools in Bantul Regency. The questionnaire used in this study aims to: (a) obtain data on the feasibility of the product based on the validation results from media experts and material experts who are competent in their fields; (b) obtain data on the assessment of a biology teacher or

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

colleague on the multimedia learning biology; (c) obtaining web-based biology learning multimedia assessment data obtained from small group tests; (d) obtain data on the independence of learning biology; (e) obtain data on motivation to learn biology; and (f) obtain data about the effectiveness of the product after students use the product to increase the independence and motivation of students in the learning process. The test is used to collect data regarding improving student learning outcomes. The types of tests used are multiple-choice tests and essay tests. The test was carried out before (pre-test) and after (post-test) receiving biology learning. The test was conducted on students who used web-based learning multimedia (experimental class) and students who used conventional learning (control class). The pre-test was used to determine the experimental and control classes' initial ability, while the post-test was used to determine the effect of web-based biology learning multimedia on student learning outcomes.

The data collection instrument used in this study was an interview guide consisting of several questions aimed at gathering initial information about the facts of the learning process and analyzing the need for commonly used learning media. Respondents in this interview were school principals and biology teachers. A preliminary study questionnaire is an open questionnaire used to collect information from students about the biology learning process that has been experienced, students' learning styles, and students' experiences in using biology learning media. The instrument for the feasibility of multimedia learning on the subject of Animalia, the Arthropoda sub-concept for media experts and material experts. This instrument was used to obtain data on the assessment of learning media experts on the material Animalia sub-concept of Arthropods on the feasibility of web-based biology learning multimedia. Before making the assessment instrument, the researcher made a grid of instruments adapted from Alessi & Trollip (2003) and Akbar (2013). The instrument used to assess the feasibility of web-based biology learning multimedia will be validated first by media experts to determine its validity. Questionnaire for the independence of students to learn biology. This instrument aims to obtain information from respondents about students' independence in the form of statements describing the students themselves. The statement answered will describe how much independent learning the student is and the increase after receiving biology learning. The grid used to make the instrument in this study was adapted from Zimmerman (1989). Questionnaire of motivation to study biology. This questionnaire was used to obtain data on student's motivation to learn biology using web-based learning multimedia and students using conventional learning. This study's learning motivational instrument grid was adapted from Glynn et al. (2008) and Uno (2013).

Data analysis technique

The data obtained from this study are in the form of quantitative and qualitative data. Quantitative data includes multimedia assessment data, independence, motivation, and student biology learning outcomes. Quantitative data obtained from multimedia assessments, independence, and motivation will be converted into qualitative data to analyze the quality of web-based biology learning multimedia, increase learning independence, and student's motivation to learn biology. Quantitative data on learning outcomes were obtained using a test technique which was then analyzed using paired t-test to determine the increase in learning outcomes. The data analysis technique to be carried out can be described as follows.

RESULTS AND DISCUSSION

The product in this research is web-based biology learning multimedia. To make it easier to understand the manuscript, the presentation of results and discussion will follow the ADDIE development model.

Analysis

This stage was carried out through interviews and observations of the implementation of the learning process in class X, which took place at a public senior high school in Bantul. These activities include curriculum analysis and learning objectives, analysis of the potential of students, and potential analysis of biology teachers.

The results of the analysis show that the curriculum used in the school is the 2013 curriculum. Based on interviews with students, it can be described that students' learning independence has different

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

levels. On the other hand, interviews with teachers resulted in the initial conclusion that biology teachers have potential that can be utilized in learning to guide and facilitate students in order to improve students' knowledge, skills, and attitudes. One potential of teachers that can be utilized in the learning process is the ability to operate computers, supported by school facilities with internet networks to enable teachers and students to broaden their horizons related to learning materials.Data analisis kebutuhan diperoleh dari hasil pengisian angket yang diberikan kepada peserta didik untuk mengetahui informasi awal mengenai gaya belajar biologi, pengalaman menggunakan media pembelajaran biologi, motivasi belajar biologi, kemandirian belajar biologi, dan hasil belajar peserta didik selama belajar mata pelajaran biologi di sekolah. Data tersebut dapat dijabarkan sebagai berikut.

The analysis of student learning styles shows that 29 students have a visual learning style, 21 students have an auditory learning style, and 19 students have a kinesthetic learning style. Information on the number of students with visual, auditory, and kinesthetic learning styles can be presented in Figure 1.

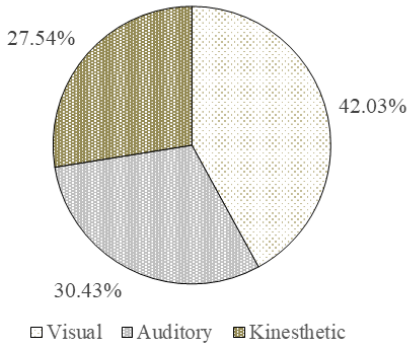

Figure 1. Student Learning Styles

Based on Figure 1, web-based biology learning multimedia was developed and directed to support the learning styles of students with visual and auditory learning styles with more combinations of material characteristics arranged according to visual learning styles. In addition to learning styles, the analysis stage also explores information about students' experiences in using media in learning biology. The purpose of collecting this information is to find out students' experience using biology learning media in learning activities in the classroom. The results of this questionnaire analysis are presented in Figure 2.

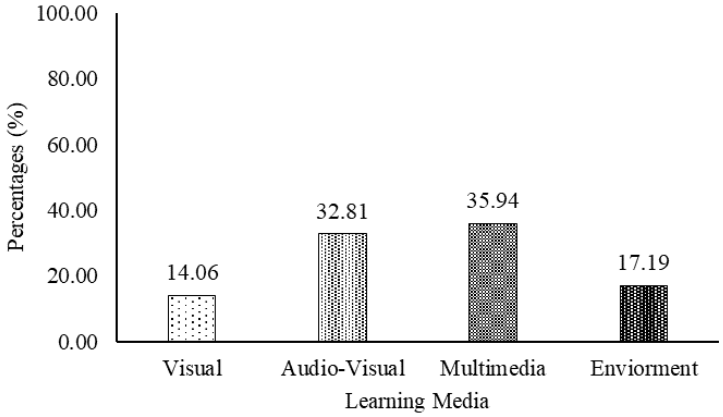

Figure 2. Student Experience using Learning Media in Biology Subjects

Students who fill out the questionnaire have different intensities of media use. The biology learning media students consist of visual, audio-visual, multimedia, and the school environment. Thus, it can be concluded that students can use all types of media depending on the needs and facilities

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

available at school. Besides, the influence of teachers in providing media in learning biology can affect the use of media to facilitate students' learn certain materials.

Design

The development of learning media is done separately. In this study, researchers are tasked with designing content, content, and media design. Furthermore, the programmer executes the design of the content and completeness of the media to produce web-based biology learning multimedia. Researchers designed the display design and flowchart of the web. The content and learning stages are designed so that students have a new experience in using the website.

Development

Web-based learning multimedia product on Animalia sub-concept Arthropoda material was developed consisting of navigation or multimedia usage instructions, the content of Arthropoda sub-concept material, and assessment materials. Navigation structure, pages, material substance, and critical functions lead students to simplify operations and learn to use multimedia.

The development stage also includes validation activities by material experts and media experts. The validation results by material experts qualitatively showed that the web-based biology learning multimedia had criteria with a score of 3 or was suitable for learning, but several parts had to be revised before being used. The results of qualitative media validation showed that the web-based biology learning multimedia had a decent category (40.8-50.4) with an assessment score by media experts 48. However, several aspects needed to be improved in the assessment, such as ease and simplicity in operation and instructions menu.

The feasibility of the web-based biology learning multimedia product was then tested on a small group of students. This test aims to obtai students' responses before being tested on large-scale students. The result shows that the products are in feasible criteria (score: 53.34-60.16). The website is ready for large-scale trials after going through revisions and improvements suggested by material experts, media experts, teachers, and student responses. The field test is a study with 34 students in the control class and 30 students in the experimental class.

Implementation and Evaluation

Learning independence

Data on independence in learning biology in conventional biology learning (control class) and students using web-based biology learning multimedia (experimental class) were taken before and after the implementation of learning.

In the control class, before the implementation of biology learning, students who had the independence of learning biology with the category of "very high" amounted to 1 person. Students who had the independence of learning biology with the category of "high" amounted to 9 people, and students who had the independence of learning biology with the "low" category were 12. Students who have the independence to learn biology in the "very low" category are 12 people. Compared to the independence of learning biology after the implementation of control class learning, the independence of learning biology has increased. Based on the number of students who experienced increased independence in learning biology in the "very high" category increased by 3%, the "high" category decreased by 6%, and the "low" category decreased by 3%. After being examined more deeply, two students experienced changes in their biology learning independence.

In the experimental class, prior to the implementation of biology learning, ten students had the "very high" category of learning biology in the "very high" category, ten students who had the "high" category of learning biology, and ten students who had the motivation to learn biology the "low" category is 10. Students who have the independence to learn biology in the "very low" category are nine people. Compared to the independence of learning biology after the implementation of experimental class learning, the independence of learning biology has increased. Based on the number of students who experienced an increase in the "very high" category increased by 6.6%, the "high" category increased by 6.7%, the "low" category increased by 3.3%, and the "very low" category increased by 10%. After being examined more deeply, 13 students experienced changes in their learning

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

independence of students, both decreasing and increasing. A comparison of the category of independent biology learning in control and experimental classes can be presented in Figure 3.

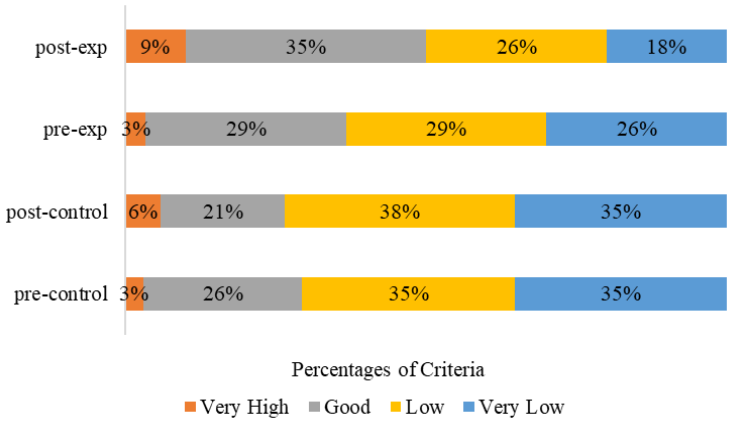

Figure 3. Profile of Students' Learning Independence Before and After Treatment

The effect of multimedia learning biology on students' biology learning independence can be seen through descriptive data and the results of hypothesis testing. Descriptive data show an increase in the average independence of learning biology before and after learning in the experimental class. Based on the results of hypothesis testing, it can be concluded that the use of web-based biology learning multimedia affects the independence of students' biology learning, following research conducted by Mawardi (2014) that the use of web-based multimedia has a higher level of learning independence compared to students who use CD-ROM and e-mail media.

The change of students after using web-based biology learning multimedia is the increasing independence of students' biology learning. These results can be seen from the intensity of students who access the website. In addition, the activities of working on the worksheets and practice questions provided in the multimedia are well utilized by students. Based on this, it can be concluded that web-based biology learning multimedia facilitates students to learn independently, reinforced by the questionnaire results, which showed an increase in the independence of learning biology when compared before and after using multimedia.

The increase occurred only slightly due to the influence on the learning process, hampered by the internet network, which was less stable when using web-based biology learning multimedia facilities. To assess the learning independence of students, the researchers made questions related to the Arthropoda material. Because the learning carried out had limitations in the internet network facilities in schools which were less stable, the researchers looked for other solutions by giving questions in the form of a worksheet to assess the learning independence of students. The activity of working on the worksheet can facilitate students as a substitute for online activities on multimedia which have a positive impact on increasing students' learning independence. The learning activities that took place consisted of 5M activities under the recommendations of the 2013 curriculum, including observing, asking questions, collecting data (information), associating, and concluding.

This information-gathering activity provides opportunities for students to read sources other than textbooks, and the use of multimedia can provide alternative learning resources. After students get the information, then in the activities of associating or processing the information obtained from multimedia. This information processing adds to the material's breadth and depth (Hosnan, 2014). Ultimately, learning biology students' independence can increase through gathering information and association.

Based on the score of learning independence in the experimental class with control, it can be seen that the learning independence of students in the experimental class is higher. The comparison shows that using web-based biology learning multimedia affects students' biology learning independence, but the comparison is not much different from the level of students' biology learning independence in the control class. The comparison that is not much different is influenced by the use and design of web-based learning multimedia. Activities in the experimental class learning process are the same as control

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

class activities, so the same learning activities can slightly influence learning independence. However, the experimental class is facilitated by web-based learning multimedia.

Learning multimedia design that presents learning objectives with structured materials can affect the independence of learning biology when compared to the learning objectives delivered in the conventional learning process. This finding follows the idea of Dabbagh & Kitsantas (2012) that students have independent learning if they know how to determine learning objectives, what is needed to achieve learning goals, and how to achieve them. Mawardi (2014) added that the efficacy of the learning model in fostering independent learning comes from learning design factors that foster motivation to learn as a fundamental component of independent learning. Web-based learning multimedia can be used by students anytime, anywhere, with the help of the internet network, so that the independence of learning biology students can increase in line with the results of Sari's research (2013) that the use of Blended Learning learning strategies in which there are online learning activities can increase students' learning independence.

Learning Motivation

Data on motivation to learn biology in conventional biology learning (control class) and students using web-based biology learning multimedia (experimental class) were taken before and after the implementation of learning. Based on the information on the results of field trials in the control class before the implementation of biology learning, students motivated to learn biology in the "very high" category is one person. The students who have the motivation to learn biology in the "high" category are five students, 15 students have the motivation to learn biology in the "low" category, and 13 students have the motivation to learn biology in the "very low" category. Compared to the motivation to learn biology after implementing the control class learning, the motivation to learn biology has increased. Based on the number of students who experienced an increase, the learning motivation of students in the "very high" category increased by 3%, the "high" category increased by 3%, the "low" category decreased by 3%, and the "very low" category decreased by 3%. After being examined more deeply, four students increased their motivation, and one decreased their motivation to learn biology.

At the beginning meeting of the experimental class, students who are motivated to learn biology in the "very high" category are 0, or there are no students who are motivated to learn biology in the "very high". Students who have the motivation to learn biology in the category "high" are eight people, students who have the motivation to learn biology in the "low" category are 13 people, and students who have the motivation to learn biology are in the "very low" category are nine people.

Compared to the motivation to learn biology after the implementation of the experimental class, the motivation to learn biology has increased. Based on students who experienced an increase, motivation to learn biology in the "very high" category increased by 17%, in the "high" category increased by 3%, in the "low" category decreased by 10%, and in the "very low" category decreased by 10%. After being examined more deeply, 15 students increased their motivation, and two decreased their motivation to learn biology. The comparison of students' motivation to learn biology before and after the implementation of biology learning in the control and experimental classes can be presented in Figure 4.

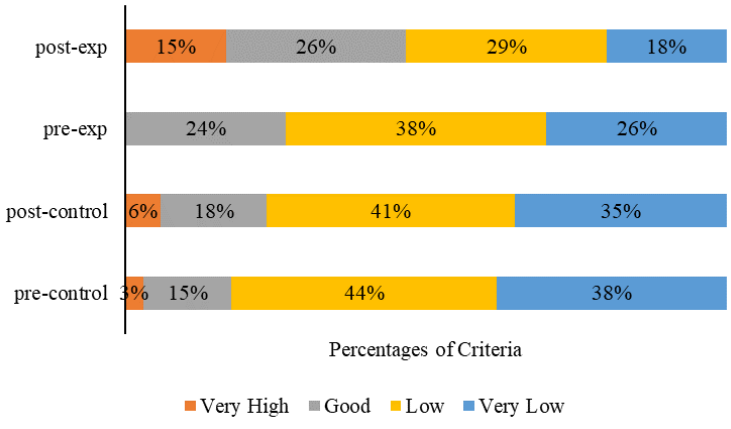

Figure 4. Profile of Students' Learning Motivation Before and After Treatment

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

According to Figure 4, student's motivation to learn biology increases using web-based biology learning multimedia. This finding is supported and strengthened by the fact that students have a visual learning style in these schools. Therefore, web-based biology learning multimedia is suitable to be developed and implemented in the school (Pesare, 2016). The fact shows that it is difficult for schools to provide realia media for Arthropod material. When viewed from the questionnaires filled out by students, the results of web-based biology learning multimedia showed an increase in learning motivation from before to after. Therefore, it can be concluded that web-based biology learning multimedia is suitable for increasing students' motivation to learn biology.

The influence of multimedia learning biology on students' motivation to learn biology can be seen through descriptive data and the results of hypothesis testing. Descriptive data show an average increase in motivation to learn biology before and after learning in the experimental class. Based on the results of hypothesis testing, it can be concluded that the use of web-based biology learning multimedia affects students' motivation to learn biology. This is following research conducted by Sjukur (2012). There are differences in learning motivation between students who are taught through online and face-to-face learning compared to students who are taught in conventional learning, reinforced by the results of research conducted by Sari & Sugiyarto (2015) that the use of problem-based learning multimedia is effective to increase students' learning motivation.

The increase occurred only slightly due to the influence of web-based biology learning multimedia. The multimedia developed utilizes the Moodle system as a basis for setting user activities (students), one of which is a user login system before entering, making it difficult for students even though the main page has been given login instructions. The difficulties of these students can harm their motivation of students. In line with Purbo (2002), socialization in media use needs to be done so that students are familiar with the biology learning process in the classroom by utilizing web-based biology learning media sources.

An increase occurred due to the activity of asking questions in the form of online quizzes available in learning multimedia. Students are asked to answer the questions in the quiz. The questions displayed on multimedia, the sequence of numbers are randomized, and after completing the quiz, students get feedback (reciprocity) and see the right answers so that students can feel curious and motivated to try to answer the quiz questions presented. According to Rudestam & Schoenholtz-Read (2010), informative feedback will encourage students to try and provide real help on how students can correct their answers. Hosnan (2014) explains that students' willingness and readiness to follow the learning process will be able to generate a good response to the stimulus they receive in the learning process.

Students' motivation to learn biology can be influenced by the presentation of material in web-based biology learning multimedia, namely supporting images and other videos, to increase students' insight regarding the material being studied. Supporting images and videos presented in multimedia are related to Arthropod material. Mayer (2009) explains that pictures can help students in the process of understanding a material. From the score of learning motivation in the experimental class with control, it can be seen that the learning motivation of students in the experimental class is higher. The comparison shows that using web-based biology learning multimedia affects students' motivation to learn biology, but the comparison is not much different from the level of student motivation to learn biology in the control class.

The standard design of the theme on each page makes the developed biology learning multimedia not yet provide a maximum function in increasing students' motivation to learn biology. Hanharan (1998) adds that educators have a very important role in understanding the natural relationship with students, especially in the learning process in the classroom, so that educators can choose and select activities that can affect the increase in students' motivation in learning. This is in line with the opinion of Sanjaya (2010) that teachers can plan to learn by utilizing various appropriate learning resources to take place effectively and efficiently.

Learning Outcome

The learning outcomes measured in this study were cognitive. The measurement is done by calculating the difference in the value of the pre-test and post-test results given to students. The control class learning outcomes before the implementation of biology learning showed an average value of 64.55, while after the implementation of biology learning, the average value was 73.52. Learning

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

outcomes in the experimental class before the implementation of biology learning showed an average value of 61.75, while after the implementation of biology learning showed an average value of 71.08. A summary of the pre-test and post-test data obtained by the experimental and control class can be presented in Figure 5.

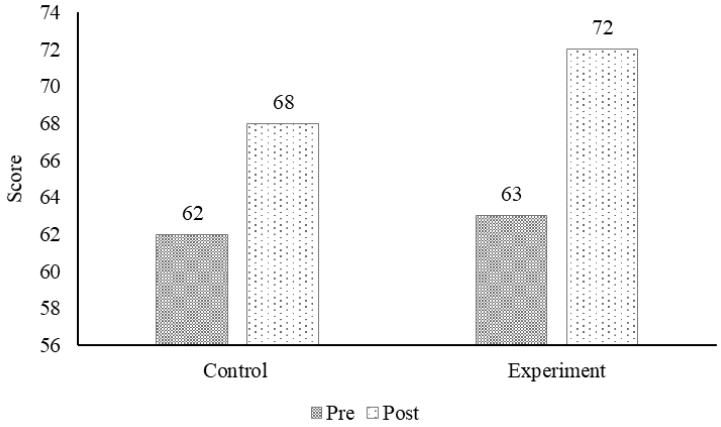

Figure 5. the Average Score of Learning Outcomes

Student learning outcomes increase when using multimedia learning biology, along with students' increasing independence and motivation to learn biology. In addition, the practice questions provided in the multimedia learning biology provide opportunities for students to practice by working on the practice questions. The effect of multimedia learning biology on students' biology learning outcomes can be seen through the pre-test and post-test results, which were calculated by analyzing paired sample t-tests. Quantitative data shows an increase in the average learning outcomes of the experimental class biology before and after the learning process. Based on the results of hypothesis testing, it can be concluded that web-based biology learning multimedia affects students' biology learning outcomes. This follows the research of Wahyudin et al. (2010) that the average value of student learning outcomes using multimedia increases.

Based on the results of quantitative data analysis, it can be concluded that the experimental class significantly improved more than the control class. Student learning outcomes increased by 15% in the experimental and 13% in the control classes. According to Sandi (2012), there are differences in the learning outcomes of students who take part in the BL learning process and students who take direct learning. The average score of learning outcomes of students who participate in the BL learning process is higher than that of students who do not. In line with Zyainuri & Marpanaji (2012) study, student learning outcomes increased by 80%.

The improvement of students' biology learning outcomes is due to changes in behaviour and reinforcement in the learning process. Changes in behaviour as a result of learning occur through training and experience and are given reinforcement in a purposeful and directed manner (Hosnan, 2014). Students who plan, implement and self-assess the learning experience that has been undertaken and carried out by the individual concerned (Hosnan, 2014). In the learning process of the experimental class, the teacher provides online activities such as quizzes and chats so that students can learn independently, although activities replace these online activities with filling out worksheets. The activity of filling out a worksheet in which there are activities of gathering information and associating can have a positive effect on improving students' biology learning outcomes.

In addition, the average score for the biology learning outcomes of students, the average score for the biology learning outcomes of experimental class students is higher than the control class. The comparison shows a positive effect of using web-based biology learning multimedia on students' biology learning outcomes, but the comparison is not much different from the level of student's motivation to learn biology in the control class. Mawardi (2014) also proves that the effectiveness of the learning model that utilizes multimedia positively impacts the competence of learning outcomes.

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

Further Research

Web-based biology learning multimedia is feasible to be used in the biology learning process at school because this multimedia has some advantages. Easy accessibility, attractiveness, ease of navigation, and facilities support teacher assessment of students, one of which is direct online quizzes, and providing feedback can help students to be studied in depth. This result is similar to Muhimmatin & Iis (2021), which show that the online test that is carried out makes it easier for students to fill out the test, and the teacher can see the test results directly. In addition, the ease of access to web-based biology learning multimedia can be accessed via a PC (Personal Computer), laptop, or android device. Thus, it will make it easy for users, especially students, because this multimedia can be accessed anytime, anywhere, without any space and time limits.

Moreover, Wati et al. (2021) declare that web-based learning will be effective if student students access the website for more than 1.5 hours. In addition, the user is also important to be socialized because the goal is that students can adapt to the new learning process. O'Neill et al. (2004) state that the implementation of e-learning strongly influences students. For this reason, socialization is needed because there is a shift in learning styles so that the learning environment can be carried out properly.

The advantages of web-based biology learning multimedia developed by researchers cannot be separated from its shortcomings. One of these weaknesses is the presentation of videos on the content of material taken from other sources, so some videos still use English narration. The next weakness is the online quiz facility and visitor activity control. The online quiz on Arthropoda material is only effective for multiple choice questions, but the essay format cannot be assessed directly and cannot provide feedback. The web system for reading student answers must match the answer key created. Another answer key with the same intent will be considered incorrect.

Activity control is limited to system reports containing the user's last log in based on log in time. This can make it difficult for teachers to control if the teacher's assessment is included in the students' reading activities. Moreover, the main weakness in this web-based biology learning multimedia is that it must use an adequate internet connection. If the internet connection speed is inadequate, this web-based biology learning multimedia will experience bugs and be difficult to appear or use. The web-based biology learning multimedia developed in this study is complementary to classroom learning, so the product developed can be used as an alternative source of biology learning and improve the quality of learning and student learning outcomes. Therefore, this research needs to be developed to find other influences in improving the quality of biology learning.

CONCLUSION

The results of the development and research show that the product of this research is web-based biology learning multimedia that can be accessed anytime, anywhere, using a web browser. The multimedia is equipped with online quiz facilities and displays interesting pictures and videos suitable for use after being revised according to suggestions and criticisms by media experts, material experts, peer assessments, and small group tests to be used as a source for learning biology on Animalia material. Arthropod sub concept. The use of web-based learning multimedia can increase students' independence and motivation to learn biology on the material Animalia sub-concept of Arthropoda. In addition, the development of multimedia learning affects improving student learning outcomes. Suggestions for the use of biology learning multimedia developed in this study include: web-based biology learning multimedia can be developed in the future by adding other essential materials besides Arthropoda material in biology subjects so that the biology learning multimedia developed in this study can be used optimally in learning biology in class, wherever and whenever students are; schools in other subjects can use web-based biology learning multimedia; Web-based biology learning multimedia can be developed better in further research on other materials to measure students' abilities in the cognitive, affective, psychomotor, and social domains.

REFERENCES

Akbar, S. (2013). *Instrumen perangkat pembelajaran.* PT. Remaja Rosdakarya.

Alessi, S. M., & Trollip, S. R. (2001). *Multimedia for learning (3rd ed.).* Pearson Education Company.

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50*, 248-287. https://doi.org/10.1016/0749-5978(91)90022-L

Dabbagh, N. & Kitsantas, A. (2012). Personal learning environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *Internet and Higher Education, 15*(1), 3-8. https://doi.org/10.1016/j.iheduc.2011.06.002

Hamalik, O. (2017). *Proses Belajar Mengajar.* Bumi Aksara

Hanharan, M. (1998). The effect of the learning environment factors on students' motivation and learning. *International Journal of Science Education, 20*(6), 737-753. https://doi.org/10.1080/0950069980200609

Glynn, S. M., Taasoobshirazi, G., & Brickman, P. (2009). Science motivation questionnaire: Construct validation with nonscience majors. Journal of Research in Science Teaching: *The Official Journal of the National Association for Research in Science Teaching, 46*(2), 127-146. https://doi.org/10.1002/tea.20267

Hosnan, M. (2014). *Pendekatan saintifik dan kontekstual dalam pembelajaran abad 21*. Ghalia Indonesia.

Mawardi (2014). Keefektifan desain pembelajaran berbasis e-learning dalam menumbuhkan kemandirian dan hasil belajar mahasiswa. *Seminar Nasional, Universitas Kristen Satya Wacana*, Salatiga.

Mayer, R. E. (2009). *Multimedia learning (2nd ed.).* Cambridge University Press

Muhimmatin, I. & Iis, N.J. (2021). Aplikasi mobile android sebagai media tes prior knowledge mahasiswa biologi. *Jurnal Inovasi Pendidikan IPA, 7*(1), 2021, 1-11. https://doi.org/10.21831/jipi.v7i1.34335

O'neill, K., Singh, G., & O'donoghue, J. (2004). Implementing elearning programmes for higher education: A review of the literature. *Journal of Information Technology Education: Research, 3*(1), 313-323.

Pesare, E., Teresa R., Nicola C., & Veronica R. (2016). Game-based learning and gamification to promote engagement and motivation in medical learning contexts. *Smart Learning Environments, 3*(5), 1-21. https://doi.org/10.1186/s40561-016-0028-0

Purbo, O. W. (2002). *Teknologi e-learning berbasis PHP dan MySQL*. Elex Media Komputindo.

Sanjaya, W. (2008). *Perencanaan dan desain pembelajaran*. Kencana.

Sari, A. R. (2013). Strategi blended learning untuk peningkatan kemandirian belajar dan kemampuan critical thinking mahasiswa di era digital. *Jurnal Pendidikan Akutansi Indonesia, 11*(2), 32-43. https://doi.org/10.21831/jpai.v11i2.1689

Sari, D., & Sugiyarto, K. (2015). Pengembangan multimedia berbasis masalah untuk meningkatkan motivasi belajar dan kemampuan berpikir kritis siswa. *Jurnal Inovasi Pendidikan IPA, 1*(2), 153 - 166. https:// doi.org/10.21831/jipi.v1i2.7501

Sjukur, S. B. (2012) Pengaruh blended learning terhadap motivasi belajar dan hasil belajar siswa tingkat SMK. *Jurnal Pendidikan Vokasi, 2*(3) 268-378. https://doi.org/10.21831/jpv.v2i3.1043

Sujatmiko & Nurlaili, L. (2003). *Kurikulum berbasis kompetensi.* Depdiknas.

Rudestam, K. E. & Schoenholtz-read, J. (2010). *Handbook of online learning.* Sage Publications

Rusdiana. (2014). *Konsep Inovasi Pendidikan.* CV Pustaka Setia.

Uno, H. B. (2013). *Teori motivasi dan pengukurannya: Analisis di bidang pendidikan.* Bumi Aksara.

Uno, H. B. (2021). *Teori motivasi dan pengukurannya: Analisis di bidang pendidikan.* Bumi Aksara.

Wahyudi, Sutikno, Isa A. (2010). Kefektifan pembelajaran berbantuan multimedia menggunakan metode inkuiri terbimbing untuk meningkatkan minat dan pemahaman siswa. *Jurnal Pendidikan Fisika Indonesia, 6*(1), 58-62. https://doi.org/10.15294/jpfi.v6i1.1105

Wati, D.W., Sardianto, M.S., & Ketang, W. (2021) Pengembangan perangkat e-learning materi gerak melingkar menggunakan LMS Chamilo. *Jurnal Inovasi Pendidikan IPA, 7*(2), 128-138. https://doi.org/10.21831/jipi.v7i2.37460

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Education Psychology, 81*(3), 329-339. https://psycnet.apa.org/doi/10.1037/0022-0663.81.3.329

Zyainuri & Eko, M. (2012). Penerapan e-learning moodle untuk pembelajaran siswa yang melaksanakan prakerin. *Jurnal Pendidikan Vokasi, 2*(3), 410-426. https://doi.org/10.21831/jpv.v2i3.1046

ISSN 2406-9205 (print), ISSN 2477-4820 (online)