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Networked-based Inquiry: An Effective Physics Learning in the New Normal COVID-19 Era in Indonesia

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This research aims to investigate the effectiveness of Networked-based Inquiry model on 21st-Century Skills and learning outcomes of physics students in senior high school. This research was a quasi-experimental with non-equivalent control group and 2x3 factorial design. One hundred twenty students participated in this research. Research instruments were 21st-Century Skills assessment sheets and learning outcomes test items. Descriptive statistics and two-way ANOVA tests with a significance level of 5% were used to analyze the research data. The average level of students' 21st-Century Skills at the end of the experimental term in the experimental group was 85 and the average N-Gain scores was 0.64. Two-way ANOVA test results showed that the experimental group and the control group had a significant difference in 21st-Century Skills level (p=0.000). There was no significant difference in the level of 21st-Century Skills of students in each experiment group (p=0.438). There was no interaction between Networked-based Inquiry variable and school category variable in determining the level of 21st-Century Skills (p=0.774). Learning outcomes test result showed the average scores of cognitive competence in the experimental group was 79.00 and percentages of completeness was 93%. The findings conclude that the model is effective in improving 21st-Century Skills and learning outcomes and can be used as a solution in the New Normal COVID-19 era.

Keywords: Covid-19, inquiry, networked, new normal, physics learning

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INTRODUCTION

The emergence of the COVID-19 outbreak has had a negative impact on various fields, especially in education. Until now, the pandemic shows no signs of easing, coupled with the new COVID-19 variants that have been found and have spread in Indonesia (COVID-19 Handling and National Economic Recovery Committee, 2021). The Indonesian government had closed all learning activities in schools and replaced class activities with online learning (Basith et al., 2020; Siron et al., 2020). However, various obstacles, such as the ICT literacy of teachers and students, internet quotas, internet bandwidth, and others, have a negative impact on the effectiveness of learning (Mailizar et al., 2020; Setyorini, 2020). Teachers had difficulty in accommodating online learning, they only gave students tests and tasks without any learning process (Sutarto et al., 2020). Parents also had difficulty in supporting and guiding their children to study at home online. Consequently, online learning did not take place effectively (Setyorini, 2020). These obstacles also affected physics learning, because physics is a science that is inseparable from observation and experiment, it was very difficult for physics teachers to carry out online learning activities that can accommodate the scientific process properly.

These obstacles were initially considered to be a short-term problem, but now it has become to be a long-term consequence. This reaffirms that the digitalization of education in Indonesia is not easy, even though the idea has long been on the government's agenda to face the fourth industrial revolution. Digitalization of education is not just about replacing face-to-face learning with online learning, but it requires adequate infrastructure, strengthening coordination between relevant ministries, a collaboration between the government and researchers, and education practitioners (Frolova et al., 2020; Mertala, 2020). Moreover, there was resistance from teachers and students to start innovative processes. In response, the government presented school authorities with recommendations and steps to be taken to guarantee a safe reopening of schools, namely face-to-face learning in a limited way and complying with the rules of health protocol. Furthermore, with the recognition of 21st-Century Skills as a standard of competence that students in the current era must possess, relevant physics learning model is a model based on scientific processes and the use of ICT in a balanced combination. Because according to the 21st-Century Skills framework, these skills cover ICT literacy (AASL, 2019; Partnership for 21st Century, 2019), then the substance of indicators of critical thinking, creative thinking, communication, and collaboration are abilities in digital and real-life aspects (van Laar et al., 2020). In other words, learning activities in the New Normal COVID-19 era are carried out by combining face-to-face and online learning.

Based on the observation of learning readiness in the New Normal COVID-19 era results, it was found that physics teachers could not use online learning management facilities optimally. The teachers used Google Classroom only to provide practice questions for students to do at home. They had difficulty when using technology to design instruction that components are in sync with each other (learning materials, methods, assessments, and media). The teachers used ICT only at the applying level,

they used laptops and projectors to show learning materials and then gave take-home online assignments to students. Based on the analysis of the 21st-Century Skills level and student learning outcomes at State Senior High School 1 Sungai Penuh, State Senior High School 2 Kerinci, and State Senior High School 4 Kerinci also show poor scores. The average level of students' 21st-Century Skills is still in the low category and the overall percentage of students' 21st-Century Skills level is only 59.60%. Then the level of mastery (on a knowledge test) in each school is less than 60%. This finding shows the importance of a physics learning model based on scientific processes and the use of ICT in a balanced combination, one of which is the Network-based Inquiry learning model.

Networked-based Inquiry learning model is based on constructivism learning theory and connectivism learning theory. The combination of both learning theories forms a learning concept capable of developing students' 21st-Century Skills (digital literacy-based skills) because this concept is based on scientific processes and the use of ICT in a balanced combination. Constructivism is a learning theory that assumes that knowledge is gained from the construction process through human interaction with humans, objects, phenomena, experiences, and their environment (Glasersfeld, 1987), not gained directly by the senses as the assumption of previous learning theories (Pritchard & Woollard, 2010), and use prior knowledge to gain new knowledge by understanding what they experience during the learning activity (Bruning et al., 2004). Constructivism shapes Network-Based Inquiry character as a learning model that emphasizes on the construction of knowledge from concrete experiences, collaborative activities, observation, and reflection. The praxis is actualized by the inquiry process, problem-solving, and collaboration. Then, in the connectivism paradigm, learning is a process when students connect and take part in the learning community to gain new knowledge. This interaction is not only through digital discussions but also through observing images, videos, and multimedia (Siemens, 2005). Connectivism shapes Network-Based Inquiry character as a learning model that emphasizes to gain new knowledge through relying on ICT to accommodate the process of student interaction with the learning community and learning resources. The praxis is actualized by processes that rely on ICT in collect information, collaboration, communication, discussion, and problem-solving.

Networked-based Inquiry is a development of the inquiry-based learning. Inquiry-based learning has a positive impact on learning outcomes, both on attitudes, skills, and knowledge (Aktamiş et al., 2016; Lai et al., 2018; Sutiani et al., 2021). Many studies have consistently shown that inquiry-based learning more effective than other learning models (Lazonder & Harmsen, 2016). Inquiry-based learning is a scientific phenomenon-based learning. Students make observations and generate hypotheses, then conduct investigations, conduct experiments, analyze the data, and conclude (Joyce et al., 2016; Pedaste et al., 2015). In these activities, students actively construct their own knowledge (student-centered learning) (Kaiser et al., 2018). This learning aims to encourage students to discover the concepts that they learn. The process in the inquiry-based learning can be defined as the process of "discovery" (Marshall et al., 2017). However, the "discovery" obtained by students in inquiry-based learning is not a discovery as inventors have done. Besides conducting experiments, investigation

activity in inquiry-based learning can also be carried out by collecting information from various reference sources (Pedaste et al., 2015).

This inquiry process is accommodated through the use of ICT at the infusing level, namely by integrating networked learning into inquiry-based learning. Networked learning is a learning approach that encourages connections between students and learning resources, between students and students, and between students and teachers by relying on ICT to accommodate these activities (Holmfeld et al., 2012; Jones, 2015). This approach refers to a socio-material understanding of how to integrate technology into learning and social processes, because networked learning is related to learning through digital technology (Jones, 2015).

The combination of both concepts is the shape of learning based on scientific processes and the use of ICT in a balanced combination. The emphasis on the Networked-based Inquiry learning model is to facilitate students in developing 21st-Century Skills and building on their knowledge and understanding through real-life and digital experiences. Mainly, the Networked-based Inquiry learning model consists of preparation for having prior knowledge, the inquiry process, and strengthening of knowledge, as shown in Figure 1.

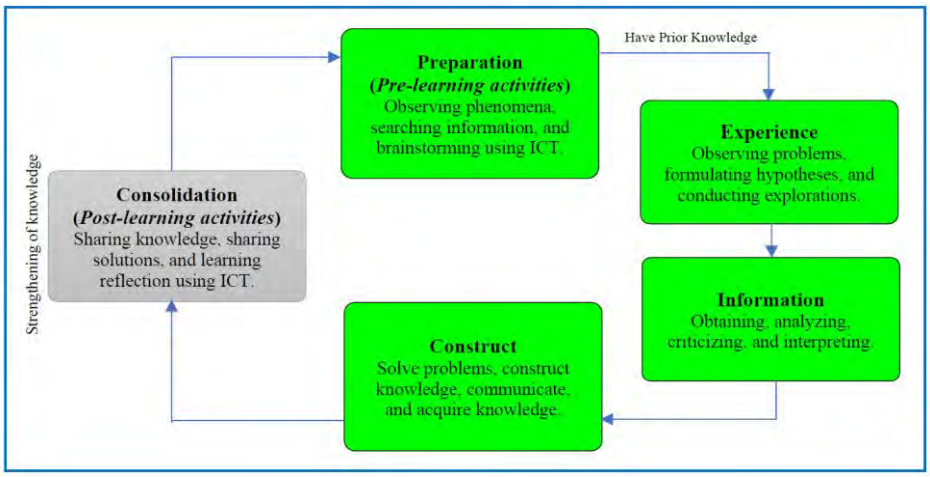

Figure 1
The basic cycle of networked-based inquiry

Based on the process cycle, Networked-based Inquiry activities are systematic and comprehensive to learn a lesson for students. The existence of a pre-learning activities process to construct students' prior knowledge increases their positive performance in the inquiry process. Moreover, to further strengthen student understanding, students are also accommodated to could questions, discuss, reinforce each other, and share information through online learning management facilities after class. Therefore, the activity in this model as a whole is capable of accommodating engage maximum student abilities, namely thinking skills (creative, critical, logical, systematic, and analytical),

scientific abilities (scientific skills and attitudes), and social skills (communication and collaboration). This model has been tested for validity by involving experts in science of education, physics education, physics learning media, educational technology, and Indonesian language. The test results showed this model has high validity based on the content, construct, and linguistic aspects, with the average validity (Aiken Value) of 0.88 (Novitra et al., 2020). This model is believed to be a multi-literate pedagogical solution that can answer the challenges of the 21st-Century, such as having ICT skills, collecting information skills, collaboration skills, communication skills, sharing information skills, critical thinking skills, and creative thinking skills. Therefore, this research aims to investigate the effectiveness of Networked-based Inquiry learning model in improving 21st-Century Skills and learning outcomes of physics students (senior high school) in the New Normal COVID-19 era.

METHOD

Research Design

This research was a quasi-experimental with a 2x3 factorial design shown in Table 1.

Table 1
Factorial design of two-way ANOVA

Model / School Category	Networked-based Inquiry	Inquiry-based Learning (Control)
High (A)	X_1Y_1	X_2Y_1
Moderate (B)	X_1Y_2	X_2Y_2
Low (C)	X_1Y_3	X_2Y_3

Note. X_1Y_1= The group in category A school that implements Networked-Based Inquiry; X_1Y_2= The group in category B school that implements Networked-Based Inquiry; X_1Y_3= The group in category C school that implements Networked-Based Inquiry; X_2Y_1= The group in category A school that implements Inquiry-based Learning; X_2Y_2= The group in category B school that implements Inquiry-based Learning; X_2Y_3= The group in category C school that implements Inquiry-based Learning

The experiment was carried out in four meetings on the study subject of Newton's Laws of Motion. To investigate the effectiveness of the Networked-based Inquiry on 21st-Century Skills, the four 21st-Century Skills sub-evaluation (creative thinking, critical thinking, communication, and collaboration) were observed using the 21st-Century Skills assessment sheet at each meeting. Furthermore, the effectiveness of the Networked-based Inquiry on learning outcomes (cognitive domain) was assessed from the results of the students' post-test scores after experimental term using learning outcomes test items.

The phases of the Networked-based Inquiry learning model involved in this research consist of online orientation, problem identify in e-resources, exploration using ICT tools, report findings, and closure. *Online orientation* is the phase before learning in class. Stimulating students to search information and brainstorm about physics phenomena video through online learning management facilities. *Problem identify in e-resources* is the phase of facing physics problems video to students and then students

generate hypotheses through online learning management facilities. *Exploration using ICT tools* is the phase of the investigation. Students collect data/information through virtual experiments or through a literature review of online materials, then discuss, analyze, and interpret it with groupmates. *Report findings* is the phase of presenting students' findings in front of the class and discussing with others. Comparing their findings with hypotheses. Then students sharing their findings on social media. *Closure* contains the sub-phases of draw conclusions and online reflection. At the end of learning in class, the teacher guides students to draw conclusions from the learning process. After learning in class, students asking questions about previous topics, exchanging ideas, and sharing information through online learning management facilities (Novitra et al., 2020).

Population and Samples

The population of this research were tenth-grade students majoring in Mathematics and Natural Sciences in Kerinci Regency and Sungai Penuh City, Jambi province. The sample consisted of 120 students from 6 classes in 3 different schools, namely SSHS 1 Sungai Penuh, SSHS 2 Kerinci, and SSHS 4 Kerinci. The cluster random sampling technique was used to select the three senior high schools based on the average value of accreditation, namely schools in the high, moderate, and low categories.

Instruments

The research instruments used to collect data were 21st-Century Skills assessment sheets and learning outcomes test items. The 21st-Century Skills assessment sheet consists of performance assessment sheet and peer assessment sheet. 21st-Century Skills assessment was developed based on the indicators of the 21st-Century Skills survey instrument by R. Kelley et al. (2019) and the 21st-Century Skills framework by Partnership for 21st Century (2019), as shown in Table 2.

Table 2
Instrument grid of 21st-Century Skills assessment

	Indicators
Creative Thinking	1. Ability to present ideas clearly (both online and in-person) 2. Ability to present original ideas (both online and in-person) 3. Ability to present many alternative solutions in solving a problem (both online and in-person) 4. Ability to collect various information/data to solve problems (both online and in-person) 5. Ability to implement existing knowledge in several situations 6. Ability to create unique product/thought
Critical Thinking	1. Ability to recognize strengths and weaknesses of self and group 2. Ability to evaluate peer arguments (both online and in-person) 3. Ability to provide feedback on peer arguments (both online and in-person) 4. Ability to deliver explanations (both online and in-person) 5. Ability to conclude the quality of information (both online and in-person) 6. Ability to use knowledge flexibly 7. Ability to understand questions asked by peers (both online and in-person) 8. Ability to ask clarifying questions (both online and in-person) 9. Ability to interpret information (both online and in-person)
Collaboration	1. Ability to manage group work 2. Ability to help the group solve problems (both online and in-person) 3. Ability to provide suggestions to groupmates (both online and in-person) 4. Ability to encourage group progress in completing tasks (both online and in-person) 5. Ability to work in a group without teacher help 6. Ability to acknowledge and respect the opinions of peers 7. Ability to carry out roles in the group 8. Be polite and kind to groupmates (both online and in-person) 9. Ability to deliberate in the group for decision making (both online and in-person) 10. Ability to manage time 11. Ability to discuss task completion (both online and in-person) 12. Ability to help peers when needed 13. Responsible for completing tasks
Communication	1. Ability to use appropriate communication media to increase knowledge (both online and in-person) 2. Ability to use formal language styles (both online and in-person) 3. Ability to listen actively when peers talk (both online and in-person) 4. Ability to present information concisely, clearly, and logically (both online and in-person) 5. Ability to present information with formal body language

This instrument is valid through a validity test involving experts in science of education, physics education, and educational technology (average Aiken's V value=0.87) (Novitra et al., 2020).

The learning outcomes test items were also analyzed first. The validity of the test items used the Pearson Product Moment Correlation. The test items were tested in eleventh-grade students and obtained 12 valid items and 8 invalid items. Then the reliability test of the 12 valid questions used the Kuder–Richardson Formula 20 (KR-20) and obtained a reliability coefficient of 0.97.

Data Analysis

Twenty-first Century Skills data were analyzed by two-way ANOVA test with a significance level of 5% using SPSS 26 software. The decision-making criteria is if the significant value (p) on the SPSS output is less than 0.05 then H_1 is accepted. The 21st-Century Skills in each sub-evaluation were determined by a calculation that refers to the

number of the student scores divided by maximum score and multiplied by 100. The 21st-Century Skills assessment was determined based on five categories comprising very high ($90 \leq N \leq 100$), high ($80 \leq N \leq 89$), adequate ($65 \leq N \leq 79$), low ($30 \leq N \leq 64$), and very low ($0 \leq N \leq 29$). The improvement of students' 21st-Century Skills (N-Gain score) was defined by the category consisting of high ($g > 0,7$), Moderate ($0,3 < g < 0,7$), and low ($g < 0,3$). Furthermore, student learning outcomes also were determined by a calculation that refers to the number of the student scores divided by maximum score and multiplied by 100.

The Networked-based Inquiry learning model is considered effective if: (1) The average level of students' 21st-Century Skills at the end of the experimental term in each experimental group is in the high or very high category; (2) The average level of student's 21st-Century Skills improvement at the end of the experimental term in each experimental group is in the moderate or high category; (3) There is a significant difference in 21st-Century Skills level between the experimental group and the control group in the three schools; (4) There is no significant difference in the level of 21st-Century Skills in the experimental group in the three school categories; (5) There is no interaction between the Network-based Inquiry variable and the school category variable in determining the level of students' 21st-Century Skills; (6) The average score of cognitive competence in each experimental group reaches a score of ≥75 and the percentage of student learning completeness is more than 70%.

FINDINGS AND DISCUSSION

Analysis of 21st-Century Skills

The results of the 21st-Century Skills analysis in each indicator before the experimental term and four meetings, as shown in Figure 2. In the control groups, the four indicators had improved, but the improvement was not significant. The average score at the end of the experimental term in each school was 70, 70, and 71. All indicators were in the adequate category. The highest score was collaboration, and the lowest was critical thinking. In the experimental groups, the four indicators had improved significantly. The average score at the end of the experimental term in each school was 85, 86, and 86. At the first meeting, the four indicators in the three schools had not achieved the adequate category, but had improved. This is because students are still adapting to the Networked-based Inquiry learning model. Critical thinking skills and creative thinking are skills that have the lowest score. Teachers' and students' habits towards the previous learning model affect the confidence of students in expressing opinions and providing feedback on the opinions of others (Festiyed et al., 2018). The important factor that affects the improvement of students' critical thinking skills in the classroom is the class culture that accustoms students with seeking truth through discussion, confidence, open-mindedness, and high-curiosity (Facione & Gittens, 2013; Ghadi et al., 2012). Mental readiness, courage, and self-confidence also affect their fluency in expressing their opinions (creative thinking) (Chan, 2013; Sullivan, 2015). In addition, the lack of practical experience of students in learning that accommodates the development of thinking skills also affects this suboptimal result (Hidayat et al., 2018).

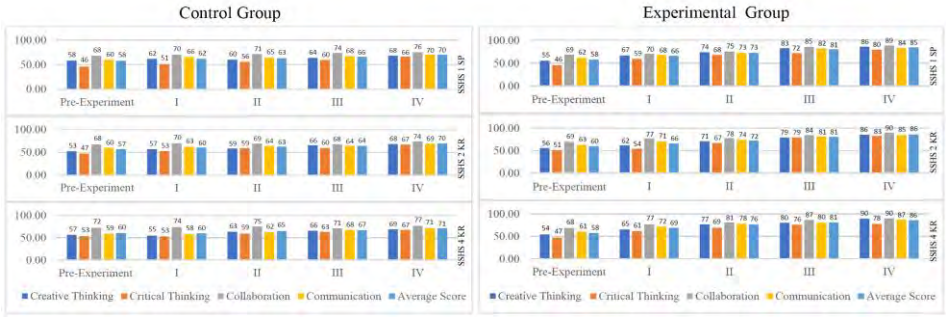

Figure 2
Results of 21st-century skills assessment

At the second meeting, students looked comfortable and set to get used to the process Networked-based Inquiry learning model, although there were still students who were hesitant about experimenting and presenting activities. At this meeting, the scores for creative thinking and critical thinking skills are getting better. The utilization of gadgets (e-books linked to the Google Classroom) in the online orientation phase provides intrinsic motivation for students to learn after learning in class actively (Razzaq et al., 2018). This phase constructs the prior knowledge of students to face learning in the classroom (Stathopoulou et al., 2018), hence students experience a process of reflection on existing knowledge and encourage creative thinking and critical thinking based on the existing knowledge (Sung et al., 2018). This process promotes students to generate various interpretations of a problem with varied ideas (J. Yang & Zhao, 2021), and these abilities also appear in a digital context (Claro et al., 2012). Consequently, they have more confidence to express their opinion, even provide feedback on the opinions of their peers (Liu et al., 2019; Zambrano et al., 2019). In addition, the inquiry process in the model also affects this improvement. Several studies also support the effectiveness of the inquiry process on creative thinking and critical thinking. According to Conradty & Bogner (2019), Rodríguez et al. (2019), and Zubaidah et al. (2017), the inquiry process is capable of improving students' creative thinking significantly because it covers brainstorming which is the primary factor in its improvement, and activities such as defining problems, generating hypotheses, evaluating evidence, and verifying theories are also considered key for developing creative thinking. The inquiry process is also capable of improving students' critical thinking significantly because it involves students in the observation and exploration, accordingly encouraging and stimulating them using logical skills (e.g. analysis, interpretation, evaluation, explanation, inference, self-regulation, etc) (Duran & Dökme, 2016; Muskita et al., 2020; Wale & Bishaw, 2020; Wartono et al., 2018).

All indicators at this meeting were classified in the adequate category, except for collaboration, which was in the high category. This is because the Networked-based Inquiry learning model emphasizes collaborative activities, especially in the third, fourth, and fifth phases. In the third and fourth phases, students collecting data, presenting the findings in front of the class, and discussing it. This inquiry process

provides opportunities that stimulate students to have better collaborative performance (Chen et al., 2018; Sinha et al., 2015; Xing et al., 2019). In the fifth phase, students exchanging ideas, asking questions about previous topics, and sharing information through online learning management facilities. This networked activity provides opportunities that stimulate students to improve their collaboration skills in accordance with the current era, namely digital collaboration (Anders, 2018; Hodgson & McConnell, 2019; Lee et al., 2020; McCulloch et al., 2017; Schreurs et al., 2019; Vivakaran & Maraimalai, 2019). Thus, students rely on each other in groups, trust each other, and take responsibility for each other (Kwon et al., 2013; Laal, 2013).

At the third and fourth meeting, the average of 21st-Century Skills level in each experimental group had achieved high category, except for critical thinking skills at SSHS 4 Kerinci, which was still in the adequate category. However, on average, critical thinking skills in the three schools were among the high category. The indicator that had the highest score was collaboration skills. During the experimental term, no significant anomalies were found in the communication skill. This is because the networked approach that uses ICT at the infusing level provides communication that students prefer. Besides facilitating discussions and presentation of findings in front of the class, the Networked-based Inquiry learning model also accommodates students in conducting digital communication through online learning management facilities. Today's communication has been reconceptualized into two-way communication through digital channels (Gushevinalti et al., 2020). The use of digital media in learning has a significant impact on the development of communication skills (Berestova et al., 2021) and affects students' learning experience because of its suitability with the current form of communication, and enhances student's motivation, performance, and confidence in writing (Cardon & Marshall, 2015; Galvin & Greenhow, 2020).

In overall, these results showed that the four indicators had improved at every meeting. The comparison of the average scores before and after the experimental term showed that the students' 21st-Century Skills have been a significant improvement, with an N-Gain score above 0.50 in each experimental group. The results of the N-Gain score in each indicator, as shown in Table 3.

Table 3
N-gain score of 21st-Century skill

School	Creative Thinking	Critical Thinking	Collaboration	Communication	Average
SSHS 1 SP	0.69	0.61	0.64	0.56	0.62
SSHS 2 KR	0.67	0.62	0.67	0.57	0.63
SSHS 4 KR	0.76	0.56	0.69	0.67	0.67
Average	0,64				
Category	Moderate				

Analysis of the effect of the Networked-based Inquiry learning model

This analysis used the SPSS 26 software. Before conducting the two-way ANOVA test, normality and homogeneity tests were administered as the prerequisite test. The

normality test was examined using the Kolmogorov-Smirnov test, with the significance level of 0.05. The results of this test, as shown in Table 4.

Table 4
The normality test result

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SSHS 1 Experiment	0.104	20	0.200*	0.964	20	0.619
SSHS 1 Control	0.139	20	0.200*	0.909	20	0.060
SSHS 2 Experiment	0.129	20	0.200*	0.944	20	0.281
SSHS 2 Control	;7	20	0.200*	0.918	20	0.093
SSHS 4 Experiment	0.128	20	0.200*	0.937	20	0.212
SSHS 4 Control	0.143	20	0.200*	0.916	20	0.082

The Kolmogorov-Smirnov test results scored a significance level on each group higher than 0.05 ($p>0.05$). This means that the data were normally distributed. The homogeneity test was examined using the Levene's test, with the significance level of 0.05 (Levene's F=1.855, Sig.=0.108). The Levene's test results scored a significance level higher than 0.05 ($p>0.05$). This means that the data were homogenous. Based on this prerequisite test, it shows that the effectiveness analysis can be examined using a parametric test, namely the two-way ANOVA test. The results of this test, as shown in Table 5.

Table 5
The two-way ANOVA test result

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6937.469a	5	1387.494	62.931	0.000
Intercept	728161.249	1	728161.249	33026.355	0.000
Learning Model	6889.497	1	6889.497	312.479	0.000
School	36.676	2	18.338	0.832	0.438
Learning Model * School	11.296	2	5.648	0.256	0.774
Error	2513.459	114	22.048		
Total	737612.176	120			
Corrected Total	9450.927	119			

The significance score of learning model aspect was less than 0.05, which was 0.000. It indicated that H_1 was accepted, which meant that there was a significant difference in level of students' 21st-Century Skills between the experimental group using the Networked-based Inquiry learning model and the control group using the Inquiry-based learning model. The significance score of the school aspect was higher than 0.05, which was 0.438. It indicated that H_1 was rejected, which meant that there was no a significant difference in level of students' 21st-Century Skills in the experimental group in the three school categories. The significance score of the interaction between Network-Based Inquiry and school category aspect was higher than 0.05, which was 0.774. It indicated that H_1 was rejected, which meant that there was no interaction between the Network-Based Inquiry variable and the school category variable in determining the level of students' 21st-Century Skills.

Learning outcomes in the experimental group

After the end of the experimental term, a test of learning outcomes was conducted in the cognitive domain. The results of this test, as shown in Table 6.

Table 6
Completeness of student learning outcomes

School	Average of learning outcomes	The number of students		Percentage of completeness
		Complete	Not complete	
SSHS 1 SP	79.2917	18	2	90%
SSHS 2 KR	80.0417	20	-	100%
SSHS 4 KR	78.0208	18	2	90%

The results show that the Networked-based Inquiry learning model has not only a positive impact on the improvement of students' 21st-Century Skills, but also has a positive impact on student learning outcomes. The results also show that the Networked-based Inquiry learning model is better than the inquiry-based learning model in improving students' 21st-Century Skills and has a positive impact on learning outcomes. This is because Networked-based Inquiry activities are systematic and comprehensive, and possesses a blend of scientific processes and the use of ICT in a balanced combination. The application of the learning model and all its components also optimizes the improvement of student competencies under the goals that have been set (Arends, 2009; Gilbert & Justi, 2016), because it covers learning that have internal consistency between its components, such as syntax, social systems, support systems, and the principle of reactions (synchronous learning components) (Joyce et al., 2016).

The social system built on the Networked-based Inquiry learning model provides teacher roles as motivator, facilitator, guide, and reflector. As a motivator, the teacher must encourage students' positive feelings in terms of their curiosity about the subject through visual representations, such as meaningful and interesting videos, animations, and graphics, thus making abstract material more concrete (Barak et al., 2011; Tang et al., 2010). As a facilitator, the teacher creates a constructive learning environment, such as brainstorming activity, information exploration, discussion, and collaboration (Bénéteau et al., 2017; Turner et al., 2018). The teacher prepares meaningful and interesting problems, learning resources, and experiments, so that students can observe, generate hypotheses, collect information, experiment, discuss, and cooperate. As a guide, the teacher guides submissive students to argue and cooperate in learning (Johnson, 2011; W. T. Yang et al., 2015). The teacher pays exclusive attention to passive students. Then, as a reflector, the teacher observes the dynamics of student behavior (Douglas & Chiu, 2013) and strives for students to stay focused and enthusiastic in learning (Roller & Zori, 2017).

The support system for the Networked-based Inquiry learning model in presenting problems and accommodating the inquiry process is ICT-based teaching materials. The teaching material is an interactive student e-book. Interactive e-books can be organized with videos, communication media, and various types of virtual technology (Asrowi et

al., 2019), so that they can be used as tools to improve student performance in constructing their knowledge (Sung et al., 2019). Interactive e-books also have a positive effect in improving the high order thinking skills of students (Adawiyah et al., 2019; Sung et al., 2018). Besides student e-books, teacher e-books and 21st-Century Skills assessment instruments are also needed as a guide for teachers in applying the Networked-based Inquiry learning model and assessing students' 21st-Century Skills.

The principle of reaction in the Networked-based Inquiry learning model assists students to conduct investigations and collaboration, not conduct investigations for students. The teacher pays attention to every interaction between students. This reaction is carried out to bring conducive and quality collaboration between students (Sinha et al., 2015). The teacher provides training to students who are dominant and submissive about how to learn collaboratively. This reaction is important because the imbalance of student participation and contribution in study groups has a negative impact on the student self-regulation aspect. If there are questions that cannot be answered with "yes" or "no", then the teacher throws back constructive questions to the students, so that the students can explore their knowledge (Rogat & Adams-Wiggins, 2014). In the inquiry process, students should not be told, but students are directed to reach a correct conclusion based on systematic thinking and reasoning (Kaiser et al., 2018). If the discussion is out of the subject context, the teacher directs students so that the discussion returns to the goal to be achieved. The inquiry process does not mean letting students think outside the subject context, but the teacher must identify the misconceptions experienced by students, then direct them back (Turner et al., 2018).

These learning aspects show that the Network-Based Inquiry learning model has interrelated and supportive components, so that it can be used as the right solution in presenting a multiliteracy pedagogy that can answer the challenges of the 21st-Century, such as having ICT skills, collecting information skills, collaboration skills, communication skills, sharing information skills, critical thinking skills, and creative thinking skills. Therefore, this research provides benefits and many implications for teachers and stakeholders to implement the learning process in the New Normal COVID-19 era and accelerate the digitalization of Indonesian education.

CONCLUSION

In conclusion, the Network-Based Inquiry learning model is effective in improving students' 21st-Century Skills and learning outcomes in the New Normal COVID-19 era. The average level of students' 21st-Century Skills in the experimental group was 85 (high category) with an N-Gain score of 0.64 (moderate category) higher compared to in the control group. The average score of creative thinking, critical thinking, collaboration, and communication at the end of the experimental term in the experimental group was 87, 80, 90, and 85, while in the control group was 68, 67, 76, and 70. There was a significant difference in 21st-Century Skills level between the experimental group and the control group in the three schools ($p=0.000$). There was no significant difference in the level of 21st-Century Skills in the experimental group in the three school categories ($p=0.438$). There was no interaction between the Network-Based

Inquiry variable and the school category variable in determining the level of students' 21st-Century Skills (p=0.774). The average score of cognitive competence in each experimental group reached a score of 79 and the percentage of student learning completeness was 93%. Thus, this research contributes to implement an effective learning process in the New Normal COVID-19 era in Indonesia. Moreover, it can be considered by education practitioners and policymakers to implementing a relevant learning model in the current era, and be an option towards digitalizing education in the future. Although the Networked-based Inquiry learning model seems effective in improving 21st-Century Skills and learning outcomes, there are limitations to this research. Future research needs to implement the model at all levels of education and in other fields of science, and control for the psychological variables involved (e.g. student intelligence, student learning styles, student interests, teacher competence, etc).

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