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# Applying Meaningful Learning (NGL and Game) to Improve Students' Scientific Concept Understanding and Scientific Literacy in Reproductive System Material

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## ABSTRACT

*Scientific concept understanding and scientific literacy are essential for students to have. Excellent scientific concept understanding and scientific literacy make it easier for students to learn new material and solve problems they face. This study aims to increase junior high school students' scientific concept understanding and scientific literacy in reproductive system materials by applying meaningful learning with NGL games. The design used in this research is Classroom Action Research (CAR) by Kammi and McTaggart (1988). The research was conducted at SMP Islam Bani Hasyim, Malang Regency, in September 2022 with 20 grade-nine students for the 2022/2023 academic year. Data collection techniques in this study are observation and tests. Data analysis techniques in research are descriptive quantitative and descriptive qualitative The CAR research was carried out in two cycles with the stages of planning, implementing, observing, and reflecting. Applying meaningful learning with the NGL game can improve students' scientific concept understanding and literacy in reproductive system materials.*

**Keywords:** 21st Century skills, Game-based learning, Meaningful learning, Scientific literacy, Conceptual understanding

## INTRODUCTION

Conceptual understanding is one of the most important abilities students have. A good conceptual understanding makes it easier for students to learn new material. Conceptual understanding is memorizing and learning concrete examples so students can define information themselves (Kholidah & Sujadi, 2018). Students understand concepts better if they can re-explain the concepts learned in their own language and apply them in everyday life (Juniantari, Pujawan, & Widhiasih, 2018). Students with an excellent conceptual understanding easily solve problems and relate them to previously provided knowledge (Suendarti & Liberna, 2021)

Scientific literacy is a person's ability to use scientific concepts to apply them in

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everyday life, explain scientific phenomena, and describe them based on scientific evidence (Fuadi, Robbia, Jamaluddin, & Jufri, 2020). By applying it to science learning, scientific literacy is one of the main keys to facing challenges in the current era. Through this, students are expected to be able to understand scientific concepts and processes needed in life to overcome problems (Asrizal, Festiyed, & Sumarmin, 2017; Atikasari & Desstya, 2022). Scientific literacy must be instilled as early as possible in students. Scientific literacy is oriented towards the importance of thinking and acting skills, which involve mastering thinking and using scientific ways to recognize and address social issues (Huryah, Sumarmin, & Effendi, 2017; Pratiwi, Cari, & Aminah, 2019). Scientific literacy is essential for students to understand the environment, health, economics, modern society, and technology (Pratiwi et al., 2019).

Field observations at SMP Islam Bani Hasyim showed that students still had difficulties working on questions that applied the science concept. Students are also less accustomed to working on scientific literacy questions. Besides that, students tend to be fixated on gadgets after the pandemic. Many students have not maximized the use of technology, such as smartphones, in learning activities. Smartphones are only used as a place to read social media and media to play games. The tendency of students to play on smartphones also affects their conceptual understanding of learning, especially the reproductive system. This statement aligns with Syahdiani, Kardi, & Sanjaya (2017) that the reproductive system is a difficult material because it is abstract. In addition, Qadariah, Lestari, & Rohman (2019) showed that reproductive system material is abstract and complex, the concept is in the form of understanding, its application is complex in real life, and there is a lack of learning resources.

Meaningful learning links new information to relevant concepts in one's cognitive structure (Rahmah, 2018). In meaningful learning, activities must be related to students' concepts so that these new concepts are genuinely understood (Najib & Elhefni, 2016). Meaningful learning occurs when people associate new phenomena with their knowledge structure. In the learning process, a person constructs what he learns and associates new experiences, phenomena, and facts with the structure of their knowledge (Baharuddin, 2020).

Smartphones are widely used today for various reasons and choices (Putra, Nugroho, & Puspitarini, 2016). Digital educational games are learning with the help of digital games. For this reason, learning and teaching are closely related to using games (Setiawan, Praherdhiono, & Suthoni, 2019). This aligns with Nurhayati (2020) that educational games are used as learning media that can be integrated with evaluation questions to create interesting, fun, and active learning.

The teacher must build scientific literacy to be embedded with scientific facts in students. In this 21st-century learning, scientific literacy is considered the key to learning outcomes in education. Thus, innovation is needed in science learning to improve students' ability to apply science concepts (Betari, Yanthi, & Rostika, 2016). In line with this, Pratiwi et al. (2019) stated that 21st-century learning must be based on science-oriented learning. Learning centers on memorizing knowledge, scientific achievement, and processes. Learning such as meaningful learning by utilizing interesting games is needed to prepare students who are excellent, scientifically literate, and understand concepts well. This research aims to implement game-based meaningful learning to improve junior high school students' understanding of scientific concepts and literacy on the reproductive system.

## METHODS

The design used in this research is Classroom Action Research (CAR). The CAR model is Kammi and McTaggart's (1988) with four stages: planning, implementing, observing, and reflecting. The research was conducted at SMP Islam Bani Hasyim, Malang Regency, in September 2022. The research subjects were 20 grade-nine students for the 2022/2023

academic year.

CAR research uses Kemmis and McTaggart's model with two cycles (Figure 1). The planning stage is action planning based on the results of observing the initial conditions. This process includes determining the learning to be applied, preparing reproductive system learning tools according to basic competencies 3.1 (linking the human reproductive system and disorders of the reproductive system with the application of lifestyles that support reproductive health) and 4.1 (presenting the results of searching information from various sources related to health and efforts to prevent disorders of the reproductive organs), prepare teaching materials, prepare articles on reproductive system research results, prepare test sheets, and prepare observation sheets. The second stage is the implementation of meaningful learning on the reproductive system material and is continued with the third stage, observation. The observation stage is carried out simultaneously with learning. Every action of teachers and students is observed by fellow teachers using observation sheets. The final stage is reflection. The previous stage's results were analyzed as learning evaluation material in cycle 1 to improve the next cycle.

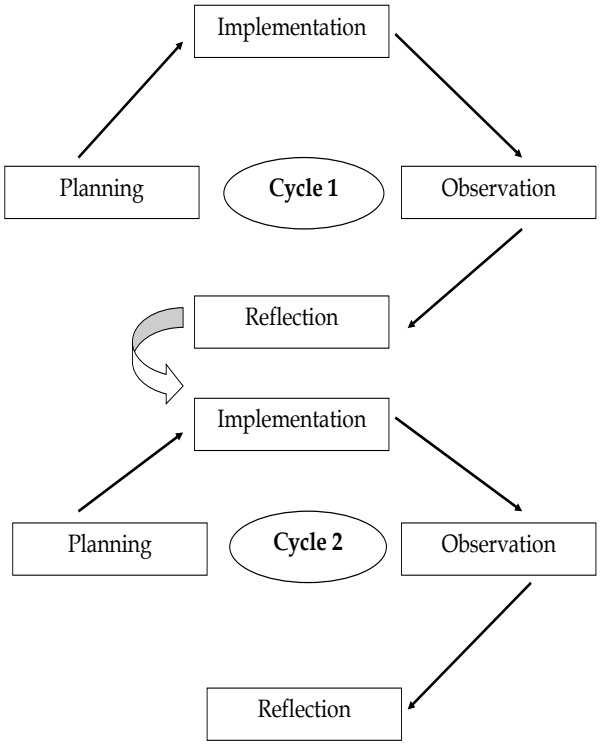


**Figure 1**. CAR Spiral Model by Kemmis and McTaggart

Data collection techniques in this study are observation and tests. The research instruments used were conceptual understanding essay test sheets with five question items, scientific literacy observation sheets with five science process indicators (Table 1), and CAR implementation observation sheets. Data analysis techniques in research are descriptive quantitative and descriptive qualitative. The quantitative data is in the form of data on conceptual understanding test results and observation results of students' scientific literacy in the form of numbers with diagrams, while qualitative data is in the form of observational data on CAR implementation presented in the form of explanatory descriptions.

**Table 1.** Scientific Literacy Indicator

| Indicator | Criteria |
|---|---|
| Indicator 1 | distinguish which is and is not the context of science |
| Indicator 2 | understand the parts of science and have a general understanding of science applications |
| Indicator 3 | have the ability to apply scientific knowledge in problem-solving |
| Indicator 4 | understand the characteristics of science and its relation to culture |
| Indicator 5 | know the benefits and risks posed by science |

## RESULTS AND DISCUSSION

### Results

The research was conducted in September 2022 at Bani Hasyim Islamic Middle School with 20 ninth-grade students. This research was conducted in cycle 1 and cycle 2. The research stages in cycle 1 are planning, implementing, observing, and reflecting. Meanwhile, cycle 2 has the same stages as cycle 1. In cycle 2, the teacher considers the reflection results in cycle 1 for lesson planning. Learning applies meaningful learning with NGL (Not Gonna Lie) and Game to the reproductive system.

The pretest and posttest scores before and after learning show students' scientific concept understanding and literacy in cycle 1. Figure 1 shows the pretest score of 71 and the posttest score of 73 for students' understanding of the concept in cycle 1. This score shows that applying meaningful learning with NGL and Game on the reproductive system increases students' conceptual understanding.

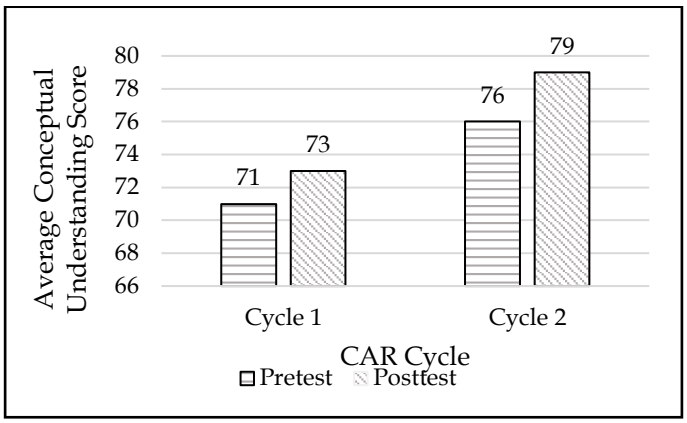


**Figure 2.** Average Scientific Concept Understanding Pretest and Posttest Scores in Cycles 1 and 2

Figure 2 shows the number of students who met the criteria for each indicator of scientific literacy ability. The pretest results show that four students met Indicator 1, five met Indicator 2, six met Indicator 3, three met Indicator 4, and two met Indicator 5. In comparison, in the posttest, two students met Indicator 1, six met Indicator 2, six met Indicator 3, five met Indicator 4, and three met Indicator 5.

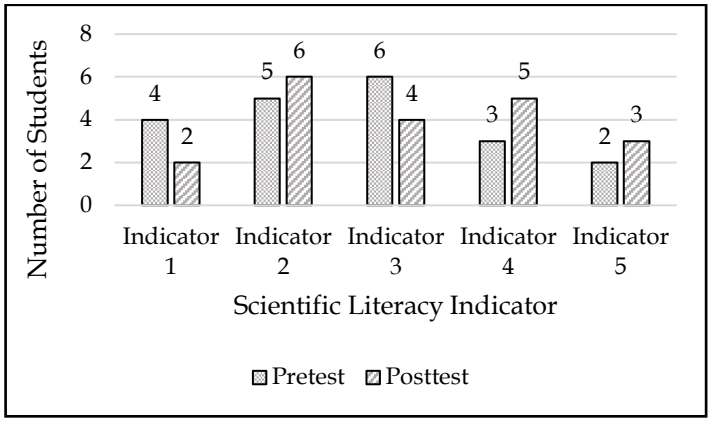


**Figure 3.** Average Scientific Literacy Pretest and Posttest Scores in Cycle 1

Apart from the research results on students' conceptual understanding in cycle 1, there are several notes in the implementation of CAR in practice. In cycle 1, teacher learning involved NGL and games to create meaningful and fun student learning. In practice, students' reading interest in research articles on the reproductive system was better than during learning before involving NGL and games. In addition to reading interest, in further learning to present the analysis of articles on the reproductive system, not all students prepared the presentation well because it was carried out according to attendance numbers.

Cycle 2 in this study reflected cycle 1 and the results of students' scientific concept understanding and literacy. This cycle continues the topic of the reproductive system. Students' conceptual understanding in cycle 2 scored 76 on the pretest and 79 on the posttest (Figure 1). This score indicates that applying meaningful learning with NGL and games in cycle 2 of the reproductive system increases students' conceptual understanding.

The results of students' scientific literacy in cycle 2 are described by pretest and posttest scores (Figure 3). In the pretest, three students met the criteria for scientific literacy Indicator 1, six met Indicator 2, four met Indicator 4, four met Indicator 4, and two met Indicator 5. For comparison, in the scientific literacy cycle 2 posttest, two students met the criteria for scientific literacy on Indicator 1, six met Indicator 2, four met Indicator 3, five met Indicator 4, and three met Indicator 5.

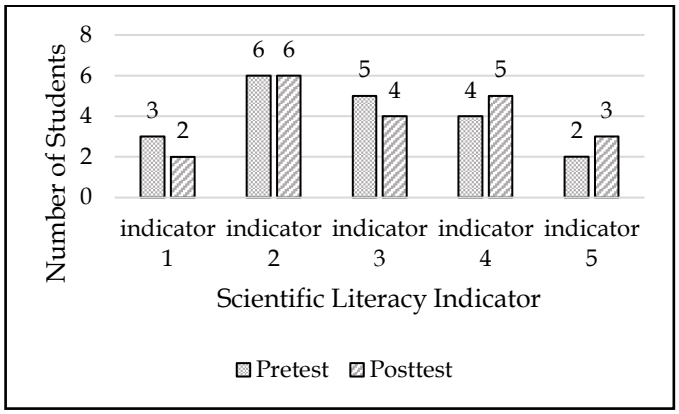


**Figure 4.** Average Scientific Literacy Pretest and Posttest Scores in Cycle 2

## Discussion

### *Implementation of CAR Cycle 1*

The planning stage is action planning based on the results of observing the initial conditions. This process includes determining the learning to be applied, preparing

reproductive system learning tools according to basic competencies 3.1 (linking the human reproductive system and disorders of the reproductive system with the application of lifestyles that support reproductive health) and 4.1 (presenting the results of searching information from various sources related to health and efforts to prevent disorders of the reproductive organs), prepare teaching materials, prepare articles on reproductive system research results, prepare test sheets, and prepare observation sheets.

Implementation activities are the realization of planning activities, such as implementing learning activities on lesson plans (introduction, exploration, explanation, concept application, and evaluation). In the introduction, the teacher gives students a conceptual understanding test and observes students' scientific literacy skills from indicators 1 to 5. Next is the engagement stage to get students' attention. The class teacher provides motivation related to the reproductive system, helping students access prior knowledge to stimulate their minds. At the exploration stage, the teacher acts as a facilitator to help students discuss the scope of the problem. The teacher can ask students to write down anything about the material to be delivered, and the teacher makes a game that keeps students in literacy, in this case, with the NGL system. At the explanation stage, the teacher explains the concept in his sentence and gives examples related to the concept. The fourth stage is concept application. Activities at this stage direct students to apply the concepts understood. The final stage is the evaluation to provide a test regarding students' scientific concept understanding and literacy on the reproductive system.

Students and class teachers conducted observation and reflection activities to discuss reflections after learning in cycle 1. In cycle 1, learning conducted by the teacher involved NGL and games. Students' interest in reading research articles on the reproductive system was better than learning without involving NGL and games. Students were more enthusiastic about game-based learning because it is not monotonous. However, in cycle 1, students were still not used to preparing themselves to present the analysis results in the articles provided by the teacher. The presentation was carried out with students advancing in front of the class in sequence according to attendance. Because of using attendance numbers, students tended not to be enthusiastic about conveying them, especially those with the early attendance number. Students with final attendance numbers also seemed to ignore it. This incident became a record of the reflection activities in cycle 1 and consideration in cycle 2.

***Implementation of CAR Cycle 2***

The implementation of CAR in cycle 2 is the same as in cycle 1. However, the planning stage in cycle 2 resulted from an improved reflection of cycle 1. The implementation stage in cycle 2 consists of the introduction, exploration, explanation, concept application, and evaluation. The introduction begins with the teacher giving a pretest before learning and providing motivation to stimulate students' thinking skills. Furthermore, at the exploration stage, the teacher, as a facilitator, helps students to discuss the scope of problems regarding the reproductive system. In this case, the teacher makes pictures to keep students in literacy with the NGL system. At the explanation stage, the teacher reinforces the material being studied. The fourth stage is concept application. The teacher directs students to apply the understood concepts. The last is the evaluation stage. The teacher gives tests regarding students' understanding of scientific concepts and literacy in the material on the reproductive system.

Students and class teachers carried out observation and reflection activities to discuss reflection after learning in cycle 2. Learning in cycle 2 showed that students were getting used to it, as seen from student participation in class. In cycle 2 learning, students are more mature and ready to deliver the analysis of research articles on the reproductive system from the teacher. Students were better prepared to present their findings when the teacher said the

presentation was not according to attendance numbers.

Based on the presentation of the implementation and research results, meaningful learning with NGL and games can improve students' scientific concept understanding and scientific literacy skills in the reproductive system. This result aligns with Rahmat et al. (2018)(Rahmat et al., 2018) that game-based learning can improve students' conceptual understanding. Conceptual understanding of a subject is the main foundation of students in problem-solving. According to Estiani et al. (2015), involving games in learning activities helps students understand abstract concepts in a lesson by creating fun and enjoyable learning to create interaction between students.

Game-based learning can create a learning environment that enhances students' abilities. It also creates a sense of comfort and fun in learning so students do not feel pressured (Estiani et al., 2015). Educational games can stimulate and increase thinking power and concentration in problem-solving. Educational games can be used as one of the educational media with a learning-by-working pattern (Wibowo & Ramadhan, 2017). In line with the principle of educational games, apart from being designed to play, this game offers learning activities.

In addition to conceptual understanding, applying learning with NGL and game increases students' scientific literacy skills in cycles 1 and 2. This aligns with Nuri et al. (2022) that integrating learning with games can improve students' scientific literacy abilities. Game-based learning makes students more active in achieving learning objectives (Candra & Rahayu, 2021). According to Winatha & Setiawan (2020), game-based learning can improve students' understanding, knowledge, and evaluation of material.

Game-based learning provides stimulus and direction to students to increase interest in reading and critical thinking skills to influence students' scientific literacy (Ratu, Nurhaerunnisah, Musahrain, & Hermansyah, 2020). According to Karlina & Abidin (2022), educational games have several advantages that positively impact students' scientific literacy. Educational games can be used anywhere and anytime by users, increasing students' interest and activeness in learning. Game-based learning offers enjoyable learning to students and stimulates their higher-order thinking skills.

Meaningful learning is a learning process with new information linked to the structure of understanding that someone going through learning activities already has (Faslah, 2011). Meaningful learning has several advantages: creating fun learning and improving students' learning skills. Through meaningful learning, students can connect information with existing concepts (Fatikhul & Abdullah, 2016). Tarmidzi (2018) also states that meaningful learning can be created with the learning concept used by the teacher. This can be seen through the positive results of this study: applying game-based meaningful learning to increase students' scientific concept understanding and scientific literacy.

The application of meaningful learning can foster students' active learning abilities in various knowledge, skills, and experiences. Through meaningful learning, students are expected to know and develop all the knowledge they have (Yogihati, 2010). The learning process that involves students fully formulating their concepts and learning processes obtained by students is the result of their understanding and discovery (Satriawati, 2019). Sukaesih & Alimah (2012) show that meaningful learning can have a real and positive influence on learning for students.

## CONCLUSION

Applying meaningful learning fosters active learning abilities in students with various knowledge, skills, and experiences. One of the efforts to implement meaningful learning is the application of NGL and game learning. NGL and game learning can improve students' scientific concept understanding and scientific literacy. Game-based learning makes students

more active in learning to achieve learning objectives. The results show that meaningful learning using NGL and games positively impacts students' scientific concept understanding and literacy. The results of this study can be used for further research by utilizing meaningful NGL learning and games if similar problems are encountered in class regarding students' scientific concept understanding and scientific literacy.

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