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Development of E-Supplement Teaching Materials Based on Socio-Scientific Issues on Environmental Change Material to Improve Process Skills and Science Literacy of High School Students

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Abstract

The results of PISA in 2018 indicate that students' scientific literacy in Indonesia needs to be improved. Current teaching materials focus more on the content of the material and have not been linked to real-life contexts. To support the improvement of scientific literacy, teaching materials related to social issues are developed that can train students in improving science process skills and science literacy. The purpose of this study is to develop e-supplement teaching materials based on Socio-Scientific Issues to improve science process skills and students' science literacy. This study is a Research and Development (R&D) study referring to the steps including (1) potential and problems (2) data collection (3) product design (4) design feasibility assessment (5) design revision (6) product trial (7) product revision (8) usage trial. The results of the study indicate that the e-supplement teaching materials used in learning are in the criteria for being suitable for use, with material validity of 85%, media validity of 100%, teacher responses of 85%, and student responses of 88%. The use of e-supplement teaching materials effectively improves students' science process skills and science literacy, with the results of N-gain Science Process Skills in both classes of 0.67, and the results of N-gain science literacy in the two classes of 0.59 and 0.49. From the results of the study, e-supplement teaching materials based on Socio-Scientific Issue are valid as teaching materials in learning Environmental Change material. E-supplement teaching materials based on Socio-Scientific Issue are effective in improving students' science process skills and science literacy in Environmental Change material.

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INTRODUCTION

The curriculum is a set of plans and arrangements for content, objectives, learning materials, and methods used in organizing learning activities to achieve certain educational goals (Permendikbud, 2020). The Ministry of Education and Culture (2019) has issued a policy called Merdeka Belajar with the launch of a new curriculum, namely the Merdeka Curriculum. Students are not molded to memorize material but have sharp and comprehensive reasoning skills regarding problems that occur in everyday life. The independent learning program can respond to challenges in the 21st century. Learners are required to be able to develop critical thinking, creativity, communication, and collaboration skills of students. Merdeka Belajar can answer the challenges of the 21st century today, because critical thinking, creative thinking, communication and collaboration skills in students are the focus of development that is trained in a student.

In the Merdeka curriculum, the biology learning outcomes in Phase E students have the ability to be responsive to global issues and play an active role in providing problem solving. These abilities include observing, questioning and predicting, planning and conducting research, processing and analyzing data and information, evaluating and reflecting, and communicating in the form of simple projects or visual simulations using available technology applications related to alternative energy, global warming, environmental pollution, nanotechnology, biotechnology, chemistry in everyday life, utilization of waste and natural materials, pandemics due to viral infections. All of these efforts are directed at achieving sustainable development goals (SDGs) through process skills.

Science Process Skills are one of the important aspects in science learning. Science process skills according to Trianto (2012) are skills that utilize scientific methods in science learning and aim to solve a problem, find a theory, principle or concept, and with science process skills, science learning can be achieved. The importance of science process skills for students is to accustom students to have a scientific attitude, be able to think critically, and understand the scientific steps in solving a problem in learning.

Organization for Economic Cooperation and Development (OECD, 2018) announced Indonesia's PISA (Programme for International Student Assessment) score to measure the performance of students in literacy, mathematics and science of students in each country to determine the strengths and weaknesses of each country. The latest PISA results for Indonesia in 2018 ranked 70 out of 78 participating countries. The PISA results show that science literacy skills in Indonesia are still in the low category or Low International Benchmark. Science literacy in schools is an important skill because it is related to science process skills, as well as applying students' knowledge and science processes to solve a problem in a real situation (Inzanah, 2017; Septia et al., 2021). Training science literacy will accustom students to develop ideas that are directly related to conceptual views and emphasize aspects of intuitive and rational thinking so that they will always try to find solutions to every problem in everyday life (Hidayani et al., 2021). The low science literacy skills of students in Indonesia are influenced by many things such as the education system, the choice of teaching methods and models by educators, learning facilities and means, learning resources and teaching materials (Kurniawati et al., 2021).

Teaching materials are an important factor and are directly related to learning activities so that they can affect science process skills and science literacy. In the learning process, the use of teaching materials in delivering material by adding process skills and science literacy can determine the success of students (Wati et al., 2019). The learning process carried out in schools, teachers more often use textbooks in learning. The textbooks used do not fully contain the content of process skills and science literacy. In addition, the teaching materials used focus more on the content of the material and have not been linked to the context of life. There needs to be a learning process that can have a positive influence on process skills and science literacy. The learning applied in this study is Socio-Scientific Issues (SSI)-based learning. SSI is a learning approach that presents current issues related to science. Implementing SSI in the learning process has the advantage that students can gain knowledge by recognizing contextual problems in the real world (Selamet et al., 2021).

E-supplement teaching materials can be applied as additional teaching materials, namely supporting learning activities to complement the available teaching materials. E-supplement teaching materials can be applied in classroom learning or at home to help students increase their insight and

knowledge. E-supplement is a digital teaching material supplement according to Masrur et al. (2017), which is a book that presents information, facts, and various things that can add to and perfect the contents of the primary book in learning and problem-solving activities for students.

The results of interviews with biology teachers at Senior High School 8 semarang stated that the teaching materials used in environmental change materials do not present real cases regarding environmental changes that are currently occurring. Environmental change materials have characteristics that are close to contextual problems that occur in the environment around students with the hope that students will be able to find solutions to solve problems so that they can be applied process skills and science literacy (Putri, 2022).

Based on the research background, to support the improvement of students' science process skills and science literacy, an e-supplement of teaching materials related to social scientific issues was developed. This study aims to analyze the validation of e-supplement teaching materials based on social scientific material on environmental change issues, and to analyze the effectiveness of the e-supplement teaching materials developed on improving students' science process skills and science literacy.

RESEARCH METHOD

The research carried out is R&D research (Research and Development) This research design modifies the research design from Sugiyono (2016) which includes (1) potential and problems; (2) data collection; (3) product design; (4) design feasibility assessment; (5) design revision; (6) product testing; (7) product revision; (8) trial use. The subjects of this research were material experts, media experts, biology teachers, and students class X. The samples used were 2 classes, namely classes X.1 and X.2. The data in this research are validation data of e-supplement teaching materials by material and media experts obtained through questionnaires, data on teacher and student responses to the practicality of e-supplement teaching materials, as well as data on the effectiveness of e-supplements in improving students' science process skills and scientific literacy, obtained through *pretest* and *posttest* . Pretest and posttest was analyzed using N-gain to determine the increase in students' science process skills and scientific literacy.

RESULTS AND DISCUSSION

E-supplements based on Socio-Scientific Issues which were developed, were analyzed for validity and effectiveness in improving science process skills and science literacy.

Validity of E-Supplement Teaching Materials Based on Socio-Scientific

The assessment of E-supplement validity includes 2 assessments, namely material validity and media validity by material experts and media experts who are competent in their fields. In the questionnaire validation for the material expert, the components assessed included aspects of content eligibility, presentation eligibility, language eligibility, and contextual assessment. The data on the results of the material expert's assessment are presented in Table 1.

Table 1 Material expert validation results of E-Supplement based on Socio-Scientific Issue

Assessment aspect	Percentage	Criteria
Eligibility of content	85%	Very Valid
Feasibility of presentation	75%	Valid
Language eligibility	87.50%	Very Valid
Contextual assessment	100%	Very Valid
Final Precentage	85%	Very Valid

Based on the results of the validation of the material obtained based on the assessment of material experts, a validity percentage of 85% was obtained. This means that the material contained in the e-suplemen teaching materials belongs to the very valid criteria. Each aspect of teaching material validation belongs to the valid category. In aspect of content eligibility, e-supplement received an assessment of 85% with very valid criteria. The learning content in the developed e-supplement product contains environmental change material that is adjusted to the learning achievements of the Merdeka Curriculum. The learning content is developed based on socio-scientific issues.

In aspect of presentation eligibility, it obtained a percentage of 75% with valid criteria. The aspect of content feasibility received the lowest assessment from material experts. This is because the questions in the e-supplement need to be modified by adding images or graphs. Researchers made improvements by reviewing the presentation of material in the e-supplement. Researchers made improvements by adding several graphs to the questions presented in the e-supplement teaching materials.

In aspect of language eligibility, it obtained a percentage of 87.50% with very valid criteria. In terms of language eligibility assessed by material experts are ease of understanding sentences, language suitability to the level of intellectual development of students, consistency of term use, accuracy of sentence structure, sentence effectiveness, and spelling accuracy.

In the media expert's validation questionnaire, the components assessed included aspects of graphical eligibility. The data on the results of the material expert's assessment are presented in Table 2.

Table 2 Media expert validation results of E-Supplement based on Socio-Scientific Issue

Assessment aspect	Percentage	Criteria
Graphic Eligibility	100%	Very Valid
Final Precentage	100%	Very Valid

Based on the results of the validation of the material obtained based on the assessment of material experts, a validity percentage of 100% was obtained. This means that the e-supplement of teaching materials has been prepared in a format according to needs, the format for preparing e-supplement teaching materials is an important thing to consider. There are two components that must be considered in determining the format of teaching materials, namely frequency and consistency in designing teaching materials.

Practicality of E-Supplement Teaching Materials Based on Socio-Scientific Issues

The practicality of teaching materials was obtained from practicality questionnaires filled in by teacher and students. The assessment is carried out after the learning process using e-sumplement teaching materials is carried out. The results of teacher responses regarding e-suplement teaching materials in Table 3.

Table 3 Practicality Assessment Results According to Teachers

Assessment aspect	Percentage	Criteria
Interest	81%	Practical
Material	96%	Very Practical
Language	75%	Practical
overall percentage	85%	Very Practical

Based on the results of the teacher's response, the percentage of the total score was 85%. This can be included in the very practical criteria, which means that e-supplement teaching materials can be used in

learning. In this assessment there are three aspects of assessment, with one aspect getting very practical assessment criteria, and two aspects getting practical assessment criteria. Furthermore, the student response questionnaire result can be seen in Table 4.

Table 4 Practicality Assessment Results According to Students

Criteria	The number of students	Percentage
Veri Practical	21	70%
Practical	9	30%
Less Practical	-	-
Impractical	-	-

Based on the results of student responses conducted in the trial class consisting of 30 students, as many as 70% of students considered e-supplements to be very practical, and another 30% considered e-supplements to be practical

Effectiveness of E-Supplement in Improving Science Process Skills

The effectiveness of the supplement was obtained by testing e-supplement in improving science process skills. This effectiveness test was carried out through a large-scale trial with the trial sample being grade X.1 and X.2 students at Senior High School 8 Semarang. Data on the effectiveness of supplements in improving science process skills of students were taken by students result working pretest and posttest questions with a total of 15 science process skills questions. Indicators of science process skills used in tests to measure science process skills include observing, grouping, interpreting, hypothesizing and applying concepts. The N-gain analysis of science process skills is presented in Table 5.

Table 5 Results of N-gain Analysis of Science Process Skills

Indicator	No. Question	$\bar{X}$ Class Score X.1		$\bar{X}$ Class Score X.2		N-gain Class X.1	N-gain Class X.2
		Pre-test	Post-test	Pre-test	Post-test		
Observing	5, 2, 9	11.85	16.85	12.04	17.96	0.61	0.74
Grouping	1, 4, 10	9.81	15.93	11.30	17.22	0.60	0.68
Interpret	3, 6, 8	10.93	19.26	9.26	17.04	0.92	0.72
Hypothesize	11, 13, 17	10.93	15.00	11.48	16.48	0.45	0.59
Applying Concepts	7, 12, 14	10.19	17.59	9.63	16.11	0.75	0.63
Total		53.70	84.63	53.70	84.81	0.67	0.67

This research was conducted with the aim of finding out the effectiveness of e-supplement teaching materials developed in improving students' science process skills. Indicators of the effectiveness of e-supplement teaching materials can be seen from the results of the N-gain test analysis. Table 5 shows the results of the N-gain analysis, there is an increase in the average score for each indikator of science process skills. The observing indikator in class X.1 obtained an increase in the N-gain analysis results of 0.61 with medium criteria. In class X.2, an increase in the N-gain results of 0.74 with high criteria. The increase in science process skills in the observing indicator occurred due to the contribution of e-supplements of teaching materials based on Socio-Scientific Issues. In the developed e-supplement, there are pictures and videos, this can train students' observation skills. Students can observe the pictures and videos available in the e-

supplement and develop the knowledge gained from the results of observing. The second science process skill indicator, namely grouping in class X.1, obtained an increase in the N-gain analysis results of 0.60 with medium criteria. In class X.2, an increase in the N-gain analysis results of 0.68 with medium criteria. The increase in science process skills in the grouping indicator occurred due to the contribution of e-supplements based on Socio-Scientific Issues. There is an explanation of the material related to the grouping of environmental change factors, and the grouping of waste in the environment, students can train their grouping or classification skills from e-supplements of teaching materials. The third indicator of science process skills is interpreting, in class X.1, there was an increase in the N-gain analysis results of 0.92 with high criteria. In class X.2, there was an increase in the N-gain analysis results of 0.72 with high criteria. The increase in science process skills in the interpret indicator occurred due to the contribution of e-supplements based on Socio-Scientific Issues. On environmental issues presented in the e-supplement, there is data related to environmental issues, students can practice their ability to interpret with data in the form of graphs contained in the e-supplement of teaching materials.

Furthermore, the hypothesize indicator, in class X.1, there was an increase in the N-gain analysis results of 0.45 with medium criteria. In class X.2, there was an increase in the N-gain analysis results of 0.59 with medium criteria. This increase can occur with the contribution of e-supplements based on Socio-Scientific Issues. In the e-supplement, there are questions that must be discussed with the group related to social issues that students have understood, with discussions in answering these questions, students' hypothetical abilities can be trained. The last indicator of science process skills in this study is applying concepts. In class X.1, there was an increase in the N-gain analysis results of 0.75 with high criteria, and in class X.2, there was an increase in the N-gain analysis results of 0.63 with medium criteria. This increase occurred due to the contribution of e-supplements of teaching materials based on Socio-Scientific Issues. In understanding environmental issues contained in e-supplements, teaching materials can train students to apply concepts and develop knowledge related to environmental changes that students already have

Based on the results of the N-gain analysis of environmental change material learners using Socio-Scientific based e-supplement teaching materials Issues carried out in two classes X can be concluded that there has been an increase in students' science process skills. E-supplement teaching materials based on Socio-Scientific Issue can bring out students' science process skills in the learning process. The results of this research are strengthened by research by Alvita (2017) which shows the implementation of learning with the application of Socio-Scientific Issue is very good, with an increase in reflective skills student judgment and students' understanding of concepts is quite significant.

According to research by Rizkita et al. (2016) which uses Socio-Scientific learning Issue problem based learning indicates Socio-Scientific learning Issue Problem Based Learning has a significant effect on students' metacognitive skills and cognitive learning outcomes. Socio-Scientific Learning Issue is a learning strategy that helps students to be active in investigating social and scientific problems that occur in society. Use of e-supplements for Socio-Scientific based teaching materials Issues in learning Environmental Change material can provide a positive response to the science process skills of class X students.

Effectiveness of E-Supplement in Improving Science Literacy

The effectiveness of the supplement was obtained by testing e-supplement in improving science literacy. This effectiveness test was carried out through a large-scale trial with the trial sample being grade X.1 and X.2 students at Senior High School 8 Semarang. Data on the effectiveness of supplements in improving science process skills of students were taken by students result working pretest and posttest questions with a total of 15 science literacy questions. Indicators of The scientific literacy used in tests to measure scientific literacy include explaining content knowledge, explaining scientific phenomena, identifying problems, interpreting scientific data, and understanding personal, national and global problems.science process skills used in tests to measure science process skills include observing, grouping, interpreting, hypothesizing and applying concepts. The N-gain analysis of science literacy is presented in Table 6.

Table 6 Results of N-gain Analysis of Science Literacy

Indicator	No. Question	$\bar{X}$ Class Score X.1		$\bar{X}$ Class Score X.2		N-gain Class X.1	N-gain Class X.2
		Pre-test	Post-test	Pre-test	Post-test		
Explains content knowledge	15, 25, 26	11.48	17.59	11.85	16.67	0.72	0.59
Explain scientific phenomena	18, 24, 28	11.67	16.67	13.89	17.41	0.60	0.58
Identifying Problems	27, 23, 20	10.00	16.11	5.93	12.59	0.61	0.47
Interpret scientific data	16, 22, 30	11.48	15.93	10.37	13.70	0.52	0.35
Understand personal, national and global problems	19, 29, 21	10.19	15.00	8.15	14.26	0.49	0.52
Total		54.81	81.30	50.19	74.63	0.59	0.49

The development of e-supplement teaching materials in this research was carried out with the aim of finding out the effectiveness of the e-supplement teaching materials developed in increasing students' scientific literacy. Indicators of the effectiveness of e-supplement teaching materials can be seen from the results of the N-gain test analysis. Table 6 shows the results of the N-gain analysis, there is an increase in the average score for each scientific literacy indicator. Results of analysis of the effectiveness of e-supplement Based on Socio-Scientific Issue shows an increase in students' scientific literacy in environmental change material, which was obtained by comparing the results of the pretest given at the beginning of learning, and the posttest given after students took part in environmental change learning with e-supplements teaching materials based on Socio-Scientific Issues. The indicator explains content knowledge. In class X.1, there was an increase in the N-gain analysis results of 0.72 with high criteria. While in class X.2, there was an increase in the N-gain analysis results of 0.59 with medium criteria. This increase occurred due to the use of e-supplements based on Socio-Scientific Issues. In this indicator, students are invited to understand what is meant by environmental change, factors that can influence environmental change, and the impact of environmental change. The material presented in the e-supplement material can provide students with knowledge related to environmental change.

The next indicator of science literacy in the competency aspect is explaining scientific phenomena. An increase in the results of the N-gain analysis in class X.1 was obtained by 0.60 with medium criteria and in class X.2 by 0.58 with medium criteria. The e-supplement presents environmental issues that students can learn. The implementation of the discussion method during learning can increase students' curiosity which can train students to have the competence to explain scientific phenomena. The next indicator in the competency aspect is identifying problems. In class X.1, an increase in the results of the N-gain analysis was obtained by 0.61 with medium criteria, and in class X.2, an increase in the N-gain was obtained by 0.47 with medium criteria. This increase occurred due to the use of e-supplements based on Socio-Scientific Issues, with environmental issues contained in the e-supplement students can practice their ability to identify scientific problems. The next indicator is interpreting scientific data. In this indicator, class X.1 obtained an increase in the N-gain analysis results of 0.52 with medium criteria, and class X.2 obtained an increase in the N-gain analysis results of 0.35 with medium criteria. The Socio-Scientific Issue e-supplement contains several data related to environmental problems that often occur, students are asked to interpret the data, and make conclusions based on the data that has been presented.

The last indicator of scientific literacy in this study is understanding personal, national, and global problems. In class X.1, there was an increase in the results of the N-gain analysis of 0.49 with medium criteria, and in class X.2 it was 0.52 with medium criteria. This increase occurred due to the use of e-supplements of teaching materials based on Socio-Scientific Issues. There are environmental issues related to environmental

problems that occur, both national and global problems that can help students train students to understand problems that occur in the environment, as well as develop their knowledge

Learning using Socio-Scientific Issue involves students in the decision-making process, and trains them to study an issue thoroughly, including issues related to their morals. This is reinforced by previous research which states that Socio-Scientific Issue is an approach that aims to stimulate intellectual, moral and ethical development, as well as awareness regarding the relationship between science and social life (Zeidler et al., 2005).

The results of this research show the use of e-supplement teaching materials based on Socio-Scientific Issues have an influence and are proven to increase students' scientific literacy. According to Rohmawati et al. (2018) learning using Socio-Scientific Issue improves students' ability to make decisions about controversial social issues. In addition to intellectual abilities, students who have science literacy skills can think socially and have good interdisciplinarity. Assessment of students' scientific literacy skills is based on their scientific abilities, such as identifying scientific problems, explaining scientific phenomena, and applying scientific knowledge (OECD, 2015). Increased scientific literacy due to the use of Socio-Scientific Issue is also supported by Pinzino (2012) who states that SSI-based learning can increase scientific literacy.

CONCLUSION

Based on results research and discussion can obtained conclusion that e-supplement teaching materials based on Socio-Scientific Issue in the valid category as teaching materials in learning material Change Environment. E-supplement teaching materials based on Socio-Scientific Issue based are effective in improving science process skills and students' scientific literacy material Change Environment . This is shown by the N-gain results of science process skills in both classes getting an increase of 0.67, and the N-gain results of scientific literacy in two classes getting an increase of 0.59 and 0.49 which are included in the medium category.

REFERENCE

Alvita, L. (2017). Penerapan Socio-Scientific Issue Based Instruction Pada Materi Pemanasan Global Untuk Meningkatkan Reflective Judgment dan Pamahaman Konsep. *Jurnal Inovasi Pendidikan Fisika (JIPF)*, *06*, 188–192.

Hidayani, S., Jamaluddin, & Ramdani, A. (2021). Pemanfaatan Hasil Pengembangan Instrumen Untuk Penilaian Literasi Sains Peserta Didik Pada Mata Pelajaran IPA di SMPN 2 Mataram. *Jurnal Pengabdian Magister Pendidikan IPA*, *4*(1), 73–77. https://doi.org/10.29303/jpmpi.v3i2.560

Kemendikbud. (2020). *Peraturan Menteri Pendidikan dan kebudayaan Republik Indonesia Nomor 3 Tahun 2020*.

Kurniawati, T. D., Akhdinirwanto, R. W., & Fatmaryanti, S. D. (2021). Pengembangan E-Modul Menggunakan Aplikasi 3D PageFlip Professional Untuk Meningkatkan Kemampuan Literasi Sains Peserta Didik. *Jurnal Inovasi Pendidikan Sains (JIPS)*, *2*(1), 32–41. https://doi.org/10.37729/jips.v2i1.685

Masrur, H., Duran Corebima, A., & Ghofur, A. (2017). Pengembangan Buku Suplemen Mutasi Gen Pada Mata Kuliah Genetika. http://journal.um.ac.id/index.php/jptpp/

OECD. (2015). *PISA 2015 Assessment and Analytical Framework*. OECD. https://doi.org/10.1787/9789264281820-en

OECD. (2018). *PISA 2018 Assessment and Analytical Framework*. OECD. https://doi.org/10.1787/b25efab8-en

Pinzino, D. W. (2012). *Socioscientific Issues: A Path Towards Advanced ScientificLiteracy and Improved Conceptual Understanding of Scientific Literacy and Improved Conceptual Understanding of Socially Controversial Scientific Theories*. https://digitalcommons.usf.edu/etd

Putri, N. A. (2022). Pengembangan E-Book Bebasis Inkuiri Pada Materi Perubahan Lingkungan Untuk Melatihkan Kemampuan Literasi Sains Siswa Kelas X SMA. 11(1), 179-193 https://ejournal.unesa.ac.id/index.php/bioedu

Rizkita, L., Suwono, H., & Susilo, H. (2016). Pengaruh Pembelajaraan Socio-Scientific Problem-based Learning Terhadap Keterampilan Metakognitif dan Hasil Belajar Kognitif Siswa kelas X SMAN Kota Malang.

Rohmawati, E., Widodo, W., & Agustini, R. (2018). Membangun Kemampuan Literasi Sains Siswa Melalui Pembelajaran Berkonteks Socio-Scientific Issues Berbantuan Media Weblog. *Jurnal Penelitian Pendidikan IPA*, *3*, 8–14. http://journal.unesa.ac.id/index.php/jppipa

Selamet, K., Sarini, P., & Suardana, I. N. (2021). Literasi Sains Awal Calon Guru Pada Bidang IPA Berkonteks Isu-Isu Sosiosaintifik. *JURNAL IPA TERPADU*, *5*(1), 42–53.

Sugiyono. (2016). Metode Penelitian Kuantitatif Kualitatif dan R&D. Bandung Alfabeta.

Trianto. (2012). Model pembelajaran. PT Bumi Aksara.

Wati, R., Lesmono, A. D., & Prastowo, S. H. B. (2019). Pengembangan Modul Fisika Interaktif Berbasis HOTS (High Order Thinking Skill) Untuk meningkatkan kemampuan Literasi Sains Siswa SMA Pada Pokok Bahadan Suhu dan Kalor. *Jurnal Pembelajaran Fisika*, *8*(3), 202–207.

Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2005). Beyond STS: A research-based framework for socioscientific issues education. In *Science Education* 89(3), 357–377. https://doi.org/10.1002/sce.20048