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Application of 21st Century Learning Skills Oriented Digital-Age Literacy to Improve Student Literacy HOTS in Science Learning in Class IX SMP

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ABSTRACT

The development of modernization and globalization of the 21st century has had a tremendous impactone of which is the low thinking skills of students. This study aims to design and apply the PjBL model as one of the 21st century learning skills that is oriented towards digital-age literacy to improve student literacy HOTS in science learning on static electricity in class IX SMP. This research is a collaborative research study using descriptive qualitative research design classroom research.This research is a quasi-experimental research using a one group pretest-posttest design. The PjBL model oriented to digital-age literacy is designed according to the characteristics of 21st century skills learning known as 4C skills (creativity, critical thinking, communication, and collaboration). Learning is designed with digital teaching materials (e-modules) designed using theapplication Kvisof Flipbook Maker and refers to the formulation of competency development in 21st century learning in thedomain digital-age literacy which includes 8 aspects. The application of the oriented PjBL model is digital-age literacy proven to be able to increase students' HOTS literacy in science learning material for static electricity class IX SMP.

1. Introduction

The development of modernization and globalization of the 21st century brings tremendous impact. One of the worrisome impacts is the inability of children (students) independently to know, understand, and overcome problems around them. For the Indonesian people, another impact that is felt due to the challenges of modernization and globalization is the low thinking skills of students.[1] The results of the International Program for International Student Assessment (PISA) study show that the achievement ofreading literacy, mathematical literacy, andscientific literacy achieved by Indonesian students is very low and can only occupy the 10 out bottom of 65 country.[2]

Furthermore, based on the Education for All Global Monitoring Report 2012 issued by UNESCO, Indonesian education is ranked 64th out of 120 countries. This is because many test materials are not included in the Indonesian curriculum, especially those related to technological and information advancement.[3] In addition, education in Indonesia still places too much emphasis on the cognitive aspect which is still limited to looking for numbers, not students' critical analysis abilities of events encountered in everyday life.[4]

The low quality and achievement of students is certainly caused by many factors and one of the contributing factors is because students in Indonesia are not trained in solving contextual problems, demanding reasoning, argumentation and creativity in solving them. Various efforts have been made by the government to overcome these problems, including efforts to improve the curriculum to become the 2013 Curriculum. One of the efforts in improving the 2013 Curriculum is to improve the assessment standards, by gradually adapting the international standard assessment model. Improvements in the assessment of learning outcomes are expected to help students improve their Higher Order Thinking Skills (HOTS) and are expected to encourage students to think broadly and deeply about learning materials. HOTS is part of the revised

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Bloom's taxonomy in the form of operational verbs consisting of analysis (C4), evaluation (C5) and creative (C6) which can be used in the preparation of questions.

The 2013 curriculum requires teachers to be able to develop 21st century skills in the learning process that aims to create a golden generation to compete universally or directly create quality education. The 2013 curriculum is designed and developed to facilitate both skilled teachers and students in increasing learning interactions, especially activity-based learning such as 21st century learning.[5]

Since the emergence of a global movement calling for new learning models for the 21st century, there has been a growing opinion that formal education must be changed. This change is important to bring up new forms of learning needed in overcoming complex global challenges. The changes in question are not related to changes in curriculum content, but changes in pedagogy, namely changes in acting from simple action to comprehensive action and the transition from traditional teaching to technology-based teaching.[6]

Identification of student competencies that need to be developed is very important to face the 21st century. Students must hone skills and enhance learning to be able to cope with global challenges, such as critical thinking skills, the ability to communicate effectively, innovate and solve problems through negotiation and collaboration. When students are directed to be able to think critically, creatively and able to solve problems, it means that students are targeted to have high order thinking skills (HOTS).

The 21st century is also called the century of industrial revolution 4.0, the century of rapid development of science and technology. The rapid development of science requires students to be able to adapt and follow these developments. The characteristics of the 21st century will produce 21st century learning characters, and have an impact on 21st century assessment. In the learning process 21st century skills are known as 4C skills, namely creativity (creativity), critical thinking (critical thinking), communication (communication), collaboration (collaboration).). 21st Century skills are essential for deep learning of knowledge and demonstrating understanding through performance. The application of 4C in 2013 curriculum learning if it is actually carried out in schools will have a tremendous impact on the nation's future generations to face the challenges of 21st century life. 21st century learning demands many things from a teacher, especially those related to abilities and skills. In his first role, the teacher prepares students to be able to have 21st century skills. Teachers are professional educators who must carry out their duties properly and with quality. Quality education can produce a complete personality with learning that develops students' creativity and trains higher order thinking skills (HOTS).

21st century learning has the main goal of building students' learning abilities and supporting the development of students to become lifelong, active, independent learners. Conceptually, educators (teachers) are professionals with the capacity of quantity and quality who are able to answer all challenges and educational needs. The demands for professionalism of 21st century educators are not on the ability of educators to know and be proficient about everything, but educators have the expertise to find out together with their students, become role models of trust, openness, and perseverance to their students to face the realities of digital life in the 21st century.[7]

The ability of educators (teachers) greatly supports the success of 21st century skills. This ability is contained in the profile of educators, namely the profile of the first 21st century educator is knowladge (knowledge), namely the intellectual abilities possessed by an educator which include mastery of subject matter, knowledge of teaching methods, knowledge regarding individual learning and behavior, knowledge of guidance and counseling, knowledge of society and general knowledge; The two performance criteria are closely related to the pedagogical abilities (skills and behavior) of educators, namely the ability of educators which includes teaching skills, guiding, assessing, using teaching aids, associating and communicating with students and skills in preparing teaching preparation or teaching planning. Third, the product criteria are related to how the process of measuring educators regarding student learning outcomes in 21st century learning. Besides that, 21st century teacher competencies consist ofcompetencies digital age literacy, inventive thinking, effective communication, and high productivity.[5]

The most important thing in 21st century education is to encourage students to have a deep knowledge base and understanding to be able to becomelearnerslife-long. Thus, the education system needs to consider a number of aspects that are domains in 21st century education. One of the most important domains in 21st century education is Digital-Age Literacy. In the 21st century, literacy skills are not only limited to the ability to read, listen, write and speak orally, but more than that, literacy skills are emphasized on literacy skills that are connected to one another in the current digital era.[6]

The success of 21st century learning skills (creativity, critical thinking, communication and collaboration), certainly cannot be separated from the factor of openness to information known as literacy or

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information literacy. In the digital literacy era where the flow of information is very abundant, students need to have the ability to choose relevant sources and information, find quality sources and evaluate sources from aspects of objectivity, reliability, and up-to-date. Within the framework of the 21st century education by en Gauge 21st Century Skills, skills a digital-age literacy is one of the main domains of concern in education today. This domain includes 8 aspects, namely: basic, scientific, economic, information, visual, technological, multicultural, and global awareness.[6]

Project-based learning (project based learning/ PPA) maybe one alternative learning models that support 21st century skills upgrading and improving student literacy HOTS. PjBL is an innovative approach to learning that offers a variety of strategies that refer to student learning success in the 21st century. In PjBL, students determine their own collaborative learning process, conduct research and create creative projects that reflect their knowledge. This can be done through the introduction of various knowledge and skills using technology and then honing students' communication and problem solving skills. Through PjBL students experience an increase in internalizing concepts and skills related to science subjects (IPA), and have a tendency to remember and understand various information obtained through the implementation of PjBL.[9]

The application of higher order thinking skills (HOTS) and literacy skills (literacy of information) of students is very urgent considering the times with extraordinary challenges. The development of the digital world has the potential to make children unable to adapt to their environment and the challenges of globalization need to be answered by applyingoriented 21st century learning skills digital-age literacy- in the world of education. The application of 21st century learning skills to improve student literacy HOTS requires the involvement of all parties in the educational environment, and not only at the concept level, but also in the form of real practice. Schools as formal educational institutions must be able to be the initiator of change, especially teachers as the front line must be able to become a force for change, at least in a scope that can be handled by themselves, such as in planning, implementing, and evaluating learning.

2. METHOD

2.1 The 21st Century Skills

21st century can be said to be the age of knowledge, a century marked by a massive transformation from an agrarian society to an industrial society and continuing to a knowledge society. This transformation process is also marked by the occurrence of a set of social and cultural changes in society due to the emergence of globalization and the rapid flow of information.[6] In order to win in the competition, three skills must be possessed in the 21st century, namely: 1) life and career skills, 2) learning and innovation skills, and 3) Information media and technology skills. More specifically for learning and innovation skills, there are 4 must-have competencies known as 4Cs, namely: critical thinking, creativity, communication, and collaboration. [10]

21st century skills are important skills that everyone must master in order to succeed in face the challenges, problems, lives and careers of the 21st century. Several organizations have formulated definitions of 21st century skills which all have almost the same essence.[11] The National Education Association has identified 21st century skills as "Four C Skills" or "The 4Cs" or also known as 4Cs which include critical thinking (critical thinking), creativity (creativity), communication (communication), and collaboration (collaboration).[10]

2.2 Aspects of Skills in the Domain of Digital-Age Literacy

Literacy is a complex process that involves the process of building prior knowledge, culture and experience to develop new knowledge and deeper understanding. The concept of literacy has also developed, including the use of various digital media in the classroom, school, residence and community. Now the term literacy has developed into multiliteracy. Multiliteracy is the ability to read, write poetry, share, paint, dance, write novels or the ability to contact various media that require literacy. Literacy is also seen as a meaningful activity from various media. Literacy is the most important element in modern educational projects.[12]

In the 21st century, literacy skills are not only limited to the ability to read, listen, write and speak orally, but more than that, literacy skills are emphasized on literacy skills that are connected to one another in the current digital era. Within the framework of the 21st century education by enGauge 21st Century Skills, skills a digital-age literacy is one of the main domains of concern in education today. This domain includes 8 aspects, namely: basic, scientific, economic, information, visual, technological, multicultural, and global awareness.[6]

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2.3 Higher Order Thinking Skill (HOTS)

21st century skills which include: critical thinking (critical thinking), creativity (creativity), communication (communication), and collaboration (collaboration) are higher order thinking skills that are very important. needed in preparing students to face global challenges [13]. When students are directed to be able to think critically, creatively and able to solve problems, it means that students are targeted to have high order thinking skills (HOTS).

HOTS is a thinking ability that includes critical thinking, logical thinking, reflective thinking, metacognitive thinking, and creative thinking [14], is the ability to connect, manipulate, and change knowledge and experience that is already owned critically and creatively in determining decisions to solve problems at school. new situation [15], a thinking process of students in a higher cognitive level developed from various concepts, cognitive methods and taxonomies of learning such asmethods problem solving, Bloom's taxonomy and taxonomy of learning, teaching and assessment [16]. Higher order thinking is a type of thinking that tries to explore questions about existing knowledge regarding issues that are not clearly defined and do not have definite answers.

HOTS-based learning in the 2013 Curriculum can be done by compiling the achievement of competencies that not only answer at the level of C1 (knowing), C2 (understanding), and C3 (applying), but also at the level of C4 (synthesis/analysis), C5 (evaluation), and C6 (creative).[17] HOTS questions in the context of an assessment measure the ability to: (1) transfer one concept to another, (2) apply and process information, (3) look for relationships from various information, (4) use information to solve a problem, and (5) examine ideas critically.[18] If students are familiarized with challenging HOTS questions, the potential of students can be encouraged to develop. However, HOTS-based questions do not mean they are more difficult than questions recall.

2.4 Century Learning Models

Since the emergence of a global movement calling for new learning models for the 21st century, there has been a growing opinion that formal education must be changed. This change is important to bring up new forms of learning needed in overcoming complex global challenges. Identification of student competencies that need to be developed is very important to face the 21st century. Students must hone skills and enhance learning to be able to cope with global challenges, such as critical thinking skills, the ability to communicate effectively, innovate and solve problems through negotiation and collaboration. 21st century learning is required to be technology-based to balance the demands of the millennial era with the goal that later students will be familiar with 21st century life skills. Students living in the 21st century must master science, metacognitive skills, be able to think critically and creatively, and be able to communicate or collaborate effectively. effectively, this situation illustrates the gap between expectations and reality.[12]

The characteristics of the 21st century will produce the character of 21st century learning, and have an impact on 21st century assessment. The most striking feature in the 21st century is the existence of multitasking, multimedia, online social networking (online social media networks), online in for searching (online search), and gameonline (online game). The 2013 curriculum requires teachers to be able to develop 21st century skills in the learning process that aims to create a golden generation to compete universally or directly create quality education. The 2013 curriculum is designed and developed to facilitate both skilled teachers and students in increasing learning interactions, especially activity-based learning such as 21st century learning.[5]

21st century learning is simply defined as learning that provides 21st century skills to students including critical thinking, creativity, communication, and collaboration. Learner-centered learning models are 21st century learning models. In the 2013 Curriculum, learning that must be applied is learning with a scientific approach.[11] To be able to improve the 21st century skills of students, an effort is needed that can be applied to learning activities. These efforts can be carried out in various ways, one of which is by applying a learning model that can support the improvement of 21st century skills. There are several learning models that can be applied in learning activities, for example: Problem Based Learning, Discovery Learning Model, Inquiry Learning Model, and Project Based Learning.

2.5 Project Based Learning (PjBL)

(Project-based learning / PjBL) can be an alternative learning model that supports the improvement of 21st century skills. PjBL is an innovative approach to learning that offers various strategies that refer to

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student learning success in the 21st century. Through PjBL, students determine their own collaborative learning process, conduct research and create creative projects that reflect their knowledge. This can be done through the introduction of various knowledge and skills using technology and then honing their skills in communicating and solving problems.[9]

The PjBL model is a learning model that refers to the philosophy of constructivism. Through projects carried out by students, indirectly the activities of students increase because students are free to apply the knowledge and skills they have. This PjBL model is more focused on concepts that involve students in problem solving activities and provide opportunities for students to work autonomously.[11] PjBL has various objectives including the development of positive student attitudes, critical thinking skills, cooperation, and independent learning abilities.[9] The steps of the PjBL model include: 1) asking basic questions, 2) designing project plans, 3) arranging schedules, 4) monitoring students and project progress, 5) testing results, and 6) evaluating experiences.[11]

2.6 Research Methods

This research is a collaborative learning research study that aims to improve the quality of learning through collaborative research between students from the Chemistry Education Study Program and lecturers as well as science teachers at SMPS Methodist-8 Medan. This research was conducted using qualitative methods research designdescriptive classrommresearch that is sutau class research aimed at explaining the various things related to teaching and learning without taking corrective action.

This study uses a quasi-experimental research with a one group pretest-posttest design. This study does not use a comparison class (controller) but has used an initial test so that the magnitude of the impact of applying theoriented PjBL model digital-age literacy as 21st century learning skills can be known with certainty. In this study, the research subjects were first given a pretest to determine the students' initial abilities before being given learning. After being given the initial test, then the student is given treatment, namely project-based learning oriented to digital-age literacy as a 21st century learning skill. After finishing learning, then all students are given a final test (posttest) to determine the effect of PjBL oriented digital-age literacy in increasing HOTS student literacy in science learning material for static electricity class IX junior high school.

The sample or respondents in this study were students of class IX SMPS Methodist-8 Medan totaling 30 students. The instruments used in this study include: 1) literacy HOTS test on Static Electricity material for class IX SMP, and 2) direct observation related to the implementation of PjBL oriented digital-age literacy in science learning in class IX SMP. The HOTS literacy test instrument is arranged in the form of multiple choice as many as 30 questions with 5 (five) answer choices. Each correct answer is given a score of 1 and the wrong answer is given a score of 0.

Data analysis in this study includes grouping data based on variables from all respondents, presenting data for each variable studied, performing calculations to answer the problems that have been formulated, and performing calculations to test hypotheses. The data analysis used includes requirements testing and hypothesis testing with aapproach paired sample t-test using the SPSS program.

3. Research Results

3.1 PjBL Model Design Oriented Digital-Age Literacy

PjBL Model oriented digital-age literacy in science learning is designed according to the characteristics of 21st century skills learning or known as 4C skills including creativity , critical thinking (critical thinking), communication (communication), and collaboration (collaboration) and the form of presentation is adjusted to the Static Electricity material/material. Digital teaching materials or e-modules on Static Electricity material are designed attractively using the application Kvisof Flipbook Makerandroid which can be opened on laptop, computer or devices so that the material can be repeated anytime and anywhere and students can read by feeling like reading a book physically because there is an animation effect where when switching pages it will look like physically opening a book. Digital teaching materials (e-modules) for Static Electricity are designed with aoriented PjBL model digital-age literacy to improve student literacy HOTS and are adapted to the characteristics of the material and student characteristics. Static electricity materials and questions are prepared based on HOTS literacy to train and improve students' HOTS literacy skills.

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The PjBL model is oriented towards digital-age literacy and digital teaching materials (e-modules). Static Electricity material is designed and refers to the formulation of competency development in 21st century education in thedomain digital-age literacy.

Table 1.Competency in Digital-Age Literacy Static Electricity Class IX Junior High School

Literacy Aspect	Competence
Basic	• Explain the application of the concept of static electricity and its symptoms in everyday life, including living things and technology. • Using mathematical reasoning in calculating electric charge, coulomb force, electric field, potential difference and electric energy.
Scientific	• Describe the results of experiments related to static electricity • Describe the relationship of quantities related to static electricity. • Read data from experimental results and calculations related to static electricity.
Economics	• Identify economic problems that utilize static electricity in everyday life and technology.
Information	• Accessing information from various related sources to explain the concept of static electricity, its symptoms and its use in everyday life, including living things and technology.
Technological	• Using technology as a tool in understanding and describing the concept of static electricity, its symptoms and their relation to everyday life, including living things and technology. • Using technology as a tool in experiments and calculations related to static electricity.
Visuals	• Create visual media to describe the concept of static electricity, its symptoms as well as to present experimental results related to static electricity (symptoms of static electricity, electrically charged objects, and electric fields).
Multicultural	-
Global Awareness	• Using reasoning in understanding global problems related to static electricity and its use in technology and everyday life. • Analyze how to solve problems related to static electricity (the electrical properties of objects).

To make it easier to achieve digital-age literacy competence and higher order thinking skills (HOTS) as a transfer of knowledge and student literacy skills, in the implementation of the PjBL model, learning indicators are formulated related to aspects of digital-age literacy and refer to Bloom's and Anderson's taxonomies. and Kratwohl which consists of dimensions of knowledge and dimensions of cognitive processes. The literacy HOTS test instrument on the Static Electricity material used also refers to competencies and indicators that have been developed and arranged in the form of 30 multiple-choice test questions with 5 (five) answer choices (A, B, C, D and E) and carried out item analysis includes: item validity and item reliability. The results of the item analysis showed that the validity of the items was between 0.414 – 0.753 with a reliability value of 0.899 which showed very good consistency between items of instrument items.

3.2 Increased HOTS of Student Literacy

The increase in HOTS of student literacy on Static Electricity material for class IX SMP is obtained based on student learning outcomes before (pretest) and after implementation using e-modules andoriented PjBL models digital-age literacy (posttest).

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Table 2. Achievement of Student Literacy HOTS Test Results

	N	Min	Max	Mean	Std. Deviation	Kolmogorov-Smirnov Test Statistic	p
Pretest	30	37	73	58.83	8.647	0.149	0.086
Posttest	30	63	100	84.47	9.247	0.141	0.130

Table 2 shows that the achievement of the students' pretest results before being given learning action and the lowest score was 37, the highest score was 73 with an average value of 58.83 and a standard deviation of 8.647 and the data had a normal distribution with the Kolmogorov-Smirnov test = 0.149 and p = 0.086. After taking action through theoriented PjBL model, digital-age literacy the posttest results obtained the lowest score of 63, the highest score of 100 with an average value of 84.47 and a standard deviation of 9.247 and the data has a normal distribution with the Kolmogorov-Smirnov test = 0.141 and p = 0.130. The results above indicate an increase in the achievement of students' literacy HOTS results.

Table 2. Hypothesis Test Results (t-test)

		Paired Differences		t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	Posttest – pretest	25.633	7.739	18.141	29	0.000

Table 2 shows, the results of hypothesis testing to increase students' literacy HOTS ability using a t-test with aapproach paired sample t-test. The results of the analysis obtained a t-value of 18,141 with a sig or probability value (p) 0.000 <0.05 so it was concluded that there was an increase in student literacy HOTS in the Static Electricity material for class IX SMP through the application of the PjBL model oriented digital-age literacy as a 21st century learning skill. with the difference in the average value (paired differences) of 25.633±7.739.

3.3 Discussion

The oriented PjBL model digital-age literacy using digital teaching materials (e-modules) is one of the 21st century learning innovations that can be applied by educators or teachers to train creativity, students' critical thinking skills, increase students' motivation to try to complete project assignments, involve students learn to access information, apply technology, develop communication skills, collaboration and the importance of group work in project completion, as well as develop students' HOTS skills and literacy skills.

Digital teaching materials or e-modules are also designed and developed based on HOTS literacy in accordance with the concept of 21st century education, one of which is learning and innovation skills, namely being able to think creatively, work creatively, and create new innovations. When students are directed to be able to think critically and creatively, it means that students are targeted to have higher-order thinking skills. 21st century education is becoming increasingly important to ensure that students have the skills to learn and innovate, the skills to use technology and information media. The principle of 21st century learning uses a learner-centered learning approach where the teacher acts as a facilitator. E-modules are also designed using the Kvisof Flipbook Maker application, which is an application to create e-books, e-modules, e-papers and e-magazines. This e-module was developed with theapplication Kvisof Flipbook Maker with the aim that students can read by feeling like physically reading a book because the e-module has an animation effect where when switching pages it will look like physically opening a book. E-modules are also designed not only in the form of text, but also by inserting images, sounds, links and videos on the worksheet. The e-module is equipped with interesting animations, practice questions based on literacy HOTS, and is prepared based on learning indicators for static electricity material for class IX SMP and refers to aspects of digital-age literacy.

The application of the PjBL model oriented to digital-age literacy as a 21st century learning and education skill has also proven effective in increasing literacy HOTS in science learning for Static Electricity material for class IX SMP. The improvement of students' literacy HOTS abilities is shown by the achievement of student learning outcomes before and after the implementation of theoriented PjBL model digital-age literacy. At the beginning of learning before being given action, from the results of the pretest, the students' initial literacy HOTS ability with an average value of 58.83±8.647 and after being given the action using the PjBL model oriented digital-age literacy, at the end of the meeting based on the posttest results obtained an average the final literacy HOTS ability of students was 84.47±9.247 and there was an increase with the average difference of students' literacy HOTS ability of 25.633±7.739. There is an increase in the

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HOTS of student literacy statistically as well as evidenced by the results of hypothesis testing with a t-test value of 18.141 and a probability value (p) of 0.000 < 0.05, so it can be concluded that there is a significant increase in student literacy HOTS on the subject of Static Electricity class IX. SMP through the application of aoriented PjBL model digital-age literacy.

The findings of this study have implications for teachers that to improve students' HOTS abilities and literacy skills, it can be done by designing and implementing innovative learning models and teaching materials, one of which is by applying aoriented PjBL model digital-age literacy. Through the application of the PjBL model as one of the 21st century learning skills oriented to digital-age literacy , it can train and assist students in developing creativity, critical thinking skills, communication skills, collaboration and increase student motivation to try to complete project assignments, access information, apply technology. , and help develop students' HOTS skills and literacy skills. Therefore, teachers are expected to be able to design and develop 21st century learning skills, one of which is the PjBL model oriented towards digital-age literacy as an effort to improve students' HOTS and literacy skills.

4. CONCLUSION

The PjBL model is oriented towards digital-age literacy as a 21st century learning skill to improve students' HOTS literacy in science learning material for Static Electricity for class IX SMP is designed according to the characteristics of 21st century skills learning known as 4C skills (creativity, critical thinking, communication, and collaboration), the form of presentation is also adapted to the Static Electricity material/material. Learning is also designed with digital teaching materials (e-modules) designed using theapplication Kvisof Flipbook Maker as a learning resource for students. The PjBL and e-module models are designed and refer to the formulation of competency development in 21st century learning in thedomain digital-age literacy which includes 8 aspects including: basic, scientific, economic, information, visual, technological, multicultural, and global awareness.The application of the oriented PjBL model digital-age literacy as a 21st century learning skill is proven to be able to increase students' HOTS literacy in science learning material for static electricity class IX SMP. This increase is evidenced by the increase in student literacy HOTS learning outcomes before and after the learning action is carried out. The average value of the pretest-posttest difference or the increase in student literacy HOTS on Static Electricity material is 25.633±7.739.

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