An analysis of 4C skill on heat in facing the industrial revolution era 4.0

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Abstract. The purpose of writing this article is to find out how to build human character to face the industrial era 4.0, so that they have an understanding of digital literal dimensions and can increase the graduates’ competence who have 4Cs skills (critical thinking, creativity, collaboration, and communication) by using collaborative inquiry, especially on temperature and heat material. This type of research is a quasi experiment with a pretest-posttest control group design. The result of this research is that students 4Cs skills using collaborative inquiry learning model are better than students 4Cs skills using conventional learning at SMA Negeri 14 Medan. Then, it is hoped that they will be able to produce humans who are in accordance with the demands of the industrial era 4.0. With 4Cs skills, they can gain and increase cooperation in a group to solve certain problems, increase their tolerance for peer opinions, try to think critically and creatively to solve problems related to something.

Keyword: 4Cs skills, industrial revolution era 4.0

1. Introduction
A good human resource is produced by a good quality of education. Education is a conscious and planned effort to create an atmosphere of learning in the learning process so that students can actively develop their potential to have religious spiritual strength, self-control, intelligence, noble morals, and skills needed by themselves, the community and the nation. The development of a country is determined by the quality of education. The quality of education certainly involves students to actively learn and direct the formation of values needed by students in living life (Sani, 2014).

At the primary and secondary education level, a curriculum is developed to emphasize in strengthening the learning and assessment process (Kemendikbud, 2018). Strengthening the learning process is carried out by: 1) using a scientific approach, 2) using science as a driving force in learning for all subjects, 3) guiding students to search, not being told, 4) emphasizing language skills as means of communication, carriers of knowledge and thinking logical, systematic, and creative. Strengthening the assessment is done by: 1) measuring the thinking level of students from low to high, 2) emphasizing questions that require deep thinking, not just memorizing, 3) measuring students’ work processes, not just students’ works, 4) using students’ learning portfolios. With the improvement of the education process, it is hoped that Indonesian children will have the competencies needed to face both external and internal challenges during the industrial revolution 4.0 (Syahputra, 2018).
Facing the industrial revolution 4.0 is certainly not an easy thing, so preparing things related to this is a must. One of the important elements that must be of concern to encourage economic growth and the nation's competitiveness in the era of the 4.0 industrial revolution is to prepare a more innovative learning system and increase the competence of graduates who have 21st century skills (Learning and Innovations Skills). Because the trend in the 21st century focuses more on certain specialties, the purpose of Indonesia's national education must be directed to the efforts to shape the individual’s skills and attitudes of 21st century.

The government's effort to achieve the national education goals is through the improvement of the curriculum that was refined into the 2013 revised curriculum 2017. The revision of 2013 curriculum has an impact on changes in science, namely the application of 21st century skills. In addition, during the seminar with the theme "Education Transformation and 21st Century Learning "at Graha Utama Kemendikbud, Jakarta, said that in the current digital era, there are at least four skills that students must have. The four skills are called 4C, namely communication skills, collaboration skills, critical thinking skills, and creativity skills. In line with previous statements, according to the National Education Association (2012), if students in this era want to compete globally, however, students must have the ability to communicate (Communication), collaborate (Collaboration), think critically (Critical Thinking), and creativity (4Cs).

1.1 Creative Thinking Skills
Creativity is the ability to create or invent. Creativity itself is not a sudden result, but is a joint result of logic, power, creativity, physicality, motivation, feelings, and imagination that are integrated into new ideas. Creativity is basically related to the discovery of something, about things that produce something new by using something that already exists. Slameto (2010) states that what is important in creativity is not the discovery of something that has never been known before, but that the product of creativity is something new for oneself and does not have to be something new for others. So it can be concluded that creativity is the ability to combine old elements into new elements for oneself and not necessarily something new for others. The characteristics of creative thinking according to Munandar (2004) are reviewed as follows: fluency, flexibility, originality, elaboration, skills to assess (evaluate), curiosity, imagination, feeling challenged, risk-taking and respect.

1.2 Critical Thinking Skills
The ability to think critically which tends to lead to physical concepts proposed by Arends (2008) consists of, (1) conjunctive concept, a constant conceptual rule structure, critical attributes combined additively and always the same, (2) disjunctive concept, a concept that consists of a number of alternative attributes, and (3) relational concept. In developing critical thinking skills for students in learning, teachers and students together must act as players. Teachers and students must solve a problem together. Teachers do not think to be students but teachers and students together seek and take responsibility in a growing process. Teachers and students must teach and learn from each other and in learning there must be mutual dialogue and horizontal communication. The implementation of learning by means of this dialogue will raise awareness of critical thinking for students. Students will be aware of their disabilities, aware of developments that continue to move forward. Thus the goals of critical thinking can be achieved easily. According to Facione (1990), there are six critical thinking skills, namely: interpretation, analysis, evaluation, inference, explanation, and self-regulation.

1.3 Communication Skills
In this context, communication can be defined as the exchange of messages between two bodies, known as the process of producing knowledge and giving meaning (Simon, 2016). Students need to strive to develop their communication skills in order to be successful in their chosen profession (Haryanti and Suwarma, 2018). Communication competencies can be observed including: 1) open, friendly and polite communication, 2) two-way communication, 3) speaking with the appropriate
intonation, 4) the ability to listen to other person, 5) paying attention to social and cultural aspects of communication, and 6) using natural body language (Sani, 2016).

1.4 Teamwork Skills

Cooperation ability is required in several types of activities. (Riska, 2015) states that students need the ability to work together because in the future this ability is needed in working with people of various ages, genders, races, religions or politics; work as individuals and as team members; know how to define a role as of a group; apply group cooperation to a variety of situations, such as planning future, solving critical problems; identifying the strengths of group members; coaching, mentoring and providing feedback. Researchers refer to indicators according to Marzano which focus indicators on hard work towards group goals, contribution/participation, and the appearance of interpersonal skills.

Collaborative inquiry learning is one of the most challenging and interesting endeavors at school. This learning is a new learning in class where students in groups are involved in independent learning activities supported by the teacher. It is hoped that this method of learning will foster students’ motivation and interest in science, namely learning to carry out similar investigative steps with scientists and they gain knowledge in a scientific process (DeLuca et al., 2017). There are four phases of collaborative inquiry as follows:

| Phase                  | Teachers and learners behaviour                                                                 |
|------------------------|-------------------------------------------------------------------------------------------------|
| Problem Framing        | During this stage, the team defines a shared vision, develops investigations into the relationship between professional practice and student learning outcomes, and formulates a theory of action. |
| Collecting Evidence    | In the second stage, the collaborative investigative team determines the types of data to be collected, how to collect the data, and where to collect it. |
| Analyzing Evidence     | Learners explore interesting ideas. Teams learn how to make data meanings by identifying patterns and themes and formulating conclusions. |
| Celebrating and Sharing| During this final stage, the team work together to present and share their new insights.       |

*Sumber: Donohono (2011)*

2. Method

This research was conducted in two classes of SMA Negeri 14 Medan. When this research was conducted in class XI even semester of 2019/2020, the population of students in this study was all students of class XI IPA SMA. Sampling was carried out randomly (cluster random sampling) and two classes were taken, where each classes had the same opportunity to be the research sample. and other classes are made into controlled classes using conventional learning models. This type of research is a quasi experiment (pseudo experiment) because the class used for treatment is a class that has been formed before. This variable involves two kinds of research variables, namely, one dependent variable and one independent variable. The dependent variable is the students’ 4C skills in the heat material of class XI IPA. The independent variable uses the Collaborative Inquiry learning model.

This quasi-experimental research design was briefly designed with the pretest-posttest controlled group design shown in the table below.
Table 2. Two Group Pretest-Postest Design

| Class       | Pretest | Treatment | Posttest |
|-------------|---------|-----------|----------|
| Experimental | T₁      | X         | T₂       |
| Controlled  | T₁      | Y         | T₂       |

Information:
X = Treatment with collaborative inquiry model
Y = Treatment using conventional learning
T₁ = Pretest in the experimental class and controlled class before being given treatment
T₂ = Posttest in the experimental class and controlled class after being given treatment

The instrument used in data collection was a test of creative thinking and critical thinking skills. The two tests were in the form of descriptions which were carried out twice, namely the pretest (initial test) and posttest (final test). The instruments used in this study were 4 types of instruments on heat material, namely the collaboration skills instrument referring to the Marzano indicator (2013), then the communication skills instrument used indicators according to Sani (2016), then the instruments and indicators of critical thinking skills according to Facione (1990), and indicators of creative thinking skills according to Munandar (2004).

The data obtained was first analyzed by hypothesis testing, after first being tested for normality and homogeneity of the data. The normality test was held to determine whether the research data was normal for each research variable, the test used was the Shapiro-Wilk test in the SPSS 22.0 program, then the homogeneity test was used to determine whether the two samples came from a homogeneous population, by distributing the data to SPSS 22.0 into the Levene test column. This process will produce the output of the Test of Homogeneity of Variances. Hypothesis testing is done by using two-party t-test, pretest mean similarity test and one-party t-test (post-test average similarity test). Two-party t-test was used to determine the similarity of students’ initial abilities in the two sample groups. At a significant level of 0.05. One-party t-test is used to determine the effect of a treatment, namely the problem-based learning model on students’ 4C skills. The hypothesis was tested using SPSS 22.0 at a significant level α = 0.05, then the testing criteria is if the significance value is> 0.05 then the two classes have the same ability. And if the significance value <0.05, the two classes have different abilities.

Correlation analysis is used to determine how the relationship between the independent variables (collaborative inquiry model) and the dependent variable (Collaboration, Communication, Critical Thinking and Creativity) of students uses the product moment correlation equation. In addition, the correlation test is used to analyze the relationship between indicators of the dependent variable and also the linearity model. The table of criteria for giving the interpretation of the correlation coefficient includes:

Table 3. Correlation coefficient

| Correlation Coefficient | Interpretation |
|-------------------------|----------------|
| 0.80 – 1.00             | Very High      |
| 0.60 – 0.80             | High           |
| 0.40 – 0.60             | Sufficiently   |
| 0.20 – 0.40             | Low            |
| 0.00 – 0.20             | Very High      |

3. Results and Discussion
The results of collaborative inquiry resulted in wise actions aimed at improving practice based on careful evidence examination (Donohono, 2011). The teacher also played a role and was involved in investigating and analyzing and finding the best solution or various types of alternative solutions, as well as helping students to pay attention to and reflect on their thinking processes.
Learning physics using collaborative inquiry models can help students to acquire process skills such as theory building, argumentation, and collaboration and improve their characteristics towards science (Junaedi, et al. 2014). The collaborative inquiry model will actively engage students with concrete objects, provide opportunities for students to work in groups, encourage students to use observation skills, develop problem-solving skills, and participate in solving concrete problems (Donohono, 2011).

Improving the 4C skills of students using the collaborative inquiry learning model is better because this learning model has several advantages, namely collaborative inquiry gives the teacher freedom to determine the learning process and theme so that it can empower students and guide students’ interest to stay involved during collaborative investigations. Students then decide what they would like to do to solve the problem, or what they would do differently based on each group's discussion of the theme. Furthermore, students can collaborate and communicate at the same time, so that students begin to have confidence in answering questions through observation, expressing opinions, ideas or questions during the discussion process (Gibson, 2017).

3.1 The Effect of Collaborative Inquiry Learning on Students' Creative Thinking Skills

The learning model in this study is a collaborative inquiry model. This model can be used to train students in doing their projects, especially in heat subjects. In addition, the purpose of this learning model is to form concepts in students' memory so that the concept can last for a long time. In this case, the teacher is expected to use the collaborative inquiry model in the teaching and learning process. So that students can sharpen their creativity in heat learning.

Before being given different treatments in the experimental class and the control class, they were given a pretest to determine the students' initial abilities in the two sample groups. The average pretest creative thinking skills of students in the experimental class was 38.24 and the average pretest of students' creative thinking skills in the controlled class was 34.71.

After the treatment in each of the two sample classes was given, then the creative thinking skills posttest was given. The average post-test of students 'creative thinking skills in the experimental class was 71.47 and the average post-test of students' creative thinking skills in the controlled class was 62.94.

This also shows that students 'creative thinking skills taught using the collaborative inquiry model are better than students' creative thinking skills with conventional learning. In inquiry learning, creativity plays a very important role in designing or making products. In line with the research of Simanjuntak et al (2019) that learning must create conditions where students can create and innovate, instead of being dictated and intimidated by the teacher. Teachers should always be facilitators in accommodating the results of creativity and innovation developed by students. Eristya and Aznam (2019) also concluded that creativity in learning physics is needed in observing, taking tools and materials, assembling tools and materials, analyzing data, solving physics problems and so on. And Sandika and Herlina (2018) state that inquiry learning can improve creative thinking skills. For example, students with high creativity if given an applicative question will be more dexterous in determining steps to solve problems.

3.2 The Effect of Collaborative Inquiry Learning on Students' Critical Thinking Skills

Critical thinking skills need to be optimized in a learning process. Critical thinking is seen as one of the main skills that students must have when leaving school and entering the real world. Critical thinking skills are a reflective and reasoned way of thinking that is focused on making decisions to solve problems (Simanjuntak et al, 2019). To develop critical thinking skills, a learning model is needed to be able to invite students to be active in learning activities. To encourage the ability of students to produce contextual works. One of the learning models that is considered to have the potential to empower critical thinking skills is the collaborative inquiry model.

In this study, the average pretest critical thinking skills of students in the experimental class was 29.41 and the pretest average of students' critical thinking skills in the controlled class was 28.82.
After the treatment in each of the two sample classes was given, then the critical thinking skills posttest was given. The average post-test of students' critical thinking skills in the experimental class was 71.91 and the post-test average of students' critical thinking skills in the control class was 64.71. Based on the results of hypothesis testing with the one-party t test to determine the effect of a treatment, namely the collaborative inquiry model on students' critical thinking skills, it can be concluded that there are differences in the results of students' critical thinking skills in the experimental class and the control class. This also shows that students' critical thinking skills taught using the collaborative inquiry model are better than students' critical thinking skills with conventional learning. This is in accordance with Nisa's (2018) research that the collaborative inquiry learning model can improve critical thinking skills, because students are accustomed to studying a problem through hand-on activities which are then analyzed through theoretical studies to formulate a hypothesis and tested through a practicum to get a conclusion. Nasution (2018) also states that there is an increase in critical thinking skills after the application of the inquiry learning model because students are given the opportunity to be actively involved in searching and investigating critically, so that students can formulate their own findings.

Inquiry learning improves scientific performance and develops students' critical thinking skills so that it is good for application in further learning. Inquiry learning strategies provide opportunities for students to maximize their learning activities (Jayanti and Bunga, 2018).

3.3 The Effect of Collaborative Inquiry Learning on Student Communication Skills

The results obtained in this study indicate that communication skills with the collaborative inquiry learning model are better than conventional learning. The mean score for the experimental class was 77.21 and was greater than the mean value for the control class, namely 69.85. Communication skills have the highest value than other skills. Communication skills are very necessary to achieve success in learning. With communication skills, students will easily communicate various matters relating to learning materials, both orally and in writing (Maryati, 2018).

In the experimental class, initially students were unable to communicate their thoughts and feelings accurately and clearly, for example in expressing opinions in discussions caused by students not listening to what other people said in the discussion. After receiving learning using the collaborative inquiry learning model, there are students who are skilled at asking questions when they do not understand the subject matter that the teacher has provided, and when given the opportunity to ask questions by the teacher, students can answer questions correctly, clearly and smoothly. In class discussions, students become skilled at articulating ideas and ideas to be achieved in accordance with the objectives of the discussion, students are not able to come up with brilliant ideas during the discussion.

In accordance with the research of Sarwi et al (2017) that inquiry learning can improve student communication skills in high school, students learn to express their opinions during discussions, both discussions between students and between groups. And Aydin (2016) both inquiry based learning with work groups can improve student communication skills including listening to each other, writing skills, being respectful during discussions, eliminating prejudice, being patient, and understanding mutual differences of opinion. Furthermore, regardless of communication skills, their personal skills are developed. One of the most important outcomes is when students do not have sufficient information or competencies related to work assignments; problems in communication skills will not be avoided.

3.4 The Effect of Collaborative Inquiry Learning on Student Collaborative Skills

Of the four skills, the average score of collaboration skills in the experimental class was higher, namely 76.62 and in the control class, namely 67.65. When a group of people collaborates, each team member can cover up the weaknesses of other individuals in the group (Irwan and Sani, 2015). In the experimental class, students emphasize their collaboration skills. When a student is unable to complete a concept, a group of friends who already understand will help. When collaborating, students' social
abilities are more prominent than working alone (Wulandari et al, 2016; Kartika et al. 2019). Caring for each other is better if a learning model requires them to present the results. In order to get good grades, all group members must master the material and tasks they do on the grounds that they have to appear their best when presenting the results (Fitri and Kusumaningtyas, 2015).

4. Conclusion
Based on the research results that have been described, the following conclusions can be drawn students 4C skills using collaborative inquiry learning model are better than students’ 4C thinking skills using conventional learning at SMA Negeri 14 Medan. And able to produce humans who are in accordance with the demands of the industrial era 4.0, with 4C skills can foster and increase collaboration in a group to solve certain problems, increase their tolerance for peer opinions, try to think critically and creatively to solve problems related to something.

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