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Blog Academic Assisted Inquiry Strategy for Conceptual Understanding of Physics Learning through 21st Century Learning Attitudes

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Abstract: This research aims to determine the impact of learning using inquiry strategies assisted by academic blogs on the 21st century skills of students in the Physics Education Study Program at IKIP PGRI Pontianak. This research is a pre-experimental design research with a One group pretest-posttest design. The sample used was all 18 fifth semester students. The data collection technique is to determine conceptual abilities using tests, while to determine 21st century skills, namely 4C skills (Critical Thinking, Communication, Collaboration and Creativity) using observation techniques. The data collection tools used were test questions and observation sheets. Based on data analysis, it is known that there is a significant increase in students' understanding of concepts before and after learning in the high category. Students master 21st century skills, namely critical thinking, communication, collaboration, and creativity in the high category in every lesson. The academic blog-based inquiry learning model is innovative in improving the quality of physics learning in the 21st century educational era.

Keywords: 21st century; Blog academic; Inquiry; Learning attitudes; Physics learning

Introduction

Currently the world has entered the 21st century or the era of industrial revolution 4.0. An era marked by the increasing use of cyber technology which is moving very quickly (Usman et al., 2022; Shokhsanam & Abdukarimova, 2022). In line with this, technological developments in Indonesia are also growing (Aspi & Syahrani, 2022), including educational aspects (Jobirovich, 2022). Education is designed in such a way that it can prepare students for a successful life in the 21st century. In response to this, we need to adapt in the education process so as not to be left behind with developments over time and of course in accordance with the national goals of the Indonesian nation based on the 1945 Constitution, namely, to make the nation's life intelligent (Hermanto, 2020). One way is through the introduction of digital technology in the learning process.

The current learning process emphasizes more than just changing students' concepts from not knowing to knowing, but rather the meaningfulness of concepts received through scientific methods. In this case, physics teachers are at the center of change in relation to science education, scientific literacy, and educational transformation. Teachers must be able to transfer their knowledge through physics learning that connects physics concepts with students' daily lives and technological developments. For this reason, learning is needed that can prepare students with skills that support the 21st century. For example, minimizing students' habits of understanding questions that rely on knowledge of concepts only, but rarely emphasizing the ability to find and analyze problems, solve problems by applying them. knowledge learned in new situations, critical thinking, arguing, innovating, and communicating. Students need to be trained to apply skills that support 21st century life, namely 4C skills (Critical Thinking, Communication, Collaboration and Creativity). It is known that students who have 4C skills

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can build their knowledge, both individually and in groups (Sari et al., 2022; Sari et al., 2021).

A number of empirical evidence shows that inquiry learning strategies are effective for optimizing 21st century skills, including critical thinking (Maknun, 2020; Sari et al., 2021), collaboration (Pietarinen et al., 2019; Tissenbaum & Slotta, 2019), communication (Santos et al., 2023) and creativity (Wahyuni et al., 2019). However, other research says that there is no difference between inquiry learning and direct learning in understanding concepts. It turns out that students with low abilities are more appropriate when taught using direct learning, and students with high abilities are more appropriate when taught using inquiry (Richter et al., 2022). Other research says that inquiry teaching has a very weak relationship to science achievement (Jerrim et al., 2022). Other research reveals that inquiry learning is not an effective method for improving the critical thinking disposition of students (pre-service teachers) (Arsal, 2017). The gap in this research shows that further research needs to be carried out to develop strategies and deepen understanding of the effectiveness of inquiry learning in achieving students' 4C competencies in learning physics.

Referring to the 21st century, with generation Z students who cannot live without digital technology, the right learning aids are digital based. In several empirical studies of inquiry research with blogs, it has been proven that the use of inquiry-based blogs can provide understanding of concepts, student learning achievements, and can be used as accompanying teaching materials (Herayanti et al., 2022). Blogs are often used successfully in higher education (Almenara et al., 2013; Tur & Urbina, 2014; Yang & Chang, 2012).

The IKIP PGRI Pontianak Physics Education Study Program is an LPTK that produces prospective teachers. In this case, 21st century skills, namely 4C, are very necessary to be developed. This is in line with the priority of the IKIP PGRI Pontianak Research Strategic Plan for the 2021-2025 periods, namely the development of 21st century competencies. The expected target for 2023 is a basic study of 21st century competencies. 4C skills are one of the 21st century skills that need to be developed consistently optimal. One way to optimize student skills for the 21st century is through lectures. Through appropriate inquiry strategies, capable 21st century skills will be formed. To facilitate the teaching and learning process, teachers can engineer learning through models or methods and learning support media (Lugiati, 2020).

The Physics Education Study Program which has implemented the Independent Campus Learning Curriculum (MBKM) is required to be able to align it with the fulfillment of the Main Performance Indicators (IKU). One of the IKU achievements that must be met in the learning system is by implementing learning related to collaborative and participatory classes. The seventh IKU is a collaborative and participatory class, so that universities and lecturers can design quality lectures and can encourage students to participate in class learning.

The use of academic blogs as an aid in inquiry strategies is still relatively new and has not been widely researched. This is a novelty of the research that will be carried out. Digital technology can empower students' abilities according to the needs of the 21st century (Arifin & Setiawan, 2020). Therefore, it is hoped that this research can provide new contributions and understanding in the use of digital technology as an aid in learning physics with inquiry strategies to improve students' 4C abilities. Implementing inquiry-based learning can train students to solve problems related to contextual issues circulating in society. Through experiments, students are directed to study literature, plan and carry out experiments on various problems and ways to solve them. Therefore, it is necessary to carry out research that identifies the impact of 21st century skills with inquiry strategies supported by academic blogs so that students have information and are prepared to face the 21st century.

Method

This research is quantitative research with a pre-experimental design. This research has a One group pretest-posttest design, namely a design where a group is given treatment, then the results are observed. This research will look at the impact of inquiry strategies assisted by academic blogs on conceptual abilities and 21st century skills. The variables in this research consist of independent variables and dependent variables. The independent variable is inquiry strategy, and the dependent variable is conceptual abilities and 21st century skills. 21st century skills in this research include the 4C skills (Critical Thinking, Communication, Collaboration and Creativity).

The population in this study were all active students in the second semester of the IKIP PGRI Pontianak Physics Education Study Program who took the Basic Physics course in the fifth semester of the 2022/2023 academic year. Determination of the sample in this study used a saturated sampling technique. The data collection tools used was test questions and observation sheets. The measurement scale used in the test is in the range 1-100, while the observation sheet uses a Likert scale with four answer intervals, namely Very Good (SB = 4), Good (B = 3), Fairly Good (C = 2) and Not Good (K = 1).

The test results obtained are then analyzed qualitatively by scoring. Data in the form of observations of 4C skills at each meeting will then be described based on the percentage of acquisition of each aspect of 4C skills. To determine the increase in conceptual abilities and 4C skills using inquiry strategies assisted by academic blogs, an analysis of the normalized gain scores was carried out which was then categorized (Hake, 1998).

Result and Discussion

Inquiry learning has become an increasingly popular model to improve students' understanding of concepts in various fields of science, including in learning physics concepts. Figure 1 shows students' concept achievement depicted through test results after they complete learning with academically assisted inquiry blogs on electromagnetic induction material. Analysis of the data in Figure 1 provides information on the extent to which the inquiry approach can contribute to the understanding and application of physics concepts by students.

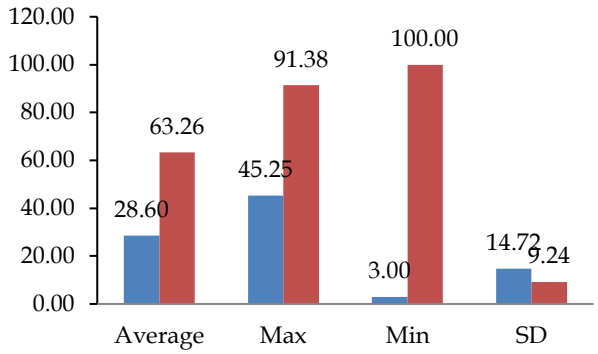

Figure 1. Achievement of student concepts in learning with academically assisted inquiry blog electromagnetic induction material

Based on Figure 1, it is known that students get good scores, where posttest scores are better when compared to pretest scores. Therefore, it can be said that students experience an increase in understanding concepts in electromagnetic induction material after being given inquiry learning assisted by academic blogs. The achievement of students' conceptual abilities in electromagnetic induction material can be seen based on the achievement of learning indicators, while to determine the magnitude of the increase in student concept achievement, a normalized gain score calculation is carried out. The results of the detailed achievement analysis can be seen in Figure 2. Based on Figure 2, information was obtained that all indicators experienced an increase in achievement from the pretest score which increased in the posts score and this increase was classified as a high category according to Hake (1998). This is in line with Margunayasa et al. (2019) which states that guided inquiry learning has a very significant influence on the achievement of learning achievement.

The achievement seen in Figure 2 is obtained based on learning experience through the implemented learning model. At every opportunity, students are given the freedom to acquire knowledge through discoveries. Students design their own thoughts to get the desired knowledge. Students not only act as recipients of the material, but they also act as discoverers of the subject matter itself (Husni, 2020).

In general, electromagnetic induction material is a material with a characteristic understanding of mathematical concepts that are usually considered difficult. However, this material can be presented interestingly and oriented to students' active participation so that conceptual understanding can be achieved. Through problem orientation given at the beginning of learning, students begin to be stimulated to think. Problem orientation is presented by providing the latest information that can attract students' attention, can raise various questions, and can provide space for students to be able to think broadly about the material presented. College students' curiosity sparks their interest in completing assignments. Through problem formulation, students are asked to answer the problems raised at the orientation stage by making a list of questions, knowledge, or experiences they must find that lead to the concept being studied. After the list of questions is completed, they make hypotheses related to the problem given at the beginning with the knowledge they already have.

Next, through the exploration stage, they conducted scientific investigations. Students gather a variety of information with the help of academic blogs and answer pre-existing questions. Academic blogs in learning are no less influential part in ensuring students' conceptual understanding. Most students have used academic blogs to get information, so they can define and understand concepts. The use of information technology in learning can provide practical experience for students (Shatri, 2020). At the exploration stage, experiments can also be carried out. In the experimental stage, students apply what they have learned from research and presentations. Through direct experimentation, they do not deal with abstract concepts but with concrete concepts that they can personally observe. The experiments they designed are also simple and can be related to real-life situations. With the

collection of this information, students can test the truth of the hypotheses that have been submitted, and in the end can draw conclusions.

If the increase in students' conceptual understanding from Figure 2 is calculated through a normalized gain score, a result of 0.88 is obtained. This means that academic blog-assisted learning is in the high category. The high value of student gain can be seen from student involvement in constructing knowledge. Through inquiry, students try to answer what they want to know through research. Personally, students have identified or defined various concepts and information through academic blogs that support the discovery process. Exposure of research results to other students also strengthens their knowledge on electromagnetic induction material. The presentation of research results is very important in the inquiry model. The goal is for lecturers to overcome misconceptions from the beginning of learning. When the percentage in front of the class lecturers can supervise, improve, and provide reinforcement to students (Supena et al., 2021). Inquiry allows students to gain in-depth conceptual learning of scientific concepts because students are involved in the practical work of scientists. Inquiry could strengthen the learning carried out by students. In inquiry learning, students have more opportunities to construct their own knowledge. The inquiry learning model provides more opportunities for students to learn directly (Gunawan et al., 2019).

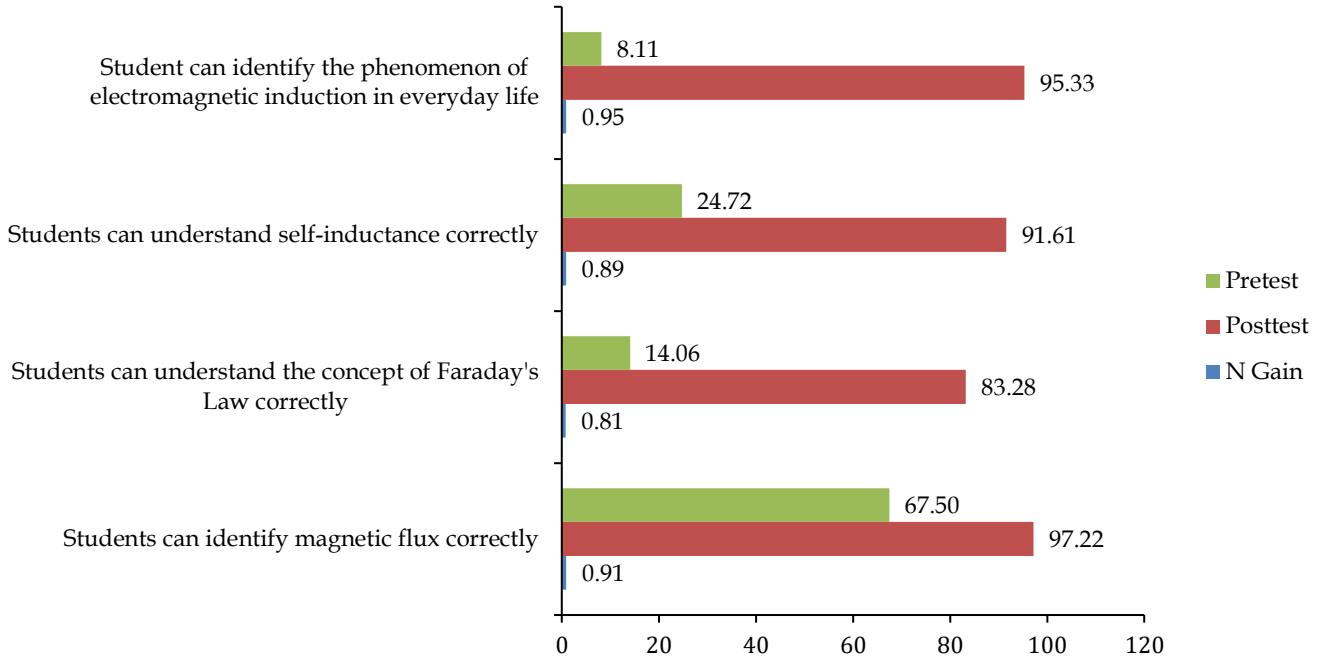

Figure 2. Conceptual achievement of students based on learning indicators

21st century skills are skills that are becoming increasingly important in preparing students to face the demands of the modern era. Figure 3 shows the results of research that provides an overview of how academic blog-assisted learning can be an effective means of shaping 21st century skills, namely critical thinking, communication, collaboration, and student creativity to face future challenges. Based on Figure 3, it is known that students' 21st century skills have improved during learning carried out in 4 meetings. It can be said that the overall 21st century skills of students improve after the completion of activities with the blog's academic-assisted inquiry learning model on electromagnetic induction material. In learning, students are given worksheets that contain a general framework of the inquiry process that can be used during learning. In this case, students are trained to be able to think critically and creatively in looking for what they want to know and how to obtain this knowledge. Students are encouraged to prove the concepts they have learned through research. The research procedure is designed by the students themselves. Students are given the opportunity to identify problems and design experiments to be able to solve their own problems or questions. From Figure 3, information was obtained that students' critical thinking skills and creativity were increasing in their meetings. That means, students' abilities in these two aspects are growing. Students begin to be able to respond to problems, be able to solve problems and think creatively in every aspect. The

ability to think critically and creativity is an important ability when talking about 21st century-themed learning (Rosidin et al., 2019).

The application of inquiry assisted by academic blogs in learning provides space for students to provide knowledge collectively. This is shown by the results of the scores obtained in the collaboration aspect in Table 3. Through academic-assisted inquiry learning, blogs can create constructive feedback between fellow students. The learning that takes place is student-centered. In line with Puspitarini & Hanif (2019), the learning process should make students the center of activity. Student involvement in learning activities determines learning success. In implementing learning, there is collaboration within the group, which can be seen from the emergence of shared responsibility for acquiring knowledge related to the topic being studied. This has an impact on the emergence of critical and creative thinking through in-depth discussions and joint reflection. Collaboration is a form of support and sharing ideas (Houghton et al., 2022). Thus, it can be said that inquiry learning assisted by academic blogs opens the door to more effective and meaningful collaboration in the classroom.

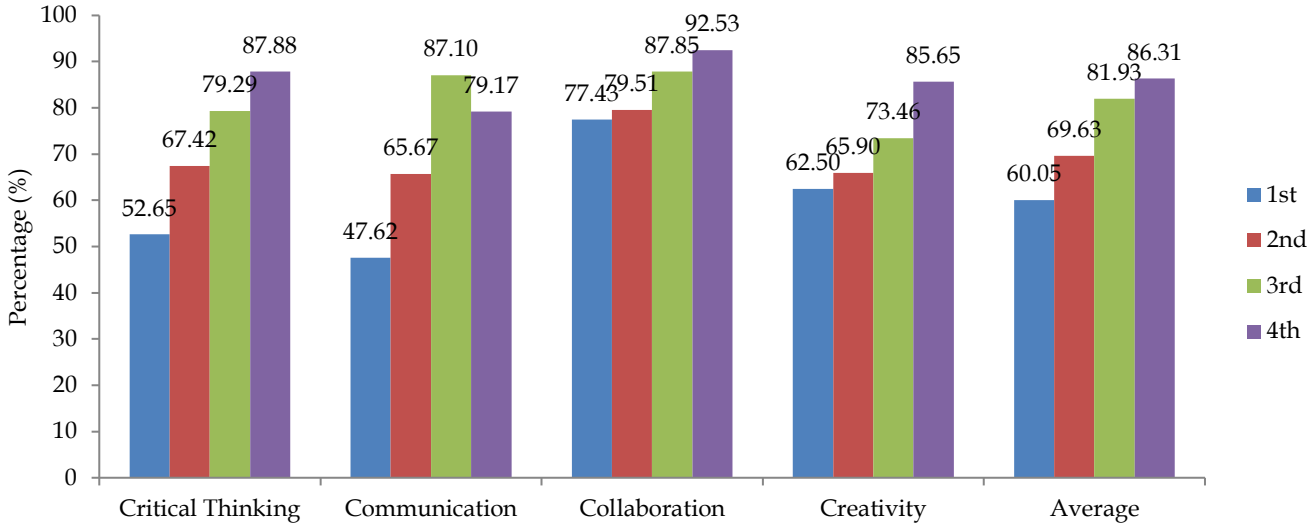

Figure 3. Achieving 21st century student abilities in learning using the academic-assisted inquiry model blog

Effective communication improved after the implementation of the blog's academically assisted inquiry learning as seen in Figure 3. Effective communication is shown through students' ability to communicate their ideas well to their group mates. Open communication created in learning is a form of mutual recognition of others (Fiock, 2020) which can generate confidence (Nadiah et al., 2019). The implementation of learning takes place collaboratively. Students work in groups when they find a problem from the information presented, make a list of what they want to know and what they want to learn, to communicate to the audience in the form of class percentages. In learning, students are asked to conduct individual research in the form of proof of concept on the topic they are studying to ensure the active participation of each group member. On this occasion, students have been able to communicate their ideas well to their group mates and other groups in class percentage. Collaboration can improve students' communication skills because collaboration involves conversations among group participants. According to Syawaludin et al. (2022) learning by inquiry can foster the ability to think, work and behave scientifically to communicate it.

When viewed from the results of the research that has been obtained, it shows that students have changed their views from a beginner's view to an expert view in the field of science. There is a shift towards the positive ability of students to conduct learning. Students can connect the concepts learned with the real world and implement various abilities in learning. Learning that relates concepts to the real world will make students understand concepts more functionally, and more importantly other than that accepted concepts will be deeply embedded in their memory (Naimi & Sakinah, 2022). 21st century skills in the form of critical thinking, communication, creativity, and collaboration trained during the learning process with an academically assisted inquiry model blog support the achievement of students' conceptual understanding of electromagnetic induction material. According to Reinhold et al. (2020) through the use of appropriate information technology

can develop various student skills, such as math skills, critical thinking skills, communication skills, problem-solving skills, and teamwork. This opinion is in line with the findings of this study, that students gain experience in solving their own mathematical problems. In designing experiments, they decide what variables to measure and calculate.

They successfully solved the problems involved in the experiment. Students have a deeper understanding of the variables in the equation, and how those variables relate to each other. With the ability of students to solve the problems involved, their critical thinking skills increase. Students who have found answers to the questions they have asked. This is proof that students have been involved in the process of building knowledge and thinking deeply (Saleh, 2019). By bringing up various thoughts, ideas that accompany information and cases in the environment, as well as physical equations, it means that students have brought out their creative abilities in learning. Students have also been able to solve problems through the stages contained in the inquiry model. Students already have growing confidence, as can be seen from their ability to communicate and collaborate better in the implementation of learning.

Seeing the success that has been achieved in this learning, it can be said that it is very important to change from the traditional classroom approach to academic-assisted inquiry learning blogs to improve conceptual understanding of the field of physics through 21st century skills, namely critical thinking, communication, collaboration, and creativity. Learning involving a variety of skills describes the activities of scientists when building and applying knowledge (Brookes et al., 2020).

Conclusion

The application of the blog-assisted inquiry model makes a positive contribution to students' understanding of concepts in physics learning, especially in electromagnetic induction material. There was a significant increase in students' conceptual understanding before and after implementing inquiry assisted by academic blogs. Students obtain high increases in learning outcomes after implementation. Apart from that, they have also mastered 21st century skills, namely critical thinking, communication, collaboration, and creativity in every meeting in the high category. Learning through 21st century learning attitudes such as critical thinking, communication, collaboration, and creativity has been proven to encourage active student involvement. The results of this research provide a strong empirical basis to support the effectiveness of the blog-based academic inquiry model as an innovative learning model in improving the quality of physics learning in the 21st century education era.

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Author Contributions
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Conflicts of Interest
The authors declare no conflict of interest.

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