Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang. Vol. 12(2) pp 1-8 ISSN:2339-0786
DOI: https://doi.org/10.26714/jps.12.2.2024.1-8

JPS JOURNAL PENDIDIKAN SAINS | JURNAL PENDIDIKAN SAINS
p-ISSN : 2339-0786 e-ISSN : 2502-1443
UNIVERSITAS MUHAMMADIYAH SEMARANG

Effect of the Discovery Learning Model Assisted by Evolution Video on Concept Mastery and Science Literacy in High School Students

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Article history
Submission : 2024-06-14
Revised : 2024-10-06
Accepted : 2024-10-06

Keyword
Discovery learning
Evolution Video
Concept Mastery
Scientific Literacy

Abstract

The objective of this research is to examine the impact of the Discovery learning model, supplemented by evolution films, on concept mastery and scientific literacy in the classroom. This study involved class XII students from SMA Negeri 1 Ngaglik, Sleman Yogyakarta. The research sample was determined using a purposive sampling technique, yielding two classes: 1 class as the control class and the other as the experimental class. The data was collected using a pretest, posttest, and final assessment. Data was analyzed using SPSS 27. The research results show that the value of Asymp. Sig. (2-tailed) from the Mann-Whitney test, mastery of experimental class concepts was <0.001 ($p<0.05$) and scientific literacy was 0.032 ($p<0.05$), indicating that the application of the discovery learning model assisted by evolutionary videos affected increasing the mastery of concepts and scientific literacy of students at Ngaglik 1 State High School.

1. INTRODUCTION

Education is an essential component of human life since it helps shape people's self-control and potential development. (Syam et al., 2022). As a result, the learning process has become an important stage in enhancing human quality and accomplishing national education objectives. According to UNESCO's Syam et al. (2022), to achieve learning effectiveness, four pillars of education must be considered: learning to know, learning to do, learning to be, and learning to live together. With support from these four pillars, Indonesia may foster an educational mindset that is comprehensive, flexible, and relevant to the moment's demands, thereby contributing to the development of an inclusive, cultured, and global-minded society. However, in their implementation, these four pillars need to be modified to the eras and features of these present generations.

The present generation was born concurrently with rapid technical advancements. The current generation's acquaintance with technology develops them into a generation with distinct traits from past generations, so the educational system must continue to modernize all subjects of study. Biology is a branch of study that is constantly evolving. Biology is a discipline of science that

focuses on direct learning experiences through process skills and attitudes. (Nurwahidah, 2023). Biological material consists of many complex and concrete concepts and not all biological objects can be observed instantly without the use of tools. As a result, biological material is sometimes considered abstract and requires the use of tools to understand, and biological material frequently triggers misconceptions.

Evolutionary material is one of the materials from biology that frequently provokes misconceptions due to students' misunderstanding of concepts connected to scientific studies of evolution, particularly Darwin's theory of evolution. This hypothesis remains controversial for some people because it contradicts religious beliefs and teachings, particularly those concerning human evolution. (Nurdiansyah et al.,2022) This can make it challenging for teachers to teach and provide pupils with a knowledge of evolutionary content. However, the teacher's issue is not only in delivering material, but also in ensuring that the biological process in this material runs according to its nature, which comprises processes, products, attitudes, and technologies (Carin, 1997). (Carin, 1997). As a result, learning biology must use suitable sources, materials, media, and learning models to ensure that scientific activities and products yield better student learning outcomes in evolutionary content.

To achieve scientific activity and successful products that increase student learning outcomes, teachers must be aware of contemporary educational advancements that are inextricably linked to the existence of the 4.0 revolution (digital revolution). The digital revolution requires 21st-century education to equip students with critical, communicative, collaborative, and creative abilities. (Priyanto. 2019). Thus, learning in this period requires collaboration between modern instruction processes and technology. Furthermore, to compete in the knowledge era, students must demonstrate high competency and a thorough understanding of topics. According to Konicek and Keeley (2015) in their book *Teaching for Conceptual Understanding in Science*, students can be said to have the ability to master the material if they can (a) think using the concept, (b) apply in other fields other than the field that has been studied, (c) explain using their language, (d) find analogies related to the concept, and (e) build *prototypes* both physical and non-physical regarding the concept.

However, in addition to concept comprehension, students must increase their science literacy to compete effectively in the twenty-first century. The OECD (2023) defines science literacy as students' ability to engage with science challenges and concepts reflectively and scientifically. According to Marantika (2018), children who understand concepts well will demonstrate better science literacy skills.

However, the educational process in Indonesia remains suboptimal in terms of supporting students' knowledge development, conceptual mastery, and science literacy. According to Nugroho and Gunansyah (2013), students' conceptual mastery is extremely low, which is due to tough and ambiguous evaluations and uninteresting learning medium. In addition, science literacy in Indonesia is inadequate, with PISA scores falling from 396 in 2018 to 383 in 2022. (OECD, 2023). Contributing issues include a lack of engaging and relevant learning tools, which generates the perception that science education is difficult to understand.

The above-mentioned low concept mastery and science literacy variables were observed in SMA Negeri 1 Ngaglik. This is owing to the employment of expository learning approaches that remain teacher-centered, particularly in evolution topics. This strategy reduces students' active participation in creating understanding autonomously, which hurts their concept mastering. Teacher-centered learning also discourages critical thinking and investigation, both of which are necessary for science literacy. Furthermore, evolution learning at SMA Negeri 1 Ngaglik lacks engaging supporting media and does not include genuine evolutionary occurrences. This reduces pupils' motivation to learn and makes them appear uninterested in learning progression.

As a result, selecting appropriate learning models and media can boost and improve concept mastering (Mashuri, 2019). One model that can be used is a constructivist-based learning model like the discovery learning model. Discovery learning is an excellent model since it provides a scientific approach that allows students to investigate facts, data, and issues to develop an understanding of key ideas. (Nugrahaeni et al., 2017). To be effective, this strategy must be accompanied by appropriate learning media, such as films, which can promote concept mastering by presenting complicated knowledge attractively and understandably (Lumbantobing et al., 2019).

This motivates researchers to research the application of the discovery learning model with the help of evolution videos developed in the research "Development of Evolution Learning Videos with a Deductive Approach to Improve Science Literacy of High School Students" because the videos developed contain phenomena, facts, and data that can be analyzed by students, allowing students to construct their knowledge about evolution and create a learning environment that The use of technology in learning, such as this video, is expected to assist students in developing the science literacy required in the era of revolution 4.0.

2. METHOD

The research design was quasi-experimental, with a nonequivalent control group design and two classes: experimental and control. The experimental class was treated with a discovery learning model aided by an evolution video, while the control class was treated with an expository model assisted by a PowerPoint slide deck, which is routinely utilized by local teachers. This research was conducted at SMAN 1 Ngaglik from October to November 2023 of the 2023/2024 school year, with research subjects being 12th graders at IPA SMAN 1 Ngaglik. The research sampling was conducted utilizing the purposive sampling technique, which was chosen by the teaching teacher at school based on the class's general ability, resulting in XII IPA 1 as the control class and XII IPA 2 as the experimental class.

Concept mastery and science literacy were assessed using test instruments consisting of 15 multiple-choice questions administered before and after the test. The test instrument was validated by qualified lecturers and practitioners, including high school teachers. The instrument used in this research is based on the instrument that had been used in product development research done by Sulchan (Hidayat et al., 2024). Those instruments had been discussed with the lecturer in the biology education department and the biology teacher. The questions that had not been appropriate were then revised to 100% fit. The validity test utilizing the validation instrument demonstrates that the question instrument meets all markers of the construction/content and language elements, indicating that it is valid and appropriate for usage.

The research stages are detailed below. (1) Pretest: Researchers administered pretest questions to determine what level of ability connected to evolution material before learning began. (2) Treatment: At this stage, researchers used the discovery learning model with evolution videos in the experimental class and the model commonly used by local teachers in the control class. (3) Posttest: At this stage, researchers evaluated student learning outcomes, particularly concept mastery and student science literacy, to determine students' final ability after treatment.

The data were examined quantitatively and qualitatively, named mixed methods research data (Johnson & Christensen, 2024). Quantitative analysis was performed by comparing the pretest and posttest test outcomes of control and experimental classes. The data was analyzed using the SPSS version 27 application. First, the data will be checked for normality and homogeneity. Following that, the data will be examined with hypothesis analysis tests, namely the independent sample t-test and the effect size test. If the data does not meet the precondition test, a nonparametric test will be employed. The t-test findings were evaluated at a significance level of 5%. The discovery learning model with evolution video has an effect if the significance value is less than or equal to 0.05 ($p < 0.05$), and no effect if it is greater than 0.05 ($p > 0.05$). Then, the effect size test is used to determine the magnitude of the effect. Meanwhile, qualitative analysis was conducted by reviewing the learning process implementation sheet, test results, and paperwork, which were then examined descriptively and utilized as reference material to determine the effectiveness of the treatment.

3. RESULTS AND DISCUSSION

Dimensionality

Table 1 shows a summary of the data analysis results for pretest and posttest scores in the experimental and control classes. There is a difference in average scores, indicating that learning with the discovery learning paradigm, aided by evolutionary films, has an impact on concept mastery and science literacy of 12th-grade students studying evolution.

Table 1. Data on Concept Mastery and Science Literacy

Data	Experiment Class		Control Class	
	Concept mastery	Science Literacy	Concept mastery	Science Literacy
Lowest score	43	30	14	13
Highest score	100	50	43	38
Average	64.4	38	33.8	30.9

Table 1 illustrates a difference in the average concept mastery and science literacy scores between the experimental and control groups. These findings indicate that the experimental class concept mastery value is 30.6 points higher than the control class mastery value, and the experimental class student science literacy value is 7.1 points higher than the control class. This demonstrates that providing a discovery learning paradigm supplemented by evolution videos has a good impact on improving concept mastery and science literacy in evolution content. The research hypothesis test will be used to determine whether or whether the discovery learning paradigm, supplemented by the evolution video, affects concept mastery and science literacy.

Prior to doing hypothesis testing, two basic tests must be met: normality and homogeneity. The Kolmogorov-Smirnov Test was used to assess data distribution normality at a 5% significance level ($\alpha = 0.05$). The results of the normality test analysis are presented in Table 2.

Table 2. Normality Test Results

Class	Significance Value *Kolmogorov-Smirnov*	
	Pretest	*Posttest*
Experiment Class	0.002	<0.001
Control Class	<0.001	<0.001

The Kolmogorov-Smirnov Test has a significance value of less than 0.05 for all groups, as shown in Table 2. As a result, the experimental and control classes cannot be considered normally distributed. The Levene Test was used to assess homogeneity at a 5% significance level ($\alpha = 0.05$). Table 3 shows the homogeneity test findings

Table 3. Homogeneity Test Results

Data	Significance Value	
	Experiment Class	Control Class
Pretest	0.321	
	0.180	

Table 3 shows that all groups have a significant value in the homogeneity test of greater than 0.05, implying that the experimental and control groups in this study are homogeneous. The results of the preparatory test show that both classes are homogeneous but not normally distributed, which means that the data does not match the parametric test's requirements. In this study, the hypothesis was tested using non-parametric tests. The Mann-Whitney Test was used to assess pupils' ability to learn concepts and understand science. Table 4 shows the results of the Mann-Whitney test.

Table 4. *Mann-Whitney* Test Results

Students' Initial Ability	Significance Value
Concept Mastery	<0.001
Science Literacy	0.032

Table 4 shows that the significance value of the Mann-Whitney Test is less than 0.05, implying that there is a significant difference in the ability to master concepts and science literacy between the control and experimental classes, implying that the provision of the discovery learning model, aided by this evolution video, significantly increases students' ability to master concepts and science literacy.

This data also reveals that students' concept mastery and science literacy improve significantly after receiving treatment in the form of a discovery learning approach supplemented with an evolution film. This assertion is consistent with Suryadi and Hasbul's (2024) observation that the learning model or method used by the instructor or educator influences student achievement.

The preceding conclusion is also corroborated by the Effect size test (Table 5), which demonstrates that students have a high level of concept mastery and a medium level of science literacy. As a result, using the discovery learning methodology in conjunction with evolution videos can effectively boost high school students' topic comprehension and science literacy. The preceding conclusion is also corroborated by the Effect size test (Table 5), which demonstrates that students have a high level of concept mastery and a medium level of science literacy. As a result, using the discovery learning methodology in conjunction with evolution videos can effectively boost high school students' topic comprehension and science literacy.

Table 5. *Effect size* test results

Class	Z Score	N	Cohen's D	Category
Concept Mastery	5.576	50	2.565	High
Science Literacy	2.150	50	0.638	Medium

Akpan et al. (2020) stated the discovery learning model is a good alternative for achieving meaningful learning by learning objectives, particularly in transferring and retaining knowledge to improve students' mastery of concepts and science literacy because the discovery learning model directs students to independently construct their knowledge using experiments and conclude from the results of these experiments. So that students have a thorough understanding of the content being studied. This methodology also forces students to actively participate in learning and discovery so that they become accustomed to analyzing and identifying problems, which is a fundamental principle in the development of science literacy abilities. This is supported by Ermawati et al.'s (2023) statement that a learning process that focuses on listening, memorizing, and copying without analyzing, discovering, and understanding the application of knowledge will result in low student science literacy skills, particularly in the areas of science attitudes and science knowledge.

The preceding remark is consistent with the findings of the study, which found that using the discovery learning model in conjunction with evolution films improved SMA Negeri 1 Ngaglik students' conceptual knowledge and scientific literacy. This conclusion is supported not just by an increase in average pretest-posttest scores, but also by the findings of students' qualitative descriptive analyses of the question instruments. Table 7 shows the findings of a qualitative descriptive analysis of the pretest and posttest question instruments.

Table 6. Results of Descriptive Qualitative Analysis of *Pretest* and *Posttest* Question Instruments

Description	Experiment Class		Control Class	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Many questions were answered incorrectly	6	5	9	9
Many questions were answered correctly	5	6	5	3

Table 6 depicts that student answers alter between the pretest and the posttest. This change implies that SMA N 1 Ngaglik students have improved their concept mastery and science literacy. However, the gain in concept understanding and science literacy was only observed in the experimental class. This increase occurred in the experimental class as a result of the discovery learning model's ability to direct students to gain knowledge independently, as well as video learning media that provides a realistic picture of evolution material, allowing students to have deep concept

mastery and good science literacy. Widyastuti et al. (2024) stated, that the discovery learning model can encourage students to investigate to get a deep knowledge because students do not just memorize topics, but also discover them on their own.

The amount of questions answered incorrectly in both the control and experimental courses demonstrates that both classes continue to have low beginning abilities in terms of concept comprehension and scientific literacy of evolutionary content. A variety of reasons contribute to pupils' lack of early topic understanding and scientific literacy during this pretest. Unpreparedness when confronted with new material is a prevalent factor among students. According to Zahra and Najibufahmi (2023), students' initial ability is the ability they have before studying and demonstrates their preparedness to accept new material, hence students' initial ability influences their learning success.

Meanwhile, correctly answered pretest questions do not always reflect a deep understanding or command of subjects, nor do they necessarily indicate excellent science literacy. Some pupils may be able to accurately answer questions due to limited knowledge or chance. This is due to the pretest's sole objective, which is to determine the degree of student understanding prior to studying. (Adri, 2020), as indicated by the existence of students who properly answered the pretest but wrongly on the posttest.

The experimental class pupils performed better on the posttest than the control class. Table 6 further shows that the number of questions correctly answered by students in the experimental class increased whereas the control class did not. The greater frequency of correctly answered questions implies that experimental class students have improved their conceptual understanding and scientific literacy. The application of discovery learning, aided by evolution videos, can increase concept mastery and science literacy by allowing students to develop information autonomously, allowing pupils to get a thorough comprehension of the content being studied. This is consistent with Saptaningrum's (2024) assertion that the data processing stage of the discovery learning syntax assists students in building knowledge independently and in groups to understand the content being studied.

The use of evolution video learning material developed by Ahmad Sulchan Hidayat also helped to improve the learning process in the experimental class. The application of this evolution movie allows students to acquire visualization of complicated concepts on evolutionary material in the Sangiran Museum in real time without actually visiting the Sangiran Museum. In addition, the utilization of videos allows students to learn about Sangiran without physically visiting the museum. Students can study and see the sangria without having to visit the museum, which saves them time, money, and energy. This statement is consistent with Faridah and Pujangga's (2024) research, which found that the usage of educational video materials can be a useful method to facilitate student-centered learning and improve students' comprehension of the issue.

According to the findings of the qualitative descriptive analysis, the questions answered by students demonstrate that the improvement in idea understanding is linear with science literacy. Students' ability to accurately answer concept mastery questions is proportionate to their ability to correctly answer science literacy questions, and vice versa. This suggests that the capacity to answer concept mastery questions is directly proportionate to the ability to answer scientific literacy questions. This is corroborated by Erniwati et al. (2020) and Rosandi et al. (2016), who argue that students' low science literacy is due to a lack of concept mastery and that enhancing concept mastery will enhance science literacy.

4. CONCLUSION

Based on the findings of the data analysis and discussion, it is possible to infer that the use of the discovery learning model in conjunction with the evolution video has a substantial impact on concept mastery and science literacy among XII-grade students at SMA Negeri 1 Ngaglik. The Mann-Whitney Test on pupils yielded a significance value of <0.001 for concept mastery and 0.032 for science literacy, indicating a value less than 0.05. As a result, the adoption of the discovery learning model learning approach, aided by evolution videos, has been shown to improve concept understanding and science literacy in learning evolution, particularly among SMA Negeri 1 Ngaglik class XII students.

ACKNOWLEDGMENT

The authors would like to thank the research group of instructional media and learning resources and the Audio Visual laboratory team in the Department of Biology Education, Faculty of Mathematics and Natural Sciences. Also, thank the principal of SMA 1 Ngaglik for all kinds of support during the data collection in school.

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