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Various Teaching Methods and Models of Virus Learning at High School and College Level: A Systematic Review

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Abstract. The topic of viruses is closely related to the daily life and problems faced by students. The concept of viruses is considered difficult by students because they are abstract and contain many unfamiliar words. This research aimed to analyze various teaching methods and models of virus learning at the high school and college level and to find out the most suitable models or methods in learning virus concepts effectively. This study reviewed research articles published on online databases, such as Google Scholar, Eric, WorldCat, and ScienceDirect. Articles were selected using the PRISMA method with the keywords "virus concepts" and "high school" "biology education" published from 2011-2020. Matched articles from Google Scholar (N = 52), Eric (N = 5) Science Direct (N = 2) WorldCat (N = 4). The articles were selected based on the research focus according to the topic, there were 10 articles according to the criteria, methods, and results of articles by the objectives of this study and were analyzed. The results showed that virus concept learning in school can be done using various learning methods and models. The best learning methods and models in learning viral concepts are contextual ones such as problem-based learning and the use of learning media such as video games. The results of the article review show that the concept of viruses through contextual learning can improve students' understanding, learning outcomes, misconceptions, and critical thinking.

Keywords: Virus concept, High school, Biology education.

INTRODUCTION

The concept of viruses is very related and close to daily life with us(Fariroh & Anggraito, 2015). The concept of viruses is one of the materials that is quite difficult to understand in biology subjects in schools. The concept of viruses considered difficult includes the concept of viral characteristics, infection processes, replication, and viral roles as well as ways to address the dangers of viruses(Corredor, Gaydos, & Squire, 2014; Firmanshah, Jamaluddin, & Hadiprayitno, 2020). Firmanshah et al., (2020) it is difficult for students to understand the concept of viruses due to abstract and complex concepts of viruses. Larsson& Tibell(2014) said the concept of viruses is closely related to molecular structures that cannot be seen without tools.

One way to overcome students' difficulties in understanding the concept of viruses is to use models, methods, and learning media. The learning model is a set of procedures used to deliver learning materials to make it easier for students to understand the materials and to achieve learning objectives. Learning models and media must be attractive, innovative, and conceptual to make it easier for students to understand the concepts of learning because humans rely heavily on conceptual understanding to understand new knowledge. This research aimed to analyze various teaching methods and models of virus learning at the high school and college levelto find out the most suitable models or methods in learning virus concepts effectively. The benefits of the results of this study are to

provide information on models or learning media that are good for teaching the concept of viruses. The following research questions are addressed in this review. 1) What were the models and learning media that can be used for virus learning? 2) What were the abilities that can be improved in viral learning?.

METHOD

This study reviewed research articles published on online databases, such as Google Scholar, Eric, WorldCat, and ScienceDirect. Articles were selected using the PRISMA method with the keywords "virus concepts" and "high school" "biology education" published from 2011-2020. Matched articles from Google Scholar (N = 52), Eric (N = 5) Science Direct (N = 2) WorldCat (N = 4). The articles were selected based on the research focus according to the topic, there were 10 articles according to the criteria namely only published articles and not proceedings, methods, and results of articles by the objectives of this study and were analyzed. The results of the selection of articles using the PRISMA method are presented in Figure 1.

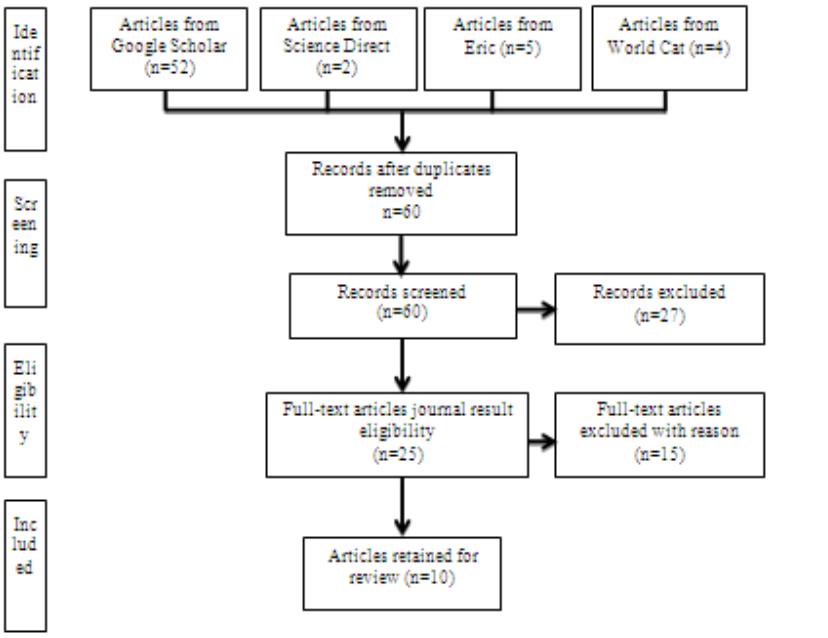

FIGURE 1. Selection of articles using Prisma method

RESULT AND DISCUSSION

Article search results from online databases using the keywords "virus concepts" and "high school" "biology education".

TABLE 1. Article search results from the online database

Criteria	Database			
	Google Scholar	WorldCat	ScienceDirect	Eric
Keyword	52	4	2	5
Articles according to the criteria	4	2	1	3

Articles that match the criteria are further tabulated.

TABLE 2. Articles according to criteria

Year	Author	Title	Type of virus learning
2013	Hakan Kurt and Gülay Ekici	What Is A Virus? Prospective Biology Teachers' Cognitive Structure on theConcept of Virus	Virus concept learning is determined by the understanding of the conceptual structure of prospective biology teachers and models and techniques of assessment on the concept of viruses.
2014	Javier Corredor, Matthew Gaydos, Kurt Squire	Seeing Change in Time: Video Games to Teach about Temporal Change in Scientific Phenomena	The process of infection and replication in the virus concept is taught using text and video games can facilitate the construction of dynamic mental models as well as create better interactions.
2015	Aida Fariroh, Yustinus Ulung Anggraito	Development of Problem Based Learning-Based Learning Tools in High School Grade X Virus Material	The viral concept is taught using PBL can improved learning outcomes and critical thinking.
2016	Kristen Johannes, Jacklyn Powers, Lisa Couper, Matt Silberglitt, Jodi Davenport	Tangible Models And Haptic Representations Aid Learning Of Molecular Biology Concept	Viral learning media using 3D modelscan make students easier to understand
2018	Diego Buchinger, Marcelo da Silva Hounsell	Guidelines for designing and using collaborative-competitiveserious games	Viral learning using collaborative-competitive serious gamescan improve students' learning outcomes
2018	Lilies Tangge, Amran Rede, Nurafriani	Influence of QRA Learning Model on Student ConceptsUnderstanding and Retention SMA 2 Kasimbar	Reasoning Questioning Answering learning model to teach virusconcept can affect understanding and retention of student virus concepts
2018	Y. Hamdiyati, F. Sudargo, A. Fitriani, A. Rachmatullah	Biology students' initial mental model about microorganism	Mental models of prospective biology teachers improved after taking lectures on virus concept using drawing and writing methods
2019	Firda Ama Zulfia, Herawati Susilo, Dwi Listyorini	Virus-Bacteria Diagnostic Test (Vbd-Test) In Identifying Biology Teacher'sMisconception	The concept of the virus is taught by making concept maps and evaluated usingVirus-bacteria diagnostic test to find out misconceptions
2019	Jie Shen	Using movie clips to lighten the learningexperience of Ebola virus infection process	Learning Ebola virus material using movie clips can improve understanding abstract concepts and add enthusiasm
2020	Muhammad Imam Firmanshah, J. Jamaluddin, Gito Hadiprayitno	Learning Difficulties In Comprehending Virus And Bacteriamaterial For Senior High Schools	Learning in virus concept using contextual media can make more interesting for students

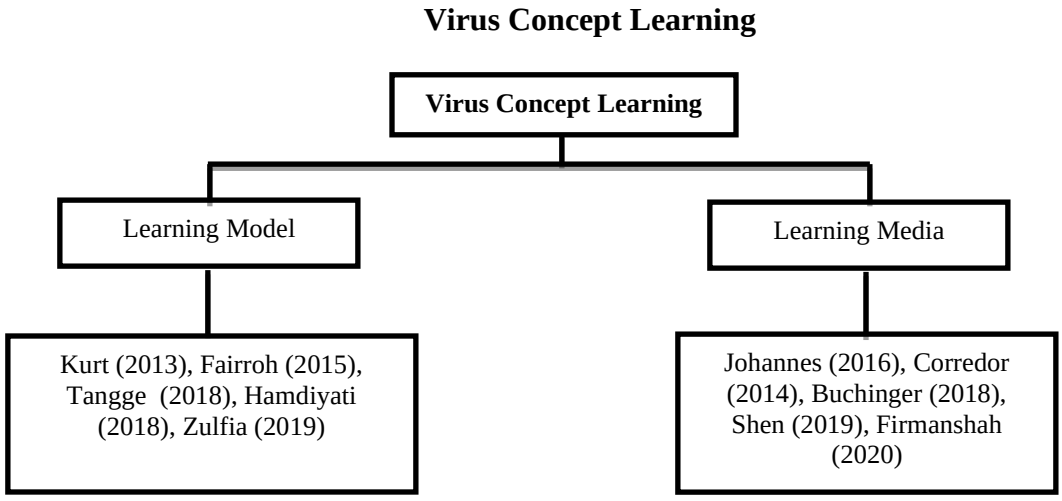

FIGURE 2. Virus Concept Learning

Virus concept learning taught using learning models put forward by Kurt (2013), Fairroh (2015), Tangge (2018), Hamdiyati (2018), Zulfia (2019). In addition, there is an opinion that the concept of viruses can be done using the learning media expressed by Johannes (2016), Corredor (2014), Buchinger (2018), Shen (2019), Firmanshash (2020).

Virus concept learning presented using a real problem-based learning model can make students more interested in learning it. Students are required to solve everyday problems related to the virus(Fariroh & Anggraito, 2015). Kurt & Ekici(2013)states that the study of viral concepts relies heavily on understanding the concept of viruses by prospective biology teachers as well as appropriate learning models to learn the concept of viruses using drawing and writing techniques. Tangge & Rede(2018)said that the concept of viruses can be defended using the group discussion method with the Reading Questioning and Answering model. The Reading Questioning and Answering model requires students active in the learning process to construct new knowledge based on the experiences and facts encountered. Hamdiyati, Sudargo, Redjeki, & Fitriani (2018) said that the study of the concept of the virus in higher education can be done using mental model-based learning and concept maps as assessments. Mental models and concept maps are chosen to determine students' interpretation of the understanding of the concept of viruses. Zulfia et al., (2019)saying that the concept of viruses can be taught using concept maps and evaluated using virus-bacteria diagnostic tests can identify misconceptions in prospective biology teachers. The concept map used contains viral material such as structure analysis, virus role, and virus replication. Then the student's understanding will be evaluated using the Virus-bacteria diagnostic test to find out the misconceptions on the concept of viruses.

The concept of viruses is taught using a student-centered learning model and requires students to be active in constructing their knowledge. Problem-based learning models also play an important role in students understanding the concept of viruses.

Johannes, Dswlf, Lrorj, & Couper (2012)uses 3D models to convey the concept of molecular structure in viruses to enhance conceptual understanding. Students were asked to assemble the structure of viral amino acid models to make it easier for students to understand the concept of molecular biology in viruses. Corredor et al.(2014) use video game media to teach the concept of molecular structure in viruses. The use of gaming media is considered more representative and contextual, making it easier for students to build more dynamic mental models and facilitate students to interact and discuss in learning.Buchinger & Hounsell(2018) teach the concept of dengue fever using collaborative-competitive serious games.Buchinger & Hounsell(2018)said that collaborative-competitive serious games can improve students' understanding and make students more confident.Shen(2019) chose the footage to set the concept of a virus. Movie trailers are chosen because they have content such as sound, design, animation, and color that makes it easy for students to understand abstract concepts and improves students' enthusiasm for learning. The materials taught are about the process of infection, how to spread, the development of viruses in biosafety laboratory level 4, and how to prevent the spread of viruses.Firmanshah et al.(2020) state that to understand students' difficulty in understanding concepts can be done using more interesting and contextual learning media such as

audiovisual media, videos, 3D models, and images. He said the use of visual media helps students remember concepts for longer.

Students' abilities can be improved using models or methods in learning the concept of viruses. Table 3 shows that 50% of students' understanding improved in learning the concept of viruses, followed by a mental model (20%)with learning outcomes, misconceptions, and critical thinking which are 10%. Abstract and complex virus concepts require a deeper understanding of students.

TABLE 3. Students' abilities

	Number of studies	Percentage (%)
Students' understanding	5	50
Learning outcomes	1	10
Misconceptions	1	10
Critical thinking	1	10
Mental model	2	20

The learning media used by researchers in the concept of viruses is a representative learning medium of viruses and contextual so that viral material is easy to understand and not abstract. Representative media can improve the understanding of student concepts more than using traditional media such as text and graphics. Contextual media also assists students in understanding abstract and complex concepts. Contextual media is proven to develop students' ability to represent abstract and complex concepts and to encourage higher-level thinking.Problem-based learning, using concept maps, 3D virus models, and video games can be used in learning the concept of viruses. Contextual learning of virus concepts can improve students' understanding, learning outcomes, misconceptions, and critical thinking.

CONCLUSION

The results showed that virus concept learning in school can be done using various learning methods and models. The best learning methods and models in learning viral concepts are contextual ones such as problem-based learning and the use of learning media such as video games. The results of the article review show that the concept of viruses through contextual learning can improve students' understanding, learning outcomes, misconceptions, and critical thinking.

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