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The Influence of Science Skills Through Scientific Learning Model In Biology Learning: A Review Study

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ABSTRACT

Scientific learning is a common approach that is quite effective in learning, especially in learning biology. This research was conducted with the aim to find out (1) the influence of science skills through scientific learning models, (2) types of scientific learning models that affect students' science skills, and (3) natural science topics using scientific learning models that affect students' science skills. This research was a meta-analysis study with a qualitative approach that adopted a literature review method by Durst & Edvardsson consisting of the following 4 steps. 15 articles were selected from 27 articles published in the last 5 years (2018-2022). The research article was searched using the Educational Resources Information Center (ERIC), SINTA Indonesia online database. Results of these analyses show that science skills affected through scientific learning model are 3C, thinking skill, literacy skill, and science process skill. These science skills are influenced through scientific learning model by project-based learning, problem-based learning and discovery learning. Biology topics used in this research are environment, plantae, histology, endocrine system, animal kingdom, ecosystem, and biodiversity; environment is the most commonly used topic in science learning.

Keywords: Life science, Scientific learning model, Skill influenced

Introduction

Regulation of the Minister of Education and Culture number 65 year 2013 (Depdikbud, 2013) regarding Process Standards for Primary and Secondary Education states that learning should emphasize the scientific approach. This is because scientific learning provides a positive learning process (Pantiwati, 2015) where students can learn many things from phenomena that exist in everyday life (Imtihana, 2021). Scientific is a learning approach based on science approach (Hernawati et al., 2018) that encourages students to be able to observe, ask, try or collect data, associate and communicate (Susanti et al., 2019). The main foundation in the development of 2013 Curriculum is expected to improve students' competence (Imtihana, 2021). The focus of learning skills through the scientific approach is primarily on problem-solving under scientific conditions and making decisions about scientific issues in a social context (Holbrook, 2009) (Zeidler, 2003) (Sadler, 2004).

One of the learning subjects that has the potential to utilise scientific learning is biology. Scientific learning in science has been proven to improve scientific skills such as scientific process skills (Hernawati et al., 2018) (Ramlawati et al., 2019), science literacy (Nurlina et al., 2019) and learning outcomes (Firman et al., 2018) (Nurkholis, 2019) (Fitria et al., 2021). Science is all about how knowledge is developed (scientific inquiry) through scientific knowledge based on observations of nature that involve explanation, imagination, and creativity (Lederman et al., 2013).

Biology is a branch of life science that studies living organisms (Ozyigit, 2020). Characteristics of life sciences emphasise direct interaction between students and the object being studied making learning biology one of the important subjects to be used in order for students to improve their competence (Imtihana & Djukri. 2021). The scientific approach based on Bruner's theory states that students learn and construct their knowledge through cognitive processes (Hosnan, 2014). Learning biology is not only about mastering the knowledge of facts, concepts, and principles, but also a systematic inquiry of investigating nature, through habits, practices, and skills (Wilson et al, 2015) (Chiappettaa & Fillmanb, 2007). Learning life science through a scientific approach involves students so they can directly help connect academic learning with real-life contexts (Firman et al., 2018). Learning-based scientific can strengthen the learning process (Susanti et al., 2019) Because by implementing inquiry, students will play a direct role in discovering concepts and principles during learning process (Nurkholis, 2019) so, scientific approach is one of learning approaches that encourage to develop attitude, skills and knowledge (Susanti et al., 2019).

Some research has been conducted about the implementation of scientific approach in biology and have a positive effect on some student's science skills. The importance of scientific learning for students encourages researchers to know what science skills are affected by scientific learning in biology. This article will identify, analyze and synthesize research about scientific learning models in published journals. The purpose of this article is to determine the types of scientific learning models used, the influence of scientific skills through scientific learning models, and biology topics that use scientific learning models. To support the research purpose, the following research questions were asked:

1. What science skills are affected through scientific learning model?
2. What kinds of scientific learning model affected student's science skills?
3. What biology topic used scientific learning model that affected student's science skills?

Methods

This research is a meta-analysis study with qualitative approach analysis (Bodgan & Biklen, 2007), data were analysed by adopting the literature review method by Durst & Edvardsson consisting of:

1. Determine the area to discuss and literature research
   Study area in this research in accordance with the submitted statement: 1) science skills affected by scientific learning model, 2) dominant scientific learning model in high school that affected students' science skills, 3) integrated biology topic used scientific learning. Data was collected by searching literature of research journals indexed by Scopus and SINTA on various websites such as Educational Resources Information Center (ERIC), and SINTA Indonesia. There are 15 journals analyzed in this article with the research subjects were high school students, examining science learning in the field of biology, and published in the last 5 years starting from 2018 to 2022. The 15 selected journals analysed in this article were 8 Scopus-indexed journals, and 7 SINTA-indexed journals (minimum SINTA 2).
2. Determine inclusion and exclusion criteria
   Inclusion criteria include 1) the keywords used in journal literature search: "scientific learning, scientific learning model, scientific learning model in biology, scientific in biology, biology, life science". Exclusion criteria include: 1) research journal published in the last 5 years (2018-2022), 2) research with the scope of integration of scientific learning with problem-based learning, project-based learning and discovery learning models in biology
3. Analysis
   Data analysis is focused on knowing science skills influenced by scientific learning model, a common scientific learning model that affects students' science skills and the scope of biology themes or topics.
4. Writing
   Writing part is conducted by presenting data and analyzing the results.

Results and Discussion

Data identification from 15 selected journals shows that scientific learning in biology has an influence on students' science skills. The data presented in the table are journal identities and research information about types of scientific learning models, science skills affected and biology topics that are integrated by scientific learning. The identification results are presented in Table 1 and Table 2.

1. Science Skill Affected through Scientific Learning Model

   Results of the study in Table 1 show that scientific learning model affects various student's skills. There are some skills that are affected by scientific learning model based on the identification of the review: creativity, critical thinking, problem-solving, cognitive learning, environmental literacy, conceptual understanding, HOTS, communication skills, and science process skills.

   1.1. 3C Skills

   Results of the identification of review articles show that scientific learning affects 3C skills such as creativity, critical thinking and communication skills. The 3C skills helps student learn and it's important to success in school and beyond. Through this skill, students are able to learn how to analyze and solve problems about the subject or information being discussed in their own way, in understanding what the problem is and how to solve it. Creativity allows students to be creative by solving problems, creating, or just trying something they haven't tried before. This skill will enable students to look at the problem from multiple perspectives including those that others may not see (Pratomo et al., 2021). Critical thinking empowers students to discover the truth especially when it comes to separating fact from opinion (Fikriyati et al., 2022). Communication skills help students

streamline their ideas and make a positive impression on those around them. When students practice communication, they become better at efficiently conveying ideas (Kiong *et al.*, 2022).

1.2. Thinking Skills

The identification of review articles shows that scientific learning can influence thinking skills such as cognitive learning, conceptual understanding, problem-solving, and HOTS. Thinking skills help students to make good decisions (Asmoro et al., 2021), understand the consequences of their actions and solve problems (Mahanal et al., 2022). Thinking is a mental process that is essential to defining and organizing experiences, planning, learning, reflecting, and creating (Asmoro *et al.*, 2021).

1.3. Literacy Skills

Results of the identification of review articles show that scientific learning also affects literacy skills such as environmental literacy. These skills help students to create knowledge. Environmental literacy which is part of literacy skills (*Anwas et al.*, 2022) helps students to understand, develop skills and motivation to make responsible decisions (Anwas et al., 2022) that consider their relationships to natural systems, communities and future generations.

1.4. Science Process Skills

Identification of review articles also shows that scientific learning can affect science process skills. Science process skills help students to understand phenomena, answer questions, develop theories and discover information (Susanti et al., 2019) and are essential in developing ideas (Susanti et al., 2019) and increasing academic achievement (Susanti et al., 2019), especially in science learning.

Table 1. Student's Skills Affected through Scientific Learning Model

Year	Author	Skills affected	Scientific Learning Model
2020	S. Suwarno, Wahidin, Sofyan Hasanudin Nur	Creativity	Project-based Learning
2021	Mimien Henie Irawati Al Muhdhar, Muhammad Khalid Faruq, Murni Sapta Sari	Critical thinking	Project-based Learning
2021	Nawawi, Eka Trisianawati, Abdul Karim	Creativity	Project-based Learning
2019	Lia Auliandari, Erie Agusta, Siti Esa Bintari	Creativity	Problem-Based Learning
2019	Rusdi Hasan, Marheny Lukitasari, Vemy Juniarti, Irwandi	Problem-solving & cognitive learning	Problem-based learning
2019	Fendy Hardian Permana, Lise Chamisijatin	Critical thinking	Project-based learning

Year	Author	Skills affected	Scientific Learning Model
2022	Rizhal Hendi Ristanto, Arin Sabrina Ahmad, Ratna Komala	Critical thinking	Discovery Learning
2021	Muhammad Minan Chusni, Sulistyo Saputro, Sentot Budi Rahardjo, Suranto	Critical thinking	Discovery learning
2020	E. Suryawati, F. Suzanti, Zulfarina, A.R. Putriana, L. Febrianti	Environmental literacy	Problem-Based Learning
2020	R.Y. Sari, H.N. Cahyo	Conceptual understanding	Discovery learning
2018	F. Riandari, R. Susanti, Suratmi	HOTS	Discovery learning
2019	Witriyani Suryamiati, Adi Pasah Kahar, Anandita Eka Setiadi	HOTS	Discovery learning
2021	Ni Komang Dina Suciari, Ibrohim, Hadi Suwono	Communication skills	Project-based learning
2021	Ratna Komala, Erna Heryanti, Amelia Rinawati	Problem-solving	Problem-based learning
2021	Irani Lailatul Badria, Ibrohim, Suhadi	Science process skills & environmental attitudes	Problem-based learning

Figure 1 shows the magnitude of various skills affected by scientific learning. The results analysis shows that there are 8 3C skill variables, 6 thinking skill variables, 2 environmental literacy variables and 1 science process skill variable. 3C skills are the skills most studied by researchers through scientific learning, while science process skills are rarely studied by researchers through scientific learning.

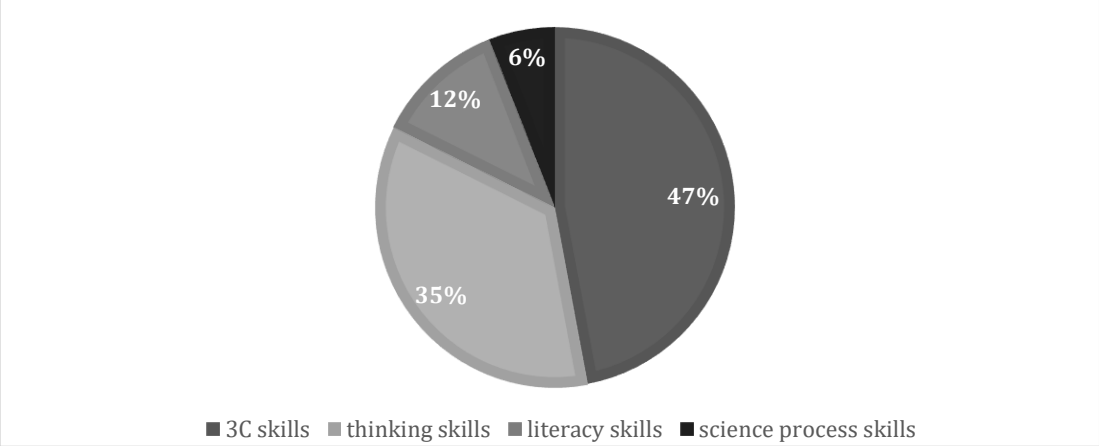

Figure 1. Interpretation of Students' Skills Affected by Scientific Learning Model

It's because 3C skills are skills that must be mastered in the current era (Chiruguru, 2020). So, this skill has popularly become variable in research. Scientific learning is also

popular since there is an independent learning policy known as "*Merdeka Belajar*" which requires students to learn independently through various learning sources. Because, scientific learning contains syntax which is needed by students to learn independently scientifically. The popularity of these two variables is the reason why many researchers have raised these variables in recent research. This can be an opportunity for further researchers to examine skills that are still rarely studied to find out their effects, effectiveness or comparisons on relevant topics of discussion.

2. Types of Scientific Learning Models

The analysis of 15 journals in Table 1 shows that there are 3 kinds of scientific learning models commonly used. Based on the results of reviews from 15 selected journals, identification kinds of scientific learning models are: project-based learning, problem-based learning, and discovery learning.

2.1. Project-based Learning

Project-based learning (PBL) or project-based instruction is an instructional approach designed to give students an opportunity to develop knowledge and skills through engaging projects set around challenges and problems they may face in the real world. Through this method, students can learn to manage obstacles more effectively, learn from failure and make adjustments until they're satisfied with their work, also learn how to manage projects and assignments more efficiently.

Results analysis of several research journals that were studied showed that there were 5 journals that examined project-based learning as scientific learning (Suwarno et al., 2020; Muhdhar et al., 2021; Nawawi et al., 2021; Permana et al., 2019; Suciari et al., 2021).

2.2. Problem-based Learning

Problem-based learning (PBL) is a student-centered approach in which students learn about the subject by working in groups to solve an open-ended problem that encourages students' motivation and learning. Through problem-based learning (PBL) students can develop critical thinking skills, problem-solving skills, and communication skills, also provides opportunities to work in groups, find and evaluate research material.

Based on analysis of research journals, there are 5 journals that examine problem-based learning (Auliandari et al., 2019; Hasan et al., 2019; Suryawati et al., 2020; Komala et al., 2021; Badria et al., 2021).

2.3. Discovery Learning

Discovery learning is a method that is carried out by the teacher by organizing the learning process in such a way that students gain knowledge that is previously unknown and not delivered in the first place, instead, students have to discover it independently. Through discovery learning, it encourages active engagement from students, motivation, responsibility, independence, develops creativity and problem-solving skills and provides students' learning experience.

The analysis has been carried out on the research journals that have been studied shows that there are 5 journals that examined discovery learning (Ristanto et al., 2022; Chusni et al., 2021; Sari & Cahyo, 2020; Riandari et al., 2018; Suryamiati et al., 2019).

3. Life Science Topics

Research topics that produce good data can be used as learning materials and be used as consideration for further research (Imtihana & Djukri, 2020). Table 2 shows that life science topics commonly used are environment (50%), plantae (12,5%), histology (6,25%),

endocrine system (6,25%), animal kingdom (6,25%), ecosystem (12,5%) and biodiversity (6,25%). Environment has become a dominant life science topic used through scientific learning. Exploration of learning topics that promote everyday life can be optimized by applying scientific learning (Hernawati et al., 2019; Hartanti et al., 2019). Based on the results of the review, life science topics used through scientific learning are: environment (Suwarno et al., 2020; Nawawi et al., 2021; Auliandari et al., 2019; Hasan et al., 2019; Ristanto et al., 2022; Chusni et al., 2021; Suryawati et al., 2020; Suciari et al., 2021), plantae (Muhdhar et al., 2021; Suryamiati et al., 2019), histology (Permana et al., 2019), endocrine system (Sari & Cahyo, 2020), animal kingdom (Riandari et al., 2018), ecosystem (Suciari et al., 2021) (Badria et al., 2021), and biodiversity (Komala et al., 2021).

Based on the analysis results in Table 2, it can be seen that all life science topics addressed in the research are topics in social contexts encountered and can be observed in daily life. Environment topic become the most widely raised topic studied in scientific learning. It's because the environment contains various issues that are quite complex, always exist and found in society's everyday life. Besides that, environment topic is concrete and can be observed directly through the senses without using any tools. In contrast, the life science topic which is abstract needs a tool such as microscope or props when learning or observing it.

The features and characteristics of life science topics raised in learning will also affect the success of the methods used by teachers in learning. Based on the analysis results, it is known that the use of scientific learning is more effective if it is carried out by bringing up concrete science topics.

Many scientific issues that are currently developing in society, especially in terms of environmental problems, should be integrated into learning because have the potential as learning resources. Some research has proven that scientific issues in social contexts have the potential as learning resources through scientific learning (Imtihana & Djukri, 2021) and can be integrated into learning in order to train students to identify and analyze social problems around them. Independently scientific learning will make it easier for students to learn and make it easier for teachers to facilitate students learning. Therefore, scientific learning becomes an alternative learning that can be used to help students develop and improve students skills mainly skills that must be mastered in the current era.

Table 2. Life Science's Topic

Year	Research Journal Literature	Scientific learning model	Topics
2020	S. Suwarno, Wahidin, Sofyan Hasanudin Nur	Project-based Learning	Environment
2021	Mimien Henie Irawati Al Muhdhar, Muhammad Khalid Faruq, Murni Sapta Sari	Project-based Learning	Plantae (ethnobotany)
2021	Nawawi, Eka Trisianawati, Abdul Karim	Project-based Learning	Surrounding environment
2019	Lia Auliandari, Erie Agusta, Siti Esa Bintari	Problem-Based Learning	Environment
2019	Rusdi Hasan, Marheny Lukitasari, Vemy Juniarti, Irwandi	Problem-based learning	Environment
2019	Fendy Hardian Permana, Lise Chamisijatin	Project-based learning	Histology

Year	Research Journal Literature	Scientific learning model	Topics
2022	Rizhal Hendi Ristanto, Arin Sabrina Ahmad, Ratna Komala	Discovery Learning	Environment
2021	Muhammad Minan Chusni, Sulistyo Saputro, Sentot Budi Rahardjo, Suranto	Discovery learning	Environment
2020	E. Suryawati, F. Suzanti, Zulfarina, A.R. Putriana, L. Febrianti	Problem-Based Learning	Environment
2020	R.Y. Sari, H.N. Cahyo	Discovery learning	Endocrine system
2018	F. Riandari, R. Susanti, Suratmi	Discovery learning	Animal Kingdom
2019	Witriyani Suryamiati, Adi Pasah Kahar, Anandita Eka Setiadi	Discovery learning	Plantae
2021	Ni Komang Dina Suciari, Ibrohim, Hadi Suwono	Project-based learning	Ecosystem and environmental changes
2021	Ratna Komala, Erna Heryanti, Amelia Rinawati	Problem-based learning	Biodiversity

Basically, implementation of scientific learning can be carried out on all life science topics provided that these topics are packaged in the syntax of relevant scientific learning models. Topic selection is the main thing that must be done by teachers before determining an appropriate scientific learning model because it will affect student achievement and learning success. Based on the analysis which has been done, the results of this study can be a reference for further researcher as preliminary research or a reference source in conducting similar research.

Conclusion

Based on the analysis review of 15 journals, there are 4 skills affected by scientific learning model, 1) 3C skills consist of creativity, critical thinking and communication skills, 2) thinking skills including cognitive learning, conceptual understanding, problem solving, and HOTS, 3) literacy skills consist of environmental literacy, and 4) science process skills. All these skills are affected through scientific learning model by project-based learning, problem-based learning and discovery learning. Life science topics used through science learning are environment, plantae, histology, endocrine system, animal kingdom, ecosystem, and biodiversity. Environment is the most widely used topic for applying scientific learning. The result of this research succeeded in finding students' skills affected by scientific learning model through the analysis and synthesis so it can be taken into consideration resource for relevant research in the future.

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