Bibliometric Analysis on Online Physics Learning during COVID-19 Pandemic: Contribution to Physics Education Undergraduate Program

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Abstract. Research will focus on generating a profile of research trends in online physics learning during the COVID-19 pandemic. The main research is bibliometric. Scopus document data collection in August 2021. The 1007 document results with keywords online physics learning. Then focused on 2020 and 2021* as 277 document results of which these 2 years are the COVID-19 pandemic period. In general, the research results show that the COVID-19 pandemic has had a positive impact on accelerating online learning in developing countries. Another finding is online learning which is proven to be effective for improving student learning outcomes in physics learning. Educational transformations today and after the COVID-19 pandemic can occur in online education, changes in learning from home, changes in roles, and approaches. The research implications are supported by recent research: (1) These findings will provide an empirical basis for the development of physics education research, especially online physics learning during the COVID-19 pandemic; (2) Deep learning system, machine learning system, and education computing can still become a research trend in current research, especially in the integration and adaptation in physics learning; (3) Retracing the trend and novelty of physics education research, especially in the physics education undergraduate program.

1. Introduction
The coronavirus pandemic has had a wide impact on a number of sectors, including education. Recent research has found COVID-19 to be dangerous and can continue to mutate [1-5]. The latest developments on the COVID-19 virus pandemic in the world have been uploaded again, obtained from worldometers.info on Friday, August 13, 2021 get the number of cases of the COVID-19 virus in the world reached 206,181,372 cases and the addition of new cases was + 712,590 cases, only in the last 24 hours. Meanwhile, the number of patient deaths in the last 24 hours of the COVID-19 virus in the world increased by +10,379 people, so that the accumulated cases of patients dying from the COVID-19 virus reached 4,347,175 people. The number of patients who have been declared cured is 185,041,837 people and around 16,792,360 active cases who are still undergoing treatment in hospitals and self-isolation at their respective homes.

The COVID-19 pandemic has also had an impact on physics learning in schools. Schools have implemented online physics learning during COVID-19 pandemic. Online physics learning has become
an alternative way in the COVID-19 pandemic. This is supported by the results of recent studies that prove the success of online physics learning variations during the COVID-19 pandemic [6-14].

Online physics learning is very difficult to implement massively in developing countries. Limited resources and financial support can hinder online physics learning in developing countries. Apparently, the COVID-19 pandemic have a positive impact on accelerating the implementation of online physics learning. This opinion is in line with the results of recent research which states that online-based physics learning can improve student learning outcomes in countries affected by the COVID-19 pandemic [15-23].

However, in previous studies, there had been no researches that specifically profiled research trends in online physics learning during the COVID-19 pandemic. Therefore, research will focus on generating a profile of research trends in online physics learning during the COVID-19 pandemic. The main research implication is for contributing to the physics education undergraduate program, in particular the profile of online physics learning during the COVID-19 pandemic.

2. Method
The main research method is bibliometric analysis [24-33]. In general, there are six steps of the research procedure as shown in Figure 1.

![Figure 1. Research procedure](image)

The Scopus document data was collected in August 2021. The 1007 document results with keywords online physics learning, then focused on 2020 and 2021* as many as 277 document results of which these 2 years are the COVID-19 pandemic period. The VOSViewer software [34-41] was used to support and figure out the research trend on online physics learning during the COVID-19 pandemic.

3. Results and Discussion
Among those 277 papers related online physics learning during COVID-19 pandemic research in the Scopus database, then the researchers visualised the research trends on this topic assisted with the VOSViewer software (see Figure 2). This effort is useful for finding the novelty of the research on this domain.
Figure 2. Network visual of research on online physics learning during COVID-19 pandemic

Figure 2 indicates the whole picture research on online physics learning during COVID-19 pandemic. Researchers on the world produced two clusters. The first cluster (red colour) was online physics learning during COVID-19 pandemic as a transformation related to student, education, online learning, physics teacher, physics course, research, activity, and school. The second cluster (green) was online physics learning during COVID-19 pandemic focus on simulation, information, solution, model, data, task, system, and machine (IoTs).

Figure 3. Density visual of research on online physics learning during COVID-19 pandemic

Figure 3 shows the density of research on online physics learning during the COVID-19 pandemic. The dominance of yellow is based on student, research, data, system, model, framework, education, and online learning. The findings indicated it was some parameters or interrelationships among variables to
capture the trend and novelty of researching on online physics learning research during COVID-19 pandemic in Figure 4.

Figure 4. Research trend on online physics learning during COVID-19 pandemic

Figure 4 shows the findings indicated it was some parameters or interrelationships among variables to capture the trend and novelty of researching on online physics learning research during COVID-19 pandemic, such as researching experiment (Figure 4a), online learning (Figure 4b), physics teacher (Figure 4c); and physics course (Figure 4d) on online physics learning research during COVID-19 pandemic. Research trends as of August 14, 2021 (Scopus Database Documents) related to experiments (6,845,363), online learning (123,697), physics teacher (16,565); and physics course (13,486). This finding has a positive contribution to the development of physics education, especially in future research trends and physics learning innovation in general. Other findings point to the top keywords trends as of August 14, 2021 (Scopus Database) connecting to online physics learning during COVID-19 pandemic such as: Students (80), E-learning (77), Online Learning (48), Physics (45), Learning Systems (38), Deep Learning (22), Education Computing (22), Machine Learning (18), Curricula (17), and Engineering Education (16). The research implications are supported by recent research:

- These findings will provide an empirical basis for the development of physics education research [42,43], especially online physics learning during the COVID-19 pandemic;
Deep learning system [44], machine learning system [45,46], and education computing [47-49] can still become a research trend in current research, especially in the integration and adaptation in physics learning;

Retracing the trend and novelty of physics education research [50-53] especially in the physics education undergraduate program.

4. Conclusion
The findings indicated there were some parameters or interrelationships among variables to capture the trend and novelty of researching on online physics learning research during COVID-19 pandemic, such as researching experiment, online learning, physics teacher, and physics course on online physics learning research during COVID-19 pandemic. Fundamental implications supported by recent research is retracing the trend and novelty of online physics learning during the COVID-19 pandemic in the physics education undergraduate program. The research limitation is that it only involves Scopus documents. Further research can be done by involving document data from the Web of Science (WoS).

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