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Research Profile of Inquiry on Physics Learning During the COVID-19 Pandemic

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Abstract: This study aims to analyze the application of inquest model learning during the COVID-19 pandemic. This research method reviewed literature and research articles as many as 15 articles that met the criteria both nationally and internationally which included inquiry models and physics learning when the pandemic was used in this research. Data collection is done indirectly and in the form of secondary data. The results showed that 1) The application of the inquiry learning model during the COVID-19 pandemic in improving students' understanding and critical and creative thinking skills increased significantly. 2) The use of online learning tools based on inquiry learning models shows an increase in students' understanding of concepts and critical thinking skills. 3) Online learning tools are categorized as feasible for use in physics learning during the COVID-19 pandemic. 4) It takes a long time to implement the inquiry learning model as long as online learning media, especially e-modules, have not met the demands of 21st century learning.

Keywords: Inquiry Learning; Physics Learning; Pandemic COVID-19

Introduction

A new virus emerged in 2019 that began in Wuhan, China. The COVID-19 outbreak is spreading (Reznik et al., 2021) where the number of cases is increasing rapidly but the clinical information of infected patients is limited (Wang et al., 2020). Indonesia is among the countries affected by the COVID-19 (Batubara, 2021) outbreak. The spread of the COVID-19 outbreak (Marpa, 2020) affected the activities of the domestic sector, especially the education sector (Sinensis & Firdaus, 2022). Various efforts are made to prevent the spread of the COVID-19 outbreak (Syafril & Novrianti, 2021), one of which is by disbursing national education units and universities (Tanjung & Rahma, 2022).

COVID-19 also changed the learning model drastically (Pamungkas & Sukarman, 2020), all learning activities are carried out online (in the network) (Zagalaz-Sánchez et al., 2021) starting from elementary school level to college (Windhiyana, 2020). In this condition, teachers are required to carry out learning through distances (Azhari & Fajri, 2021) that have never been carried out before with minimum standards according to applicable policies (Murfi et al., 2020).

Online learning is considered effective (Wijaya et al., 2020) for distance learning where teachers are required to adapt in these conditions (Bao, 2020). Online learning utilizes *software* in its implementation such as WhatsApp (Ying et al., 2021), Zoom meeting, Google meet, Google Classroom (Saidu & Al Mamun, 2022) to facilitate its implementation (Aiken, 2020). E-learning technology plays a role in supporting the teaching and learning process (Asad et al., 2020) and sharing learning resources. e-learning is expected to improve the quality, efficiency and effectiveness of learning (Bismala et al., 2022), especially physics learning.

Educational goals will be achieved if teachers can encourage students (Yao et al., 2020) to actively engage in the learning process.(McKellar et al., 2020). Physics explains the symptoms of nature (Atangana & Gómez-Aguilar, 2018) using formulas to prove a natural event and conduct experiments to develop students' reasoning (Permata & Bhakti, 2020). Considering that learning carried out online student experiment activities become

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hampered (Gunawan et al., 2020). If there are applicative examples in everyday life (Dwijayani, 2019), students can more easily understand various concepts of physics (Nurmayani et al., 2018).

The learner-centered learning model (Narut & Supradi, 2019) acts as an alternative to these problems, one of which is the inquiry learning model (Herawati et al., 2021). The inquiry learning model is a model based on constructivism philosophy (Zorlu & Sezek, 2019) because through this learning model students can build their own knowledge (Sugianto et al., 2020) and explore what is happening and seek answers to their own questions (Dewanti et al., 2019) according to the criteria of the learning model where students are required to be more active (Ticaya et al., 2020).

Guided inquiry learning models are used to build an understanding of student concepts (Hidayat et al., 2022) by supervisory and direction teachers (Suratno et al., 2018). The implementation of the inquiry learning model adjusts online learning activities (Nurhayati et al., 2019) during the COVID-19 pandemic by utilizing online learning media (Sudarmin et al., 2021). Based on the above exposure, this study was conducted to analyze the application of learning the inquiry model during the COVID-19 pandemic.

Method

This research is included in the type of literature review (Hamilton et al., 2021) research that examines research articles to interpret relevant information (Husniyah et al., 2021) so that study literature is used as a research method (Nguyen et al., 2021). National and international research articles that meet the criteria, particularly those covering inquiry models and physics learning during the pandemic are used in this research. Data collection is carried out indirectly and in the form of secondary data (Ramadhani, 2021). Miles and Huberman put forward techniques in data analysis, namely data reduction, display data, and conclusion drawing / verification data such as **Figure 1.**

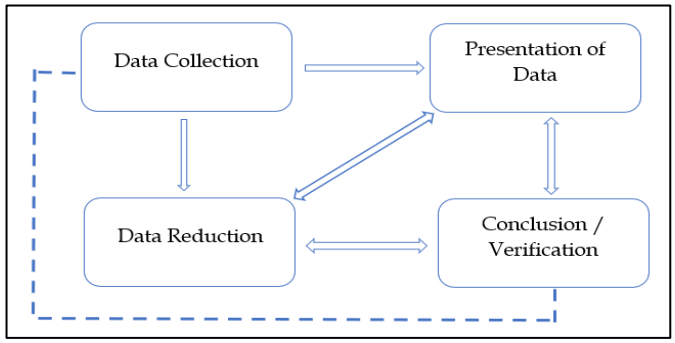

Figure 1. Qualitative Data Analysis Chart

Result and Discussion

This study reviewed articles relevant to the application of the inquiry model to learners during the pandemic (Khotimah et al., 2021). **Table 1** shows several national and international research articles analyzed based on the research design used (Liu et al., 2021). The research articles used were published in the range of 2018-2022.

Table 1. Relevant Research of Inquiry on Physics Learning During the COVID-19 Pandemic

Author	Research Purpose	Research Result
(Risma & Yulkifli, 2021)	Analyze the development of the physics e-module using a smartphone-assisted Inquiry Based Learning model for an alternative X class of online learning.	Demonstrating the implementation of the physics learning process of high school X class students has not been fully in accordance with the demands of online learning, especially the application of e-module physics based on the inquiry model
(Kurniawan & Syafriani, 2021)	Investigate inquiry-based learning concepts to improve students' critical thinking skills in online learning.	Students' critical thinking skills are improved through the application of guided inquiry-based e-modules integrated with Ethnoscience
(Ihsan et al., 2019)	Analyze using the Inquiry based learning (IBL) model with a Contextual Teaching and Learning (CTL) approach to the development of electronic modules.	The results showed students were less active, creative and had difficulty understanding physics concepts. For competency the student's attitude is very good, but for competence, knowledge and skills need to be improved based on the use of the inquiry model.
(Havid et al., 2020)	Obtaining the results from the initial analysis that became the basis for developing an inquiry model-based worksheet.	Through this research, LKS improvements are needed and achieving the demands of inquiry-based physics learning.
(Chao et al., 2021)	Investigate the effectiveness of online science investigations during the COVID-19 pandemic.	Students experience a significant decline in experimental design skills after web-based inquiry learning, particularly in developing participants and creating hypotheses significantly.

Author	Research Purpose	Research Result
(Serevina & Lestari, 2021)	Develop online learning devices using Inquiry Learning models for physics subjects on rigidity of objects	The development of online learning tools using the inquiry learning model on rigid equilibrium materials is effective and suitable for the physics learning of the high school class XI learning process.
(Budi et al., 2021)	The research aims to produce Electronic Student Worksheets of Physics (eSWoP) with the help of Sway to use PhET simulations on physics learning about temperature and heat.	The result of this study is a PhET-assisted eSWoP teaching material that can be used through a variety of electronic devices, using PhET simulations that can help students understand temperature and heat physics subjects.
(Yuliati et al., 2021)	Describes the mastery of concepts and science literacy of students, especially in physics materials, namely Newton's Law in inquiry-based learning for STEM education.	Students who have kindness mastery of concepts, they have a tendency to good science literacy.
(Nurdiana et al., 2021)	Investigate the effectiveness of teamwork levels in guided inquiry-based online learning with experimental methods.	Demonstrated the effectiveness of the level of teamwork after online learning based on the guided inquiry model with experiments mostly classified as moderate.
(Maknun, 2020)	Improve students' understanding of concepts and critical thinking skills through guided inquiry learning models.	The understanding of physics concepts and the critical thinking ability of experimental classes is superior to control classes and conventional classes.
(Zain & Jumadi, 2018)	Knowing the effectiveness of blended learning-based guided inquiries to improve students' critical thinking skills on optical subject matter.	Demonstrate guided inquiries in effective learning physics to improve students' critical thinking on optical matter.
(Nasution et al., 2018)	Developing physics learning instruments to achieve the process of improving skills and describing the quality of instrument learning development results in high school Batak culture-based scientific inquiry models.	Learning instrument components meet the criteria and static fluid physics learning materials specifically for 10th grade high school are suitable for use in learning.
(Wahyuni et al., 2019)	Investigate and develop guided inquiry-based physics learning devices with experiments to enhance students' creativity.	The results show that learning tools are valid and effective in improving student creativity.
(Susilawati et al., 2022)	Testing ripple tanks wave-based learning media is guided by the conceptualization and creativity of students' material characteristics of mechanical waves.	Understanding of student concepts is improved through the application of wave ripple tanks learning media and guided inquiry model learning devices have valid characteristics.
(Yani & Misbah, 2021)	Produce decent modules based on guided inquiries to improve students' critical thinking skills.	Through the learning outcome test it is known that the elasticity module of the solidity of the guided inquiry model is feasible to train students' critical thinking skills.
(Festiyed et al., 2022)	Investigating the effectiveness of 21st century inquiry model-based networks and physics learning outcomes of high school students.	The inquiry model is effective in improving 21st century skills and student learning outcomes that can be used as a solution in the New Normal era of COVID-19.
(Baihaqi et al., 2021)	Improving the LKS package based on the inquiry model integrated with traditional games in offline and online classes.	LKS has proven effective in optimizing the inquiry process online and offline to investigate topics of momentum and impulses during the COVID-19 pandemic.

Author	Research Purpose	Research Result
(Callaghan et al., 2021)	Reviewing the benefits of engagement and interest in STEM for students participating in an optimal inquiry-based learning model during the COVID-19 pandemic.	Students are involved in inquiry-based open learning through a special program with a virtual discovery during the COVID-19 pandemic to increase students' enthusiasm for learning.
(Kang & Seo, 2021)	Reviewing high school physics online learning activities during the first semester of the school lockdown due to COVID-19.	Physics learning activities during the COVID-19 pandemic are distinguished based on the emphasis of teaching including content explanations, participatory learning, and independent first-hand experiences.
(Ahmed & Gwamna, 2020)	Integrating Information and Communication Technology (ICT) in the teaching of Physics outside of COVID-19.	The results showed that Physics educators must be prepared to cooperate with the use of ICT in teaching while involving students in a series of activities as required by the inquiry teaching method.
(Hasyim et al., 2020)	Explaining the improvement of students' critical thinking skills using guided inquiry through online learning assisted by Android-based PhET Simulation.	Learning using guided inquiry with the help of Android-based PhET simulations can improve ability students' critical thinking significantly.
(Hadi et al., 2022)	Representing the implementation of an inquiry learning model based on experimental methods during the COVID-19 pandemic in improving physics learning outcomes for high school students.	The implementation of a guided inquiry learning model with experimental methods has a significant effect on the physics learning outcomes of high school students during the COVID-19 pandemic.
(Maison et al., 2021)	Observing and reviewing students' attitudes towards physics through the application of inquiry and Jigsaw cooperative learning models.	The results showed that there was no significant difference in attitudes in both groups and students had a positive attitude towards physics.
(Herlina et al., 2022)	Sharing the results of experiments carried out during the COVID-19 pandemic related to optical materials for secondary schools based on the inquiry model.	Optical learning based on the inquiry model can be carried out by utilizing simple media that is easy to obtain without complicated processes as an alternative during the COVID-19 pandemic.
(Novitra et al., 2021)	Improve and evaluate valid, practical, and effective online-based Inquiry models to improve high school students' 21st Century physics skills.	The inquiry model meets the category to improve students' 21st Century Skills and is an alternative to improving the quality of physics learning.
(Putranta et al., 2021)	Exploring the strategies of physics teachers in implementing traditional game-based learning using the inquiry model in high schools during the COVID-19 pandemic.	The ability of physics teachers and students, learning facilities is the main factor determining the success of traditional game-based physics learning during the COVID-19 pandemic using the inquiry model.
(John et al., 2022)	Investigating the influence of inquiry-based science teaching approaches on the task competencies of high school physics students in Kitui District, Kenya.	There are statistically significant differences in assignment competence between students taught using the inquiry model and those taught by the conventional model.
(Rahmatullah et al., 2021)	Verifying the influence of contextual physics teaching materials assisted by android-based laboratories using inquiry models in improving students' understanding of concepts.	It is proven that contextual physics teaching materials assisted by android-based virtual labs are effective in using the effective inquiry model to improve students' understanding of concepts.
(Usman et al., 2021)	Assessing the comparison of the effectiveness between virtual labs and traditional labs as a medium for distance learning during the COVID-19 pandemic based on guided inquiry.	Virtual media labs are suitable to be used as an alternative to distance learning methods during the COVID-19 pandemic based on guided inquiry.

Author	Research Purpose	Research Result
(Safitri et al., 2021)	Knowing the influence of KFM-based e-modules in physics learning during the COVID-19 pandemic based on inquiry models improves students' critical thinking skills.	The use of the Kvisoft Flipbook Maker-assisted e-module can improve students' critical thinking skills during the COVID-19 pandemic.

Inquiry is a learning model designed to teach the relationship between one concept and another. The concept of the inquiry learning model involves students in conducting investigations accompanied by teachers who play a role in guiding students to conduct investigations (Usman et al., 2021). Teachers need to have the skills to diagnose students' difficulties and provide assistance in solving the problems they face (Safitri et al., 2021)

Characteristics of Inquiry Learning Models

Reviewed through its application during the COVID-19 pandemic, the inquiry learning model is considered good enough to be developed in the world of education to identify learning objectives related to the preparation of both knowledge or skills, then explain to students, improve activity abilities and physics learning outcomes, and provide opportunities for students to practice applying the concepts that have been learned in the teaching and learning process (Liu et al., 2021).

Integrating teaching activities around finding and solving problems socially and personally for students is a characteristic point in the inquiry model. The problem under investigation was chosen because it requires students to find out more of the subjects around them (Hadi et al., 2022). The characteristics of the inquiry learning model are based on learning activities that provide opportunities for students to explore problems by asking questions, conducting investigations, experiments to research independently to get the knowledge they need. According to Risma & Yulkifli, (2021) the characteristics of the inquiry learning model include: 1) Driving question or problem, 2) Interdisciplinary focus, 3) Authentic investigation, 4) Production of artifacts and exhibits, 5) Collaboration Inquiry Learning (Susanto et al., 2022).

Inquiry Learning Model Syntax

Inquiry model learning is designed so that students are involved in scientific activities directly. It was identified that the syntax of the guided inquiry learning model consists of 5 phases as follows:

Phase 1. Presenting a question or problem. The teacher guides the students to identify the problem, then the teacher divides the students into groups. The problems given to students start from the simplest idea. Given an actual problem then explains the research steps to the students (objects and steps of the Yes / No question). Teachers are required to have a deep knowledge of the problems presented.

Phase 2. Making hypotheses. Activities where the teacher provides opportunities for students to brainstorm opinions in forming hypotheses. In phase 2 the teacher will examine the hypothesis already developed by the student. The teacher's role is to guide students in determining hypotheses that are relevant to the problem and prioritizing which are the priorities of the investigation. If the question asked to the teacher has not been able to be explained in the word yes or no, the teacher asks the student to reconstitute the question asked so that it can be continued to collect data and be linked to the problem situation.

Phase 3. Designing experiments. The role of a teacher is to expand students' research by developing the type of information they obtain. The teacher gives the student the opportunity to determine the steps that correspond to the hypothesis to be carried out. The teacher guides the students to sequence the stages of the experimental experiment which have two uses, namely exploration and direct testing. The exploration stage aims to find changes to the results obtained by theories and assumptions while in conducting the experiment to find a theory. students pilot theories and hypotheses to come up with testing. By researching a theory, we need to ask a lot of verification and experimentation questions.

Phase 4. Conducting experiments to obtain information. Teachers guide students in obtaining information through experiments.

Phase 5. Collect data and analyze data. After carrying out the implementation stages, students analyze their research patterns then determine the most effective questions and how to ask productive ones, and the type of information they need but have not yet obtained. The teacher gives each group the opportunity to convey the results of processing the collected data. The teacher guides the students in making conclusions.

Advantages of Inquiry Learning Model

Each learning model has its own advantages and disadvantages both in theory and in its direct implementation, especially in various special conditions (Susanto, 2019). Based on the review of data and analysis that has been conducted shows that the application of inquiry learning models during the pandemic in improving the understanding and ability to think critically and creatively students has increased significantly. Through the application of the inquiry

model, students can provide answers with original thoughts with their language based on experiments and the results of discussions that have been carried out by utilizing available media (Havid et al., 2020).

The use of online learning devices based on inquiry learning models as an alternative during the COVID-19 pandemic shows an improvement in students' understanding of concepts and critical thinking skills during online learning. Online learning devices are categorized as suitable for use in physics learning during the COVID-19 pandemic and according to the criteria so that they are considered effective in the physics learning process. The inquiry model meets the category to improve students' 21st Century Skills and is an alternative to improving the quality of physics learning (Ihsan et al., 2019).

Learning media continues to develop, especially in the field of science. Inquiry-based learning media aims to develop student conceptualization and creativity. However, based on the results of preliminary studies conducted by Risma, (2021), it shows that the e-module learning media has not met the demands of 21st century learning as evidenced by the low characteristic results of students. PhET is one of the learning media that can be operated during remote learning because it is online Android-based PhET simulation assistance learning in the application of inquiry models can significantly improve students' critical thinking skills (Festiyed et al., 2022).

The advantages of the inquiry learning model according to Nasution et al., (2018) are as follows: 1) Emphasize the development of cognitive, affective, and psychomotor aspects in a balanced manner so that this learning is considered more meaningful. 2) Provide space for students to learn according to their learning style. 3) In accordance with the development of modern learning psychology that considers learning is a process of behavior change thanks to the existence of experience. 4) Being able to serve the needs of students who have above-average abilities means that students who have good learning abilities will not be late by students who are weak in learning (Anggereni et al., 2019).

Disadvantages of Inquiry Learning Model

Physics learning activities during the COVID-19 pandemic are distinguished based on the emphasis of teaching including content explanations, participatory learning, and independent first-hand experiences. In this situation, physics educators must be prepared to cooperate with the use of ICT in teaching while involving students in a series of activities as required by the inquiry teaching method.

According to Hasyim et al., (2020) assessments are reviewed based on student characteristics which include the student's learning style, motivation, interests, knowledge competencies and skills. The non-fulfillment of one of these aspects will affect other aspects so that the development of inquiry learning-based physics e-modules needs to be reviewed further.

Through the results of the review that has been carried out, it can be known the weaknesses of the inquiry learning model including: 1) Difficulty in controlling student activities and success (Festiyed et al., 2022). 2) It is not easy to design because it bumps into student habits (Hadi et al., 2022). 3) Sometimes in its implementation it takes a long time so that the teacher finds it difficult to trouble it with the specified time (Yuliati et al., 2021).

The compounds of 2-Hydroxy-N-(pyridine-2-yl)benzamide series and their Mannich base derivatives have been successfully synthesized. The anti-inflammatory activity result was still low potential, with IC_{50} range = 0.121-0.145 mM. Molecular docking studies show that all synthesized compounds bind at the active site of receptors COX-1 (PDB ID:1EQG) and COX-2 (PDB ID:5KIR) but are non-selective.

Conclusion

Based on research using study literature, it was concluded that: 1) The application of the inquiry learning model during the COVID-19 pandemic in improving students' understanding and critical and creative thinking skills increased significantly. 2) The use of online learning tools based on inquiry learning models shows an increase in students' understanding of concepts and critical thinking skills. 3) Online learning tools are categorized as feasible for use in physics learning during the COVID-19 pandemic. 4) It takes a long time to implement the inquiry learning model as long as online learning media, especially e-modules, have not met the demands of 21st century learning.

The implications for further research in learning by applying the inquiry learning model are expected to be able to utilize and create learning media that can be accessed online to improve conducive, active, innovative and creative learning situations so as to improve students' critical thinking and creative thinking skills, especially in physics learning. The limitations of this research include an inquiry learning model in physics learning during the COVID-19 pandemic. Researchers hope to conduct research centrally on learning models during the COVID-19 pandemic in future studies.

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References

Ahmed, N. A., & Gwamna, M. U. (2020). Integrating information and communication technology in teaching and learning. *Journal of Educational Assessment and Pedagogical Process (JEAPP)*, *1*(1), 49–79. Retrieved from http://www.oecd-ilibrary.org/content/chapter/9789264239555-5-..FD0EA2B45D

Aiken, A. (2020). Zooming in on privacy concerns: video app zoom is surging in popularity. in our rush to stay connected, we need to make security checks and not reveal more than we think. *Index on Censorship*, *49*(2), 24–27. https://doi.org/10.1177/0306422020935792

Anggereni, S., Rismawati, & Ashar, H. (2019). Perbandingan pengetahuan prosedural menggunakan model discovery terbimbing dengan model inquiry terbimbing. *Jurnal Pendidikan Fisika*, *7*(2), 156–161. https://doi.org/10.24252/jpf.v7i2.5823

Asad, M. M., Hussain, N., Wadho, M., Khand, Z. H., & Churi, P. P. (2020). Integration of e-learning technologies for interactive teaching and learning process: an empirical study on higher education institutes of pakistan. *Journal of Applied Research in Higher Education*, *13*(3), 649–663. https://doi.org/10.1108/JARHE-04-2020-0103

Atangana, A., & Gómez-Aguilar, J. F. (2018). Decolonisation of fractional calculus rules: breaking commutativity and associativity to capture more natural phenomena. *European Physical Journal Plus*, *133*(4), 1–22. https://doi.org/10.1140/epjp/i2018-12021-3

Azhari, B., & Fajri, I. (2021). Distance learning during the covid-19 pandemic: school closure in indonesia. *International Journal of Mathematical Education in Science and Technology*, *53*(7), 1934–1954. https://doi.org/10.1080/0020739X.2021.1875072

Baihaqi, H. K., Jumadi, J., Mardiani, A., & Religia, R. (2021). Analyzing student inquiry in online and offline classes during the covid-19 pandemic through momentum and impulse worksheets. *Momentum: Physics Education Journal*, *5*(2), 161–174. https://doi.org/10.21067/mpej.v5i2.5567

Bao, W. (2020). COVID-19 and online teaching in higher education: a case study of peking university. *Human Behavior and Emerging Technologies*, *2*(2), 113–115. https://doi.org/10.1002/hbe2.191

Batubara, B. M. (2021). The problems of the world of education in the middle of the covid-19 pandemic. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*, *4*(1), 450–457. https://doi.org/10.33258/birci.v4i1.1626

Bismala, L., Manurung, Y. H., & Siregar, G. (2022). The impact of e-learning quality and students ' self - efficacy toward the satisfaction in the using of e-learning. *Malaysian Online Journal of Educational Technology*, *10*(2), 141–150. https://doi.org/http://dx.doi.org/10.52380/mojet.2022.10.2.362

Budi, A. S., Sari, S. W., Sanjaya, L. A., Wibowo, F. C., Astra, I. M., Puspa, R. W., Misbah, M., Prahani, B. K., & Pertiwi, W. A. (2021). PhET-assisted electronic student worksheets of physics (eSWoP) on heat for inquiry learning during covid. *Journal of Physics: Conference Series*, *2104*(1), 1–7. https://doi.org/10.1088/1742-6596/2104/1/012030

Callaghan, N. I., Khaira, S., Ouyang, A., Cadavid, J. L., Chang, H. H., Co, I. L., Diep, P., Ivanov, N., Li, G., Li, N. T., Tran-Nguyen, N., Smith, C., Davenport Huyer, L., & Kilkenny, D. M. (2021). Discovery: virtual implementation of inquiry-based remote learning for secondary stem students during the covid-19 pandemic. *Biomedical Engineering Education*, *1*(1), 87–94. https://doi.org/10.1007/s43683-020-00014-z

Chao, Q., Lu, T., Zhao, X., Peng, Q., & Zhao, G. (2021). Teaching pupils to design comparative experiments with web-based inquiry unit during covid-19 pandemic: a pilot study. *Journal of Physics: Conference Series*, *1931*(1), 012003. https://doi.org/10.1088/1742-6596/1931/1/012003

Dewanti, N. K., Djumadi, Wilujeng, I., & Kuswanto, H. (2019). Application of outdoor inquiry learning model on cognitive learning outcomes of class xi senior high school students. *Journal of Physics: Conference Series*, *1233*(1), 1–8. https://doi.org/10.1088/1742-6596/1233/1/012070

Dwijayani, N. M. (2019). Development of circle learning media to improve student learning outcomes. *Journal of Physics: Conference Series*, *1321*(2), 1–7. https://doi.org/10.1088/1742-6596/1321/2/022099

Festiyed, Novitra, F., Yohandri, & Asrizal. (2022). Networked-based inquiry: an effective physics learning in the new normal covid-19 era in indonesia. *International Journal of Instruction*, *15*(2), 997–1016. https://doi.org/10.29333/iji.2022.15255a

Gunawan, Suranti, N. M. Y., & Fathoroni. (2020). Variations of models and learning platforms for prospective teachers during the covid-19 pandemic period. *Indonesian Journal of Teacher Education*, *1*(2), 75–94. https://doi.org/10.110-04-2020-0103

Hadi, S., Izzati, N., Nurul, R., Aulia, A., Rahmat, S., & Dinda, Y. A. (2022). Guided inquiry learning with experimental methods during the pandemic period in improving physics learning outcomes of high

school students. *AMPLITUDO : Journal of Science and Technology Inovation*, *1*(1), 18–25. Retrieved from https://journals.balaipublikasi.id/index.php/amplitudo/article/view/4%0AIntroduction

Hamilton, D., McKechnie, J., Edgerton, E., & Wilson, C. (2021). immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design. In *Journal of Computers in Education* (Vol. 8, Issue 1). Springer Berlin Heidelberg. https://doi.org/10.1007/s40692-020-00169-2

Hasyim, F., Prastowo, T., & Jatmiko, B. (2020). The use of android-based phet simulation as an effort to improve students' critical thinking skills during the covid-19 pandemic. *International Journal of Interactive Mobile Technologies*, *14*(19), 31–41. https://doi.org/10.3991/ijim.v14i19.15701

Havid, M., Yulkifli, & Septiani, T. (2020). Preliminary analysis to develop student worksheet based on inquiry based learning model for 21st century physics learning. *Journal of Physics: Conference Series*, *1481*(1), 1–5. https://doi.org/10.1088/1742-6596/1481/1/012057

Herawati, A., Astra, I. M., & Supriyati, Y. (2021). The effect of inquiry learning model and logical mathematical intelligence on the learning outcomes of high school students. *Journal of Physics: Conference Series*, *1816*(1), 1–7. https://doi.org/10.1088/1742-6596/1816/1/012010

Herlina, K., Wicaksono, B. A., Andra, D., & Nyeneng, I. D. P. (2022). Development of a simple and low-cost light diffraction props for teaching and learning optics during covid-19 outbreak. *Jurnal Pendidikan MIPA*, *20*(1), 23–29. Retrieved from http://jurnal.fkip.unila.ac.id/index.php/jpmipa/%0Adevelopment

Hidayat, R. K., Sahidu, H., & Gunada, I. W. (2022). Pengembangan perangkat pembelajaran berbasis inkuiri terbimbing terintegritas dengan karakter untuk meningkatkan pemahaman konsep fisika peserta didik. *Jurnal Ilmiah Profesi Pendidikan*, *7*(2), 285–291. https://doi.org/10.29303/jipp.v7i2.462

Husniyah, R., Asrizal, A., & Usmeldi, U. (2021). Literatur review pengaruh pembelajaran berbasis kecakapan hidup (life skill) terhadap hasil belajar fisika peserta didik. *Konstan - Jurnal Fisika Dan Pendidikan Fisika*, *6*(2), 74–79. https://doi.org/10.20414/konstan.v6i2.93

Ihsan, I., Yulkifli, & Festiyed. (2019). Analysis of electronic module development using model inquiry based learning with approach contextual teaching and learning in physics material of senior high school class x. *Journal of Physics: Conference Series*, *1317*(1), 6–11. https://doi.org/10.1088/1742-6596/1317/1/012160

John, K. G., Embeywa, H., & Koech, P. K. (2022). The effects of inquiry-based science teaching approach on task competence of secondary school physics students in kitui county, kenya. *Paper Knowledge . Toward a Media History of Documents*, *3*(2), 107–115. https://doi.org/https://doi.org/10.29303/jppipa.v8i2.1542

Kang, N. H., & Seo, J. (2021). Emerging online science teaching practices: insights from high school physics teaching cases in south korea during covid-19 pandemic. In *Asia-Pacific Science Education* (Vol. 52, Issue 4). https://doi.org/10.1163/23641177-bja10030

Khotimah, R. P., Adnan, M., Ahmad, C. N. C., & Murtiyasa, B. (2021). Science, mathematics, engineering, and mathematics (STEM) education in indonesia: a literature review. *Journal of Physics: Conference Series*, *1776*(1), 1–9. https://doi.org/10.1088/1742-6596/1776/1/012028

Kurniawan, R., & Syafriani. (2021). The validity of e-module based on guided inquiry integrated ethnoscience in high school physics learning to improve students' critical thinking. *Journal of Physics: Conference Series*, *1876*(1), 1–7. https://doi.org/10.1088/1742-6596/1876/1/012067

Liu, C., Zowghi, D., Kearney, M., & Bano, M. (2021). Inquiry-based mobile learning in secondary school science education: a systematic review. *Journal of Computer Assisted Learning*, *37*(1), 1–23. https://doi.org/10.1111/jcal.12505

Maison, Tant, T., Kurniawan, D. A., Sukarni, W., Erika, & Hoyi, R. (2021). Assessing students' attitudes towards physics through the application of inquiry and jigsaw cooperative learning models in high schools. *International Journal of Instruction*, *14*(4), 439–450. https://doi.org/10.29333/iji.2021.14426a

Maknun, J. (2020). Implementation of guided inquiry learning model to improve understanding physics concepts and critical thinking skill of vocational high school students. *International Education Studies*, *13*(6), 117. https://doi.org/10.5539/ies.v13n6p117

Marpa, E. P. (2020). Technology in the teaching of mathematics: an analysis of teachers' attitudes during the covid-19 pandemic. *International Journal on Studies in Education*, *3*(2), 92–102. https://doi.org/10.46328/ijonse.36

McKellar, S. E., Cortina, K. S., & Ryan, A. M. (2020). Teaching practices and student engagement in early adolescence: a longitudinal study using the classroom assessment scoring system. *Teaching and Teacher Education*, *89*(1), 102936. https://doi.org/10.1016/j.tate.2019.102936

Murfi, A., Fathurrochman, I., Atika, A., & Saiva Jannana, N. (2020). Kepemimpinan sekolah dalam situasi krisis covid-19 di indonesia. *MANAGERIA: Jurnal*

Manajemen Pendidikan Islam, *5*(1), 119–136. https://doi.org/10.14421/manageria.2020.51-07

Narut, Y. F., & Supradi, K. (2019). Literasi sains peserta didik dalam pembelajaran ipa di indonesia. *Jurnal Inovasi Pendidikan Dasar*, *3*(1), 61–69. https://doi.org/10.1007/s40692-020-00169-2

Nasution, D., Harahap, P. S., & Harahap, M. (2018). Development instrument ' s learning of physics through scientific inquiry model based batak culture to improve science process skill and student ' s curiosity dev elopment instrument ' s learning o f physics through scientific inquiry model based batak cu. *Journal of Physics: Conference Series*, *970*(1), 1–9. https://doi.org/10.1088/1742-6596/970/1/012009

Nguyen, K. A., Borrego, M., Finelli, C. J., DeMonbrun, M., Crockett, C., Tharayil, S., Shekhar, P., Waters, C., & Rosenberg, R. (2021). Instructor strategies to aid implementation of active learning: a systematic literature review. *International Journal of STEM Education*, *8*(1), 1–18. https://doi.org/10.1186/s40594-021-00270-7

Novitra, F., Festiyed, Yohandri, & Asrizal. (2021). Development of online-based inquiry learning model to improve 21st-century skills of physics students in senior high school. *Eurasia Journal of Mathematics, Science and Technology Education*, *17*(9), 1–20. https://doi.org/10.29333/ejmste/11152

Nurdiana, I. M., Sunarno, W., & Wahyuningsih, D. (2021). Physics online learning during the covid-19 pandemic uses a guided inquiry model with experimental methods on teamwork ability and student learning outcomes. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 350. https://doi.org/10.29303/jppipa.v7i3.728

Nurhayati, R., Waluya, S. B., & Asih, T. S. N. (2019). Model pembelajaran inkuiri blended learning strategi flipped classroom dengan media interaktif untuk meningkatkan kemampuan berpikir kritis. *Seminar Nasionar Pascasarjana UNNES*, 4. https://doi.org/10.46328/unnes

Nurmayani, L., Doyan, A., & Sedijani, P. (2018). Pengaruh model pembelajaran inkuiri terbimbing terhadap hasil belajar fisika peserta didik. *Jurnal Penelitian Pendidikan IPA*, *4*(2), 2–7. https://doi.org/10.29303/jppipa.v4i2.113

Pamungkas, D. E., & Sukarman. (2020). Transformasi dunia pendidikan di sekolah dasar. *Jurnal Review Pendidikan Dasar: Jurnal Kajian Pendidikan Dan Hasil Penelitian*, *6*(3), 1–9. http://journal.unesa.ac.id/index.php/PD

Permata, A., & Bhakti, Y. B. (2020). Keefektifan virtual class dengan google classroom dalam pembelajaran fisika dimasa pandemi covid-19. *JIPFRI (Jurnal Inovasi Pendidikan Fisika Dan Riset Ilmiah)*, *4*(1), 27–33. https://doi.org/10.30599/jipfri.v4i1.669

Putranta, H., Kuswanto, H., Hajaroh, M., Dwiningrum, S. I. A., & Rukiyati. (2021). Strategies of physics learning based on traditional games in senior high schools during the covid-19 pandemic. *Revista Mexicana de Fisica E*, *19*(1), 1–15. https://doi.org/10.31349/REVMEXFISE.19.010207

Rahmatullah, Dwandaru, W. S. B., Kuswanto, H., & Karanggulimu, A. (2021). The effect of contextual physics teaching materials assisted by an android-based virtual lab to improve students' conceptual understanding during the covid-19 pandemic. *Proceedings of the 6th International Seminar on Science Education (ISSE 2020)*, *541*(Isse 2020), 502–508. https://doi.org/10.2991/assehr.k.210326.072

Ramadhani, D. P. (2021). Analisis penerapan asesmen formatif dalam pembelajaran ipa dan fisika : literature review. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *11*(2), 110–120. https://doi.org/10.24929/lensa.v11i2.172

Reznik, A., Gritsenko, V., Konstantinov, V., Khamenka, N., & Isralowitz, R. (2021). COVID-19 fear in eastern europe: validation of the fear of covid-19 scale. *International Journal of Mental Health and Addiction*, *19*(5), 1903–1908. https://doi.org/10.1007/s11469-020-00283-3

Risma, M., & Yulkifli. (2021). Preliminary study of development of physics e-module using smartphone-assisted inquiry based learning models to support 21st century learning. *Journal of Physics: Conference Series*, *1876*(1), 1–13. https://doi.org/10.1088/1742-6596/1876/1/012044

Safitri, A., Permata, M. D., & Wilujeng, I. (2021). The effect of using the e-module assisted by the kvisoft flipbook maker in improving student's critical thinking skills during the covid-19 pandemic. *Proceedings of the 6th International Seminar on Science Education (ISSE 2020)*, *541*(Isse 2020), 545–551. https://doi.org/10.2991/assehr.k.210326.078

Saidu, M. K., & Al Mamun, M. A. (2022). Exploring the factors affecting behavioural intention to use google classroom: university teachers' perspectives in bangladesh and nigeria. *TechTrends*, *1*(0123456789), 1–16. https://doi.org/10.1007/s11528-022-00704-1

Serevina, V., & Lestari, M. A. (2021). Development device learning online use model inquiry learning on theory the balance of tough things. *Journal of Physics: Conference Series*, *1876*(1), 1–9. https://doi.org/10.1088/1742-6596/1876/1/012072

Sinensis, A. R., & Firdaus, T. (2022). Keefektifan pembelajaran daring pada mata kuliah dasar-dasar proses pembelajaran fisika di masa pandemi covid-19 (studi komparasi pembelajaran luring dan daring). *Jurnal Ilmiah Multi Sciences*, *14*(1), 31–35.

https://doi.org/https://doi.org/10.30599/jti.v14i1.1464

Sudarmin, Mursiti, S., Sarwi, S., & Listiaji, P. (2021). Secondary metabolite learning model from taxus sumatrana with ethnoscience integrated inquiry using online system and google form application. *Journal of Physics: Conference Series*, *1918*(3), 1–6. https://doi.org/10.1088/1742-6596/1918/3/032025

Sugianto, I., Suryandari, S., & Age, L. D. (2020). Efektivitas model pembelajaran inkuiri terhadap kemandirian belajar siswa di rumah. *Jurnal Inovasi Penelitian*, *1*(3), 159–170. https://doi.org/10.47492/jip.v1i3.63

Suratno, J., Ardiana, & Tonra, W. S. (2018). Computer-assisted guided discovery learning of algebra. *Journal of Physics: Conference Series*, *1028*(1), 1–7. https://doi.org/10.1088/1742-6596/1028/1/012132

Susanto, I. (2019). Pengaruh model pembelajaran inkuiri berbantuan power point terhadap hasil belajar fisika pada materi pokok gerak harmonik sederhana siswa kelas x semester ii sma negeri 4 tebing tinggi T.P 2016/2017. *Jurnal Pendidikan Fisika*, *1*(1), 1–15. https://doi.org/http://doi.org/10.1016

Susanto, I., Tafonao, F., & Simangunsong, I. T. (2022). Peningkatan hasil belajar dengan model inquiry learning berbasis konsep merdeka belajar siswa pada materi pokok pengukuran kelas x smk swasta harapan mekar 1 medan T.A. 2021/2022. *JURNALPENELITIANFISIKAWAN*, *5*(1), 69–74. Retrieved from http://jurnal.darmaagung.ac.id

Susilawati, Doyan, A., & Harjono, A. (2022). Development of learning media for wave ripple tanks with the implementation of guided inquiry models on students ' mastery of concepts and scientific creativity. *Journal of Research in Science Education*, *8*(2), 1–7. https://doi.org/10.29303/jppipa.v8i2.1542

Syafril, & Novrianti. (2021). The factor analysis of online learning barriers on learning evaluation course during covid 19 pandemic. *Journal of Physics: Conference Series*, *1779*(1). https://doi.org/10.1088/1742-6596/1779/1/012021

Tanjung, Y., & Rahma, M. A. (2022). Pengembangan instrumen tes fisika berbasis pengetahuan faktual pada materi gelombang bunyi di sma. *Jurnal Ikatan Alumni Fisika Universitas Negeri Medan*, *8*(5), 1–7. https://doi.org/10.1080/0020739X.2021.1875073

Ticaya, Ikhsan, M., & Yusrizal. (2020). Students' learning outcome through the implementation of guided inquiry learning model using autograph. *Journal of Physics: Conference Series*, *1460*(1), 1–6. https://doi.org/10.1088/1742-6596/1460/1/012043

Usman, M., Suyanta, & Huda, K. (2021). Virtual lab as distance learning media to enhance student's science process skill during the covid-19 pandemic. *Journal of Physics: Conference Series*, *1882*(1), 1–9. https://doi.org/10.1088/1742-6596/1882/1/012126

Wahyuni, S., Kosim, Gunawan, & Husein, S. (2019). Physics learning devices based on guided inquiry with experiment to improve students' creativity. *Journal of Physics: Conference Series*, *1233*(1), 1–8. https://doi.org/10.1088/1742-6596/1233/1/012034

Wang, D., Hu, B., Hu, C., Zhu, F., Liu, X., Zhang, J., Wang, B., Xiang, H., Cheng, Z., Xiong, Y., Zhao, Y., Li, Y., Wang, X., & Peng, Z. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in wuhan, china. *JAMA - Journal of the American Medical Association*, *323*(11), 1061–1069. https://doi.org/10.1001/jama.2020.1585

Wijaya, T. T., Zhou, Y., Purnama, A., & Hermita, N. (2020). Indonesian students learning attitude towards online learning during the coronavirus pandemic. *Psychology, Evaluation, and Technology in Educational Research*, *3*(1), 17–25. https://doi.org/10.33292/petier.v3i1.56

Windhiyana, E. (2020). Dampak covid-19 terhadap kegiatan pembelajaran online di perguruan tinggi kristen di indonesia. *Perspektif Ilmu Pendidikan*, *34*(1), 1–8. https://doi.org/10.21009/pip.341.1

Yani, M., & Misbah, &. (2021). Development of solid elasticity modules with guided inquiry model to train critical thinking skills. *Physics Education Journal*, *4*(1), 44–56. Retrieved from http://jurnal.unipa.ac.id/index.php/kpej

Yao, J., Rao, J., Jiang, T., & Xiong, C. (2020). What role should teachers play in online teaching during the covid-19 pandemic? evidence from china. *Science Insights Education Frontiers*, *5*(2), 517–524. https://doi.org/10.15354/sief.20.ar035

Ying, Y. H., Siang, W. E. W., & Mohamad, M. (2021). The challenges of learning english skills and the integration of social media and video conferencing tools to help esl learners coping with the challenges during covid-19 pandemic: a literature review. *Creative Education*, *12*(07), 1503–1516. https://doi.org/10.4236/ce.2021.127115

Yuliati, L., Yogismawati, F., Purwaningsih, E., & Affriyenni, Y. (2021). Concept acquisition and scientific literacy of physics within inquiry-based learning for stem education. *Journal of Physics: Conference Series*, *1835*(1), 1–7. https://doi.org/10.1088/1742-6596/1835/1/012012

Zagalaz-Sánchez, M. L., Cachón-Zagalaz, J., Arufe-Giráldez, V., Sanmiguel-Rodríguez, A., &

González-Valero, G. (2021). Influence of the characteristics of the house and place of residence in the daily educational activities of children during the period of covid-19' confinement. *Heliyon*, *7*(3), 1–11. https://doi.org/10.1016/j.heliyon.2021.e06392

Zain, A. R., & Jumadi. (2018). Effectiveness of guided inquiry based on blended learning in physics instruction to improve critical thinking skills of the senior high school student. *Journal of Physics: Conference Series*, *1097*(1), 1–9. https://doi.org/10.1088/1742-6596/1097/1/012015

Zorlu, Y., & Sezek, F. (2019). Investigation of the effects of group research method of applying modeling based teaching method in the particle structure and properties of matter unit on. *SAKARYA UNIVERSITY JOURNAL OF EDUCATION*, *1*(1), 455–475. https://doi.org/10.19126/suje.481295