

## ANALYSIS OF USAGE OF 4C LEARNING SKILLS IN PHYSICS STUDENT WORKSHEETS CLASS XI SEMESTER 2 IN WEST SUMATERA

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### ABSTRACT

*One of the implementations of the 2013 curriculum is to apply 4C skills in classroom learning using Student Worksheets. Applying 4C's to Student Worksheets can help students practice 4C skills. Observation results show that the worksheets used in Senior High Schools in Solok Regency and City vary, and the use of 4C skills is not yet known. The objective is to analyze 4C skills on Student Worksheet Class XI Physics Semester 2 in the District and Solok. This type of research is descriptive research with a qualitative approach. The population of this research is all physics worksheets for students of class XI State Senior High School Semester 2 used in Solok Regency and City. The sample of this study was 35 Physics Student Worksheets of SMA Class XI Semester 2, which was designed and used by physics teachers at State Senior High Schools in Solok Regency and City. The research data were taken through documentation studies and interviews. The data processing technique in this study was Content Analysis. Based on the results of the study, it was concluded that the use of 4C skills on the Physics Student Worksheets for Class XI Semester 2 in Solok Regency and City was still low, with the category of less facilitating. The average percentage obtained from the use of 4C learning skills in each component is as follows. Critical thinking 31.9%, creativethinking 19.47%, communication 21.68%, and collaboration 14.84%*

**Keywords :** Physics Student; Worksheets; 4C Learning Skills



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## I. INTRODUCTION

The 21st century is a century that demands the quality of human resources. Quality human resources can be produced through professional institutions to deliver superior results. Through education, students are trained to have the skills to learn to innovate and use information technology and be able to work and survive with the skills they have. So, everyone must have various skills to be able to answer the demands of the 21st century [1]

21st century education needs quality human assets to be able to get advanced end result that can compete globally in the 21st century. The demand of 21st century education are being able to create education that could produce human resources who're successful of critical questioning and problem solving, able to communicate and collaborate, in addition to the capability to create and renew [2]. *US-based Partnership for 21st Century Skills* (P21), noted that critical thinking, creative thinking, communication, and collaboration are competencies needed in the 21st century [2,3]. Students need these 4C skills to meet the demands of the 2013 curriculum and the 21st century.

Skills are fundamental for students to achieve the expected learning outcomes. To be able to answer the demands of the 21st century, a person must have several skills, including: (1) skills in using information technology, (2) skills for life and career, and (3) learning and innovation skills. Learning and innovation skills include (a) critical thinking and problem solving, (b) communication and collaboration, and (c) creativity and innovation [3]. This skill is known as the 4C skill. 4C skills are one of the skills that are needed especially for students in carrying out life in the modern era.

Critical thinking is a skill that can process, parse, and make hypotheses, generally using more diverse information [4]. Reflective thinking that makes sense or is based on the reason that is focused on determining what to believe and do is what is meant by critical thinking skills [5]. Critical thinking is also defined as an intellectual process that is active and full of skills in making understanding or concepts, applying, analyzing, synthesizing, recognizing problems and their solutions, concluding and evaluating any information obtained from observations, experiences, common sense, thoughts, and communication [6]. So critical thinking skills are learning behaviors related to problem-solving with reasonable reflective thinking or based on the reasoning that has the purpose of processing, parsing, and evaluating, which results in interpretation, analysis, evaluation, inference, and explanation of considerations that contain objective evidence.

Creativity means doing things differently from other people so that it has its own characteristic [6]. Creative thinking skills are skills to develop new solutions to every problem and find new things that have not existed before are original and involve their thinking to produce varied and unique new ideas [7]. So, creative thinking skills are skills to do different things from other people to create something new in various fields that are original to meet the needs of the present. In addition to critical thinking skills and creative thinking, other skills needed are communication skills.

Communication is an activity to transfer information in writing or verbally by conveying it properly [8]. Communicating means developing speech and language that has emotional and social content, namely how the communication session can take place reciprocally [9]. So it can be concluded that communication skills are the ability to establish good interactions with other people. Good communication will create good cooperation as well, and one form of collaboration is collaborating.

Collaboration is the use of communicative skills to achieve common goals, work productively with others, synergize with each other, respect others, and work as a team while generating shared ideas [10]. Collaboration is also defined as working effectively, flexibly, and somewhat with others to complete everyday tasks [11]. So it can be concluded that collaboration skills are the ability to work together effectively and productively, respect, and be responsible for completing a task.

Based on interviews that researchers have conducted with several high school physics teachers in Solok Regency and City, some facts regarding 4C learning skills were obtained. Based on the interviews that have been completed, the researchers found that the 4C skills have not been fully applied in the learning process. The reason is that students are not used to critical thinking, and students reading interest is still low. In addition to conducting interviews, the researchers also analyzed the semester exam questions. From the analysis results, it was found that the application of HOTS questions on the final semester exam questions was relatively low. Even though we both know that the HOTS indicator is part of the 4C learning skills, this is due to several factors, namely teachers, students, the applied learning model, and the use of teaching materials.

Good learning outcomes certainly cannot be separated from the good learning tools used, one of which is teaching materials. Asrizal, et al. stated that teaching materials have a significant role in the learning process in all subjects, one of which is the Student Worksheet [12]. Worksheets are teaching materials that have been packaged in such a way that requires students to study these teaching materials independently [13]. Student Worksheets used by teachers should also meet specific standards. One of the standards that must be met is to apply the 4C learning skills. 4C skills should be applied to Student Worksheets because they can help students improve their thinking skills.

A survey conducted at State Senior High Schools in Solok Regency and City obtained information on Student Worksheets used by physics teachers at State Senior High Schools. Use of physics student worksheets for class XI semester 2 in West Sumatera can be seen in Table 1.

**Table 1.** Use Of Physics Student Worksheets For Class XI Semester 2 In West Sumatera

Student Worksheet	Number of Users
Publisher	5 school
Teacher	8 school
Not using student workheet	12 school

(Source: Survey, 2021)

From the survey conducted, information is obtained that the use of Physics worksheets in West Sumatera, especially in Solok Regency and City. However, many teachers still do not know whether the worksheets used are appropriate according to the 2013 curriculum, one of which is applying the 4C learning skills. In addition, no research has been found related to the analysis of the use of the 4C learning skills on the Physics Student Worksheets for Class XI Semester 2 in Solok Regency and City. From this background, the purpose of this study is to analyze learning skills Student Worksheet 4C in Class XI Physics Semester 2 at the grain content of the material in the Student Worksheet.

## II. METHOD

The type of this research is a descriptive research and uses a qualitative approach. Descriptive research is research that has the aim of describing the phenomenon as it is. Descriptive research is a simple form of research that can describe and explain existing phenomena, both natural and engineered [14]. The qualitative approach aims to describe data in the form of written or spoken words by observing people around [2,15].

The population is a collection of objects determined by researchers to study and conclude based on specific characteristics [15]. The population of this research is all Worksheet Physics Class XI Semester 2, which is designed and used by teachers in Solok Regency and City. The sample is part of the object that is owned by the population. The sampling technique used is *non-probability sampling* with a saturated sample type. The saturated sample is a sampling method by using all the population. In this study, the researcher took a sample of the Physics Student Worksheet for Class XI Semester 2, which was designed by physics teachers and used by physics teachers in State Senior High Schools in Solok Regency and City.

An instrument is a tool used to measure the object being observed [15]. The instrument used was an analysis sheet in a statement regarding the Worksheet of High School Physics Students for Class XI semester 2 related to 4C learning skills. This instrument is an instrument that the researcher made together with the research team, namely Desti Armelia Fitri. This instrument has been previously validated and used in research with the title "Review The Availability of 4C Components on The Worksheet of High School Physics Students N Class XI Semester 1 In West Sumatera. The steps in the preparation of a good instrument are as follows: The steps in compiling a good instrument are as follows [2] :

1. Planning, in the form of formulating goals, determining variables, and variable categories. At this stage, a literature review is carried out regarding what variables will be included in the instrument and what categories are appropriate for the instrument to be made.
2. Instrument grid writing. At the stage of compiling an instrument draft, the instrument lattice is made first. The instrument grid table contains indicators to be analyzed, sub indicators and instrument item numbers for the instruments to be made. Then the instrument is made according to the lattice that has been prepared beforehand.
3. Writing instrument items. After the stage of writing the instrument grid, the next is the stage of making the instrument. The instruments are arranged based on the grid that has been made.
4. Trial, in the form of a validity test. Tests are carried out to test whether the research instrument used is feasible or not in the study by considering its validity. The overall validity results were searched using the formula *Kappa Cohen*. At the end of the assessment, the value is obtained *moment kappa* (k).

$$\text{Moment Kappa (k)} = \frac{Po - Pe}{1 - Pe} \quad (1)$$

Description :

K = kappa moment indicating product validity

Po = realized proportion, calculated by dividing the number of values given by the validator divided by the maximum number

Pe = unrealized proportion, calculated by subtracting the total number of values given by the validator divided by the maximum number

Kappa moment determination category can be seen in Table 2.

**Table 2.** Kappa Moment Determination Category (k)

Interval	Category
0.81 – 1.00	Very valid
0.61 – 0.80	Valid
0.41 – 0.60	Keep
0.21 – 0.40	Less valid
0.01 – 0.20	Invalid

(Source: Ref [2,14])

Validation results processed from three expert validators are in the correct category. This result can be seen in Table 3.

**Table 3.** Instrument Validation Value Results By Third Validator

Nu.	Validator	Value	Category
1	Validator 1	75	Valid
2	Validator 2	83	Very valid
3	Validator 3	76.5	Valid

Data collection techniques are the methods used by researchers to obtain research data or information. In this study, the data was obtained through the study of documentation and interviews. The document in question can be in writing, pictures, or monumental works of someone [14]. The interview consisted of several questions regarding the learning process carried out by teachers in schools related to the 4C indicators. Documentation studies are carried out by collecting documents or data needed in research. The data obtained through the documentation method is data on the High School Physics Student Worksheet for Class XI Semester 2, which high school teachers use in Solok Regency and City.

There are three stages in this research procedure, the first stage of preparation. The preparation stage is to design research, determine the subject and object of research or books to be used, and prepare research instruments [14]. In this research, the preparation stage is to obtain information on the Physics Student Worksheets for Class XI Semester 2 in Solok Regency and City, prepare a draft research instrument, test the instrument's validity, and analyze the results of the instrument validity test, and improve the instrument. The second stage of implementation, the implementation stage, is to collect data as needed. The implementation stage in this research is to collect data by analyzing the Physics Student Worksheets for class XI semester 2 in Solok Regency and City. The third, the completion stage. This stage includes activities to process research data, draw conclusions, and report research results. The last stage in this research is the data obtained from analyzing all the samples and then processing, drawing conclusions, and making a report on the research results from the data that has been processed.

After carrying out the three stages of the research procedure, the next step is data processing. Data processing in a study is a vital activity because, from this activity, the data obtained will be tested and assessed. The results of the data processing techniques will significantly affect the results of the research conducted. The data analysis technique in this research is *content study*. The content study is a method by making inferences (conclusions) contextually so that communication messages can be fully understood. Content review is a procedure used to draw valid conclusions from a book or document [2]. It can be concluded that the data analysis technique with the content study is a step used to conclude both books and documents so that they can be fully understood.

The data processing techniques used in this study are:

1. Summing up the occurrence of the 4C indicator in each LKS analyzed.
2. Calculating the percentage of presentations for high school physics worksheets for class XI semester 2, which can facilitate the 4C indicator in each worksheet analyzed by the formula:

$$\frac{\sum \text{4C indicators that appear}}{\text{total } \sum \text{4C Indicators}} \times 100\% \quad (2)$$

3. Determine the average percentage of the proportion of each category of 4C indicators from all LKS analyzed.
4. Determining the criteria for presenting the physics LKS for SMA class XI semester 2 which can facilitate the 4C indicator can be seen in Table 4

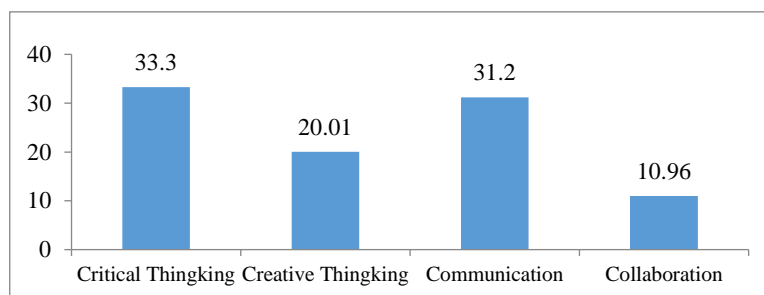
**Table 4.** Presentation Of High School Physics Worksheets For Class XI Semester 2 That Can Facilitate 4C Skills

Interval	Criterion
81-100	Very Facilitating
61- 80	Facilitating
41- 60	Enough Facilitation
21- 40	Less Facilitating
0 – 20	Not Facilitating

(Source: Ref [2])

### III. RESULTS AND DISCUSSION

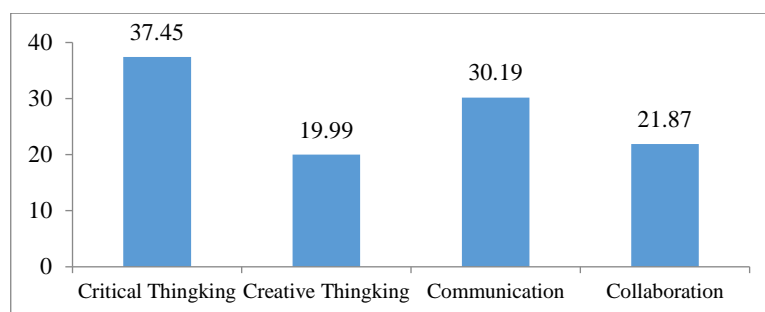
Based on the research that has been done, the sample consists of 8 Student Worksheets made by physics subject teachers in 8 schools in the district and city of Solok. The material contained in the student worksheets is thermodynamics, mechanical waves, traveling and stationary waves, sound waves, optical instruments, and global warming. The Student Worksheets are coded TD, MW, TS, SW, OI and GW for each material. The analysis was carried out to determine the use of 4C learning skills in the Worksheet in each material. The discussion of the study results of the use of 4C learning skills on the Physics Student Worksheets for Class XI Semester 2 is described as follows. The results of the analysis of the use of 4C learning skills on thermodynamic material are described in Figure 1.



**Fig.1.** Average 4C skills on material thermodynamics

Based on Figure 1 shows the results of the analysis of 4C skills on thermodynamics material worksheets. The analysis results showed that the highest average percentage on thermodynamic material was found in the critical thinking skills component, 33.3% in the less facilitating category. The lowest rate was found in the collaboration skills component at 10.96% in the non-facilitating category. While the components of creative thinking skills get a percentage of 20.01% with the type of less facilitating and the communication component getting a rate of 31.2% with the category of less facilitating.

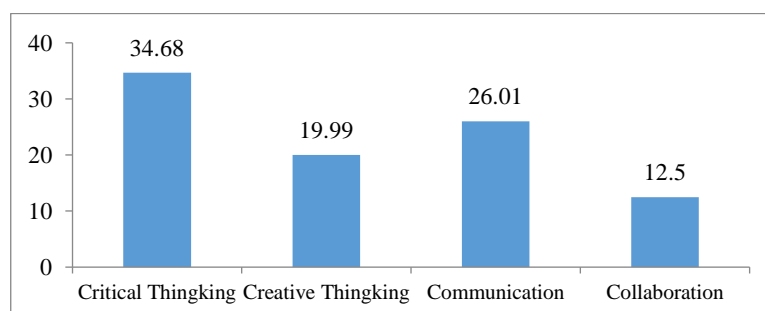
The results of the analysis of the use of 4C learning skills on mechanical wave material are described in Figure 2.



**Fig. 2.** Average 4C skills on material mechanical wave

Based on Figure 2 shows the results of the analysis of 4C skills on the LKS material for mechanical wave characteristics. The study results showed that the highest average percentage on the mechanical wave characteristics material was found in the critical thinking skill component, 37.45% in the less facilitating category. The lowest rate was found in the creative thinking skill component at 19.99% in the non-facilitating category. While the collaboration skills component gets a percentage of 21.87% with the type of less facilitating and the communication component receives a rate of 30.19% with the less facilitating.

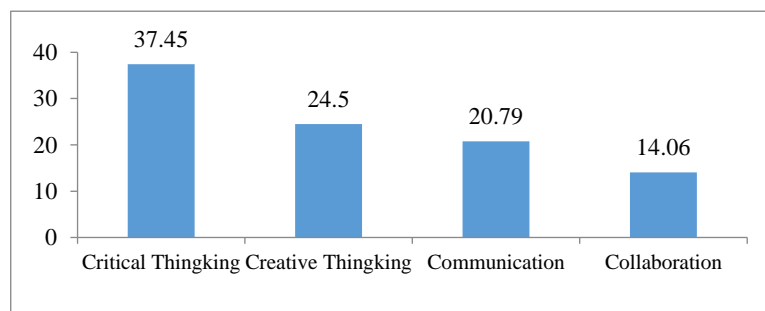
The results of the analysis of the use of 4C learning skills on traveling and stationary waves material are described in Figure 3.



**Fig. 3.** Average 4C skills on material traveling and stationary waves

Figure 3 above shows the analysis results of the use of 4C skills on the walking wave and stationary wave worksheets. The analysis results showed that the highest average percentage on traveling and stationary wave materials was found in the critical thinking skill component, 34.68% in the less facilitating category. The lowest rate was found in the collaboration skills component at 12.5% in the non-facilitating category. Meanwhile, the creative thinking skill component gets a percentage of 19.99% in the non-facilitating category, and the communication component receives a rate of 26.01% in the less-facilitating category.

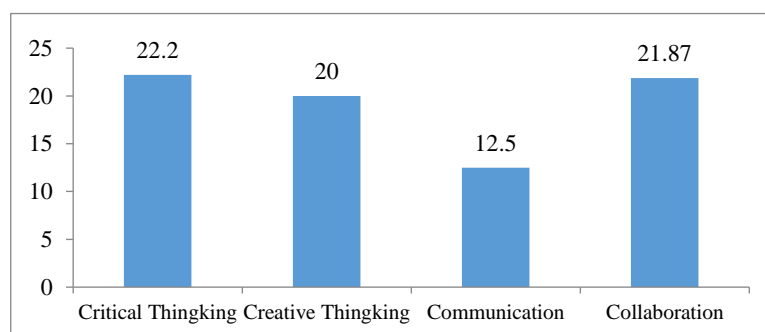
The results of the analysis of the use of 4C learning skills on traveling and stationary waves material are described in Figure 4.



**Fig. 4.** Average 4C skills on material sound waves

Figure 4 above shows the analysis results of the use of 4C skills on the sound wave material worksheet. The analysis results showed that the highest average percentage on sound wave material was found in the critical thinking skill component, 37.45% in the less facilitating category. The lowest rate was found in the collaboration skills component at 14.06% in the non-facilitating category. While the creative thinking component gets 24.5% in the less facilitating category, and the collaborative indicator component receives a percentage of 20.79% in the less facilitating category.

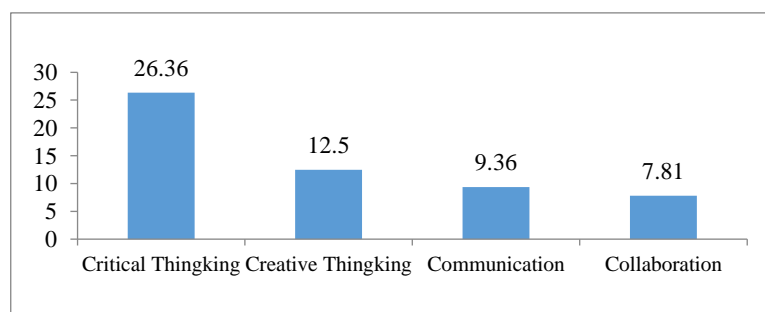
The results of the analysis of the use of 4C learning skills on traveling and stationary waves material are described in Figure 5.



**Fig. 5.** Average 4C skills on material optical instrument

Figure 5 above shows the analysis results of the use of 4C skills on the optical instrument material worksheet. The analysis results showed that the highest average percentage of sound wave material was found in the critical thinking skill component, 22.2% in the less facilitating category. The lowest rate was found in the communication skill component at 12.5% in the communication skill component non-facilitating category. While the components of creative thinking skills get a percentage of 20% in the non-facilitating category and the collaboration skills component get a rate of 21.87% with less facilitating.

The results of the analysis of the use of 4C learning skills on traveling and stationary waves material are described in Figure 6.

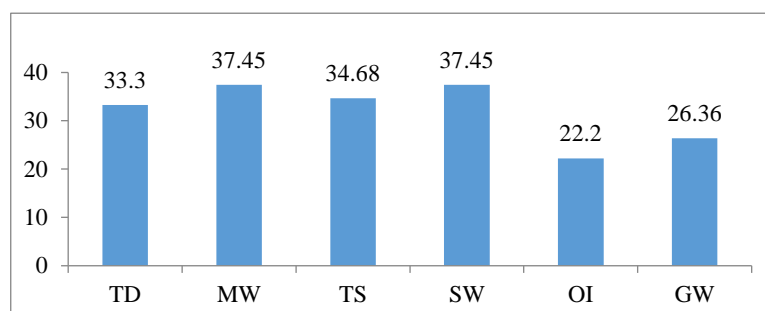


**Fig. 6.** Average 4C skills on material global warming

Figure 6 above shows the analysis results of the use of 4C skills on the optical instrument material worksheet. The analysis results showed that the highest average percentage on sound wave material was found in the critical

thinking skill component, 26.36% in the less facilitating category. The lowest rate was found in the collaboration skills component at 7.81% in the non-facilitating category. While the components of creative thinking skills get 12.5% in the non-facilitating class, the communication skills component gets 9.36% in the less facilitating category.

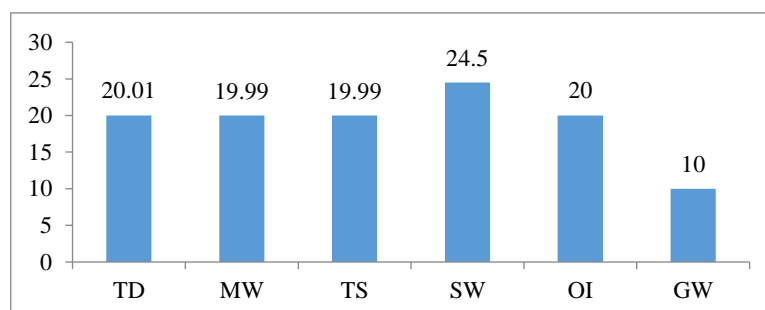
The results of the analysis of the use of 4C learning skills on the material analyzed based on each component included critical thinking skills, creative thinking skills, communication skills and collaboration skills. The results of the Student Worksheet analysis for the material for grade XI semester 2 on the components of critical thinking skills can be seen in Figure 7.



**Fig. 7.** Average percentage of critical thinking skills for each material

Based on Figure 7, it can be seen that the average percentage of critical thinking skills in each material on the Worksheet varies. The highest percentage value was obtained on the material of mechanical wave characteristics and sound waves of 37.45% with the category of less facilitating. The lowest percentage was obtained on the material of optical instruments of 22.2%, with less facilitating. In terms of thermodynamics, the rate is 33.3%, with less facilitating. On the material of travelling and stationary waves get a percentage of 34.68% with the category of less facilitating. At the same time, the global warming material receives a rate of 26.36%, with the type of less facilitating.

The results of the Student Worksheet analysis for the material for grade XI semester 2 on the components of critical thinking skills can be seen in Figure 8.

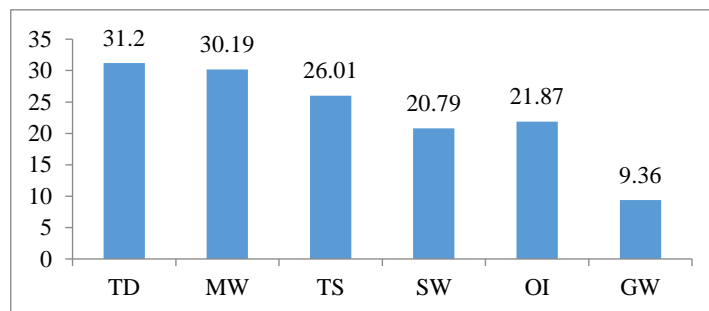


**Fig. 8.** Average percentage of creative thinking skills for each material

Based on Figure 8, it can be seen that the average percentage of creative thinking skills in each material on the Worksheet varies. The highest percentage value was obtained on sound wave material of 24.5% with less facilitating, and the lowest percentage was obtained on global warming material of 10% in the non-facilitating category. In terms of thermodynamics, the rate is 20.01%, with less facilitating. In the optical instrument material, the percentage is 20% in not facilitating. Meanwhile, the characteristics of mechanical waves and travelling and stationary waves get the exact percentage value, which is 19.99% in the category of not facilitating.

The results of the Student Worksheet analysis for the material for grade XI semester 2 on the components of critical thinking skills can be seen in Figure 9.

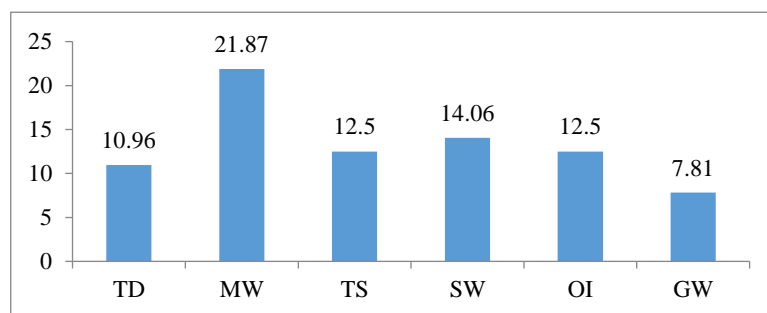




**Fig. 9.** Average percentage of communication skills for each material

Based on Figure 9, it can be seen that the average percentage of communication skills in each material on the Worksheet varies. The highest percentage value was obtained on thermodynamic material of 31.2% in the less facilitating category. The lowest percentage was obtained on global warming material of 9.36%, in the non-facilitating variety. In mechanical wave characteristics, the rate is 30.19%, with less facilitating. On the material of travelling and stationary waves get a rate of 26.51% with less facilitating. At the same time, the material for optical instruments and sound waves get a percentage value of 20.79% and 21.87% with the category of less facilitating. Communication skills are essential because communication is an activity to transfer information in writing or verbally by conveying it well. So, with communication skills, students can receive information as a whole.

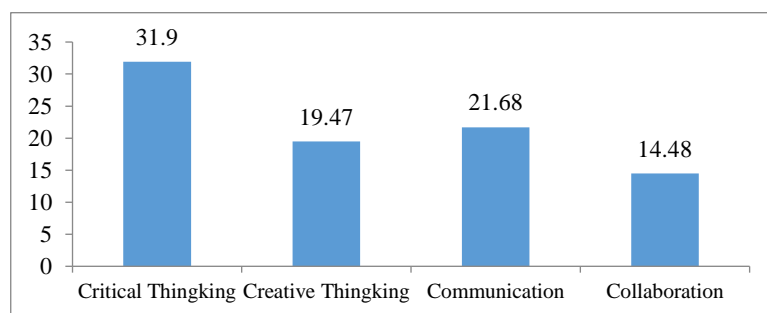
The results of the Student Worksheet analysis for the material for grade XI semester 2 on the components of critical thinking skills can be seen in Figure 10.



**Fig. 10.** Average percentage of collaboration skills for each material

Based on Figure 10, it can be seen that the average percentage of collaboration skills in each material on the Worksheet varies. The highest percentage value was obtained on the material of mechanical wave characteristics and optical devices, which was 25% in the less facilitating category. The lowest percentage was obtained for the travelling and stationary wave materials of 14.28% in the non-facilitating category. In thermodynamics, the rate is 14.62%, with not facilitating. In the sound wave material, the percentage is 16.07%, with the type of not facilitating. At the same time, the global warming material gets a value of 15.62%. Collaboration skills are essential for students because they can improve students communication skills. Collaboration is the use of communicative skills to achieve common goals, work productively with others, synergize with each other, respect others, and work as a team while generating shared ideas

The results of the analysis of the average use of 4C learning skills on the analyzed material can be seen in Figure 11.



**Fig. 11.** Average percentage of 4C skills for each component



Based on Figure 11, the average results of the analysis of the use of 4C learning skills in each 4C component obtained the highest average percentage on the critical thinking skills component, which was 31.9% with the category of less facilitating, and the lowest average rate was obtained in the collaboration skills component. 14.84% in the non-facilitating category, the creative thinking skill component gets 19.47% in the non-facilitating category. The collaboration skills component receives an average of 21.68% with the less facilitating category.

The analysis of the use of 4C learning skills on the Student Worksheets for physics students of class XI in semester 2 aims to determine the applicability of 4C learning skills in Student Worksheets, namely critical thinking skills, creative thinking skills, communication skills, and collaboration skills. The worksheets analyzed were teacher-made worksheets used by high school physics teachers in the district and city of Solok. The results of sample collection from 23 schools in Solok Regency obtained 8 schools that used Student Worksheets made by the teachers themselves.

After analyzing the content presented on the LKS related to the 4C learning skills, the assessment results on each LKS were obtained. Not all materials contain 4C learning skills well. The LKS analyzed also have advantages and disadvantages in facilitating 4C learning skills for students.

Based on the results of the analysis of the Thermodynamics material, different percentage results were obtained for the use of 4C learning skills in the contents of the Student Worksheet. Critical thinking skills are the most common skills found in Student Worksheets, while collaboration skills are the most difficult skills to find. In thermodynamics, the component that is most widely applied is the component of critical thinking skills, and the component that is least used is the component of collaboration skills. Student Worksheets on thermodynamic material require students to be more active during the learning process. Involved students in the learning process can understand the learning material optimally. However, because the use of 4C learning skills is still low in the presentation of the contents of the Student Worksheet used, the role of the teacher during the learning process is needed to be able to improve students' 4C skills.

In the material characteristic of mechanical waves and traveling and stationary waves, the component most commonly found is the element of critical thinking skills. Critical thinking skills in these two materials are very much needed because the material on the characteristics of mechanical waves and traveling waves and stationary waves requires students to use various formulas to solve problems. At the same time, the lowest component is the component of creative thinking skills for the material of mechanical wave characteristics and the component of collaboration skills for the material of traveling waves and stationary waves.

In the sound wave material, the component that is most commonly found in the element of critical thinking skills and the part that is difficult to see is the component of communication skills. This shows that communication skills have not been used maximally on the Student Worksheet, so the Student Worksheet material on sound waves is categorized as less facilitating communication skills.

The following material is optical instrument material. The component that was found the most was the component of critical thinking skills. However, if you look at it as a whole, the optical instrument material has the lowest percentage of critical thinking skills usage compared to other student worksheets. Meanwhile, the skill component that is difficult to find is the collaboration skill component.

The last material is global warming material. In global warming, the percentage of use of the 4C learning skills is low. The skill component that was found the most was the critical thinking skill component, while the lowest component was the collaboration skill component

The research results obtained are relevant for the research [14], who stated that the greatest 4c skill contained in the student's worksheet was critical thinking. In addition, the highest 4C skills contained in the student's worksheet were critical thinking skills, and the lowest was collaboration skills [2]. This indicates that critical thinking skills have been applied to the student worksheet, but overall, 4C skills have not been fully implemented.

#### IV. CONCLUSION

Student Worksheets that have the highest critical thinking skills are Student Worksheets on the characteristics of mechanical waves, travelling and stationary waves and sound waves by 37.45% with the category of less facilitating and the lowest in the material of optical instruments by 22.2% with the type of less facilitating. For creative thinking skills, the highest percentage is in the sound wave material at 24.5% in the less facilitating type and the lowest in global warming material at 10% in the non-facilitating category. For communication skills, the highest percentage is found in thermodynamic material of 31.2% with the type of less facilitating and the lowest on global warming material of 9.36% in the non-facilitating category. As for collaboration skills, the highest percentage of use is found in the material characteristic of mechanical waves and optical instruments, which is 21.87 in the less facilitating category, and the lowest rate is in global warming material at 7.81% in the non-facilitating category

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