

Integration of 4C Skills on Student Worksheets Prospective Professional Physics Teachers in West Sumatra

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Abstract. The 21st century is an era full of challenges which requires the world community to improve the way they think, learn, work and live in the world in order to keep up with the rapid progress of information technology. The aim of this research is to determine the extent of integration of 4C skills in student worksheets. This research uses a quantitative approach, with descriptive research type. The object of this research is a student worksheet on Light and Optical Instruments created by 10 prospective professional physics teachers at one of the state universities in West Sumatra. This research instrument is in the form of a questionnaire prepared based on the 4C skill indicators formulated by R.T. Kelley, etc. in the form of positive statements. Based on the analysis that has been carried out on student worksheets made by prospective professional physics teachers, it can be concluded that the content of 4C skills consisting of critical thinking skills is in the high category, while creative thinking skills, communication skills and collaboration skills are in the high category medium category. This research is expected to be able to provide information and an overview of the extent of the distribution of 4C skill content on student worksheets.

Keywords : 4C Skills, Student Worksheets, Physics

1. Introduction

The 21st century is an era full of challenges [1] which requires the world community to improve the way they think, learn, work and live in the world [2] in order to keep up with the rapid progress of information technology [3]. This skill was introduced by the National Education Association with the term 4C [4] including aspects of communication, collaboration, critical thinking and problem solving, creativity and innovation [5]. Equalization of Science and Technology (IPTEK) in the world of education [6] focuses on developing student competencies [7] as well as digitizing the use of computers and smartphones in learning [8] in order to produce capable students facing global challenges [9] and the development of the industrialization 4.0 era [10]. Anis Baswedan said that mastery of 4C skills is very important [11] especially in Indonesia [12] to create the nation's next generation who are independent, tough and able to compete according to the demands of an increasingly competitive era. and increasingly advanced technology [13]. This was also agreed by Partono through his research at the Indonesian School Den Haag (SIDH) in 2021 which implemented various learning strategies and concluded the importance of 4C competencies for the future [14].

Critical thinking skills are a cognitive process that helps self-regulation and is also related to motivational factors such as self-efficacy, expected results, task value, and goal orientation [6] regarding the ability to identify, analyze and solve a problem [15] to meet the demands of the global world [16]. Critical thinking aims to enable students to correlate learning with contextual problems found in everyday life [17]. This is characterized by the birth of an idea and the production of a product that has never existed before [18]. Munandar stated that the characteristics of creative thinking skills are thinking clearly or in detail, originality and flexibility [19]. Communication is the transfer of

information [4], both verbally and in writing [20] where each person captures each other's reactions [21]. Collaboration is in the form of the ability to work together, respect and be responsible for what one does with each other [20] which aims to ensure that students are able to create relationships and be responsible for themselves and others [15], so it has high potential for solving complex scientific problems [22].

Education is the spearhead of human resource development through improving the quality and quantity of students' mindsets. This improvement needs to be supported by building a conducive and targeted learning climate so that students have learning skills and are able to innovate through the use of technology and information media as demanded by the 21st century [10]. One of the subjects that is in line with the demands of the 21st century and is also the main pillar of the development of science and technology is physics, because this scientific discipline provides an understanding of phenomena that occur in life [23]. Learning physics requires students to do more research, experiments and practicums, so that students can build their knowledge to discover new concepts or prove the truth of a concept that has been formulated by previous experts. Apart from that, this activity also facilitates students to develop a sense of curiosity and develop a scientific attitude to become active, creative and innovative scholars [13]. Learning activities are based on how someone can store the knowledge they have acquired to change their behavior for the better [24]. The level of success in teaching and learning activities is marked by the achievement of learning indicators/goals. One of the indicators of this success is teacher competence [5].

A teacher is a professional whose main task is to educate, teach, guide, direct, train, assess and distribute students [25]. On the other hand, a teacher is also an instructor who inspires, encourages, directs, leads and ultimately becomes a role model for his students [16]. The expertise of a professional teacher will be reflected in their implementation, both in terms of material and methods [26] and can be measured by how well they understand their roles and responsibilities in the classroom [27]. A teacher's biggest responsibility is to help students achieve learning goals, so that teachers are required to be more innovative [28] through optimizing the implementation of the learning process [29]. One of the teachers' efforts in organizing optimal learning is through the provision of quality teaching materials, in order to create positive interactions between teachers and students, so that learning objectives can be realized as expected [30]. Teaching materials are tools used by educators to convey lesson material to students [31] with the aim of making learning more realistic, interesting and practical [23]. One strategy that teachers can use to activate students' role as students is through implementing student worksheet as teaching materials [32].

Interesting and systematic student worksheet can stimulate students to discover concepts through individual and group activities [10], as well as assist teachers in managing and monitoring the learning process in order to realize learning goals through improving students' process skills and scientific attitudes [30]. This statement is strengthened by several studies that highlight the positive impact of implementing student worksheets, as carried out by Asrizal, et al in 2019 [33] in movement material and proven to improve student learning outcomes. Three years later, Asrizal et al again conducted research on the implementation of STEM-integrated student worksheet [31], accompanied by Havid and Yulkifli who integrated the Inquiry Based Learning model [1]. However, in reality, the student worksheets format available in schools is not in accordance with the 2008 Ministry of National Education regulations [30] and does not meet the learning needs and requirements of the 2013 curriculum [13]. Among the many studies, no one has carried out an analysis and study regarding the 4C skill indicators on student worksheets used by teachers in the learning process. Therefore, the aim of this research is to measure the integration of 4C skills in student worksheets created by future teachers, namely prospective professional physics teachers. This research is expected to be able to provide information and an overview of the extent of the distribution of 4C skill content on student worksheets.

2. Method

This research uses a quantitative approach, with a type of descriptive research, namely research that describes real or engineered phenomena [6]. The object of this research is a student worksheet on Light and Optical Instruments created by 10 prospective professional physics teachers at one of the state universities in West Sumatra. Analysis of the Student Worksheets was carried out by the researchers themselves using research instruments in the form of questionnaires prepared based on the 4C skill indicators formulated by R.T. Kelley [34] in the form of a positive statement using a Likert scale [35] with the following details:

Table 1. Indicators of 4C skills.

<i>Critical Thinking Skills (C-1)</i>	
1	Student worksheet provides space for students to be able to recognize their own and group limitations
2	Student worksheet provides space for students to be able to evaluate someone's argument (both in person and online)
3	Student worksheet provides space for students to be able to provide feedback on someone's argument (both in person and online)
4	Student worksheet provides space for students to be able to convey explanations (both in person and online)
5	Student worksheet provides space for students to be able to summarize the quality of information (both in person and online)
6	Student worksheet provides space for students to be able to understand how to use knowledge from one situation to another
7	Student worksheet provides space for students to be able to understand questions asked by other people (both in person and online)
8	Student worksheet provides space for students to be able to ask questions to clarify something (both in person and online)
9	Student worksheet provides space for students to be able to interpret information (both directly and online)
<i>Creative Thinking Skills (C-2)</i>	
1	Student worksheet provides space for students to be able to produce ideas clearly (both in person and online)
2	Student worksheet provides space for students to be able to produce original ideas (both in person and online)
3	Student worksheet provides space for students to be able to answer problems with many alternative solutions (both face to face and online)
4	Student worksheet provides space for students to be able to find sources of information to solve problems (both directly and online)
5	Student worksheet provides space for students to be able to apply existing knowledge in solving a problem
6	Student worksheet provides space for students to be able to create new and unique products
<i>Communication Skills (C-3)</i>	
1	Student worksheet provides space for students to be able to use the right tools/media to increase knowledge (both face to face and online)
2	Student worksheet provides space for students to be able to use formal communication styles (both face to face and online)
3	Student worksheet provides space for students to be able to listen actively when other people speak (both in person and online)
4	Student worksheet provides space for students to be able to present all information clearly, concisely and logically (both in person and online)
5	Student worksheet provides space for students to be able to use formal body language during presentations
6	Student worksheet provides space for students to be able to answer questions clearly and concisely (both face to face and online)

Collaboration Skills (C-4)

- 1 Student worksheet provides space for students to be able to share the work of group members fairly
- 2 Student worksheet provides space for students to be able to help groups solve problems (both directly and online)
- 3 Student worksheet provides space for students to be able to provide useful feedback to team members (both in person and online)
- 4 Student worksheet provides space for students to be able to review the team's progress in completing assignments (both in person and online)
- 5 Student worksheet provides space for students to be able to solve problems without asking the teacher for help
- 6 Student worksheet provides space for students to be able to recognize and respect the opinions of group members
- 7 Student worksheet provides space for students to be able to act according to their roles
- 8 Student worksheet provides space for students to be able to be polite and kind to teammates (both in person and online)
- 9 Student worksheet provides space for students to be able to discuss in groups for decision making (both face to face and online)
- 10 Student worksheet provides space for students to be able to use their time efficiently
- 11 Student worksheet provides space for students to be able to discuss and complete assignments on time (both in person and online)
- 12 Student worksheet provides space for students to be able to offer assistance to others when needed
- 13 Student worksheet provides space for students to be able to complete assignments without having to be reminded

Code 'SS' for highly appropriate information (score 5), 'S' for appropriate information (score 4), 'R' for underestimating information (score 3), 'TS' for inappropriate information (score 2) and 'STS' for very inappropriate information (score 1). After accumulating scores based on the analysis carried out on the contents of the Student Worksheet, the calculation results will be interpreted in various categories as shown in table 2.

Table 2. Interpretation of scoring.

No	Score	Categories
1	0-20	Very Low
2	21-40	Low
3	41-60	Medium
4	61-80	High
5	81-100	Very High

3. Result and Discussion

3.1 Critical Thinking Skills (C-1)

From the analysis carried out on the student worksheet made by 10 prospective professional physics teachers based on 9 indicators critical thinking skills, the following results were obtained :

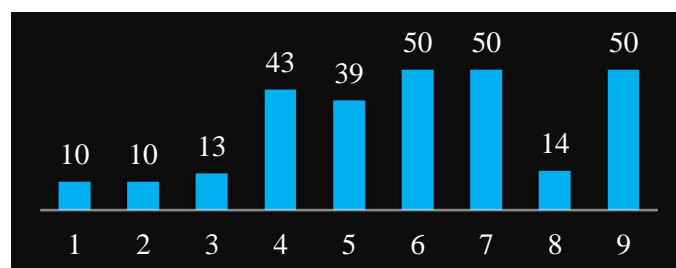


Figure 1. Scoring of critical thinking skills.

In critical thinking skills, the lowest scores are in indicators 1, 2, 3 and 8. Where almost all Student Worksheet do not provide space for students to evaluate their own and group abilities (indicator 1), which should be marked by a pre-test. On the other hand, Student Worksheet also does not provide space for students to evaluate (indicator 2) and provide feedback (indicator 3) on someone's argument, which should be marked by a triggering statement to stimulate students. Lastly, almost all Student Worksheet do not provide space for students to ask questions and clarify things related to what they want to understand (indicator 8).

Data processing on the total score on the C-1 indicator is:

$$C_1 = \frac{Skor_{total}}{Skor_{maks}} \times 100$$

$$C_1 = \frac{279}{450} \times 100 \quad (1)$$

$$C_1 = 62$$

Indicator C-1 shows the number 62, which means that the content of critical thinking skills in the Student Worksheet made by prospective professional physics teachers is in the high category.

3.2 Creative Thinking Skills (C-2)

From the analysis carried out on the student worksheet made by 10 prospective professional physics teachers based on 6 indicators creative thinking skills, the following results were obtained:

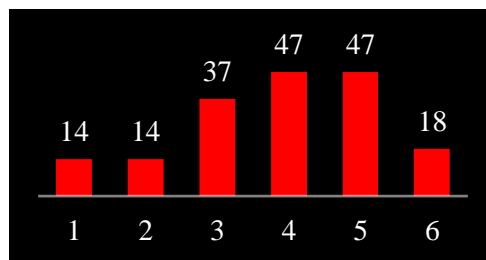


Figure 2. Scoring of creative thinking skills.

In creative thinking skills, the lowest scores are in indicators 1, 2 and 6. Student Worksheet does not provide space for students to express clear ideas (indicator 1) and original (indicator 2) in order to produce new and unique products (indicator 6). In fact This can be realized by integrating project-based learning (PJBL) in Student Worksheet, so that students have creative power even though they start from simple work first.

Data processing on the total score on the C-2 indicator is:

$$C_2 = \frac{Skor_{total}}{Skor_{maks}} \times 100$$

$$C_2 = \frac{177}{300} \times 100 \quad (2)$$

$$C_2 = 59$$

Indicator C-2 shows the number 59, which means that the content of creative thinking skills in the Student Worksheet made by prospective professional physics teachers is in the medium category.

3.3 Communication Skills (C-3)

From the analysis carried out on the student worksheet made by 10 prospective professional physics teachers based on 6 indicators communications skills, the following results were obtained:

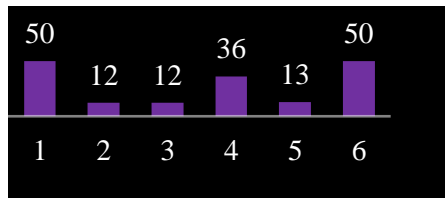


Figure 3. Scoring of communication skills.

In communication skills, the lowest scores were on indicators 2, 3, and 5. Almost all of the Student Worksheet analyzed did not provide explicit instructions for presenting their understanding in class forums, so measuring presentation patterns in class was difficult to measure. This should be overcome by providing clear guidelines regarding systematics, ethics and presentation assessment rubrics in class.

Data processing on the total score on the C-3 indicator is:

$$C_3 = \frac{Skor_{total}}{Skor_{maks}} \times 100$$

$$C_3 = \frac{173}{300} \times 100 \tag{3}$$

$$C_3 = 57,7$$

Indicator C-3 shows the number 57.7, which means that the communication skills content on the Student Worksheet made by prospective professional physics teachers is in the medium category.

3.4 Collaboration Skills (C-4)

From the analysis carried out on the student worksheet made by 10 prospective professional physics teachers based on 13 indicators collaboration skills, the following results were obtained:

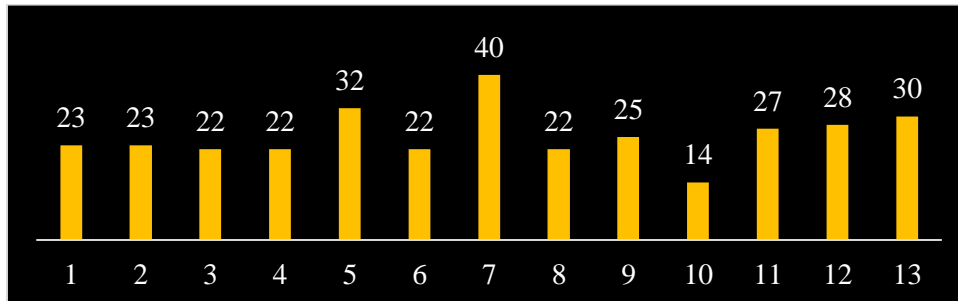


Figure 4. Scoring of collaboration skills.

In collaboration skills, the lowest score is indicator number 10. Almost all Student Worksheet do not provide a clear time allocation regarding the stages that must be passed in learning. In general, Student Worksheet also does not provide clear rules regarding group rules, including division of work, ethics and the role of each group member.

Data processing on the total score on the C-1 indicator is:

$$C_4 = \frac{Skor_{total}}{Skor_{maks}} \times 100$$

$$C_4 = \frac{330}{650} \times 100 \tag{4}$$

$$C_4 = 50,8$$

Indicator C-2 shows the number 50.8, which means that the collaboration skills content on the student worksheet created by prospective professional physics teachers is in the medium category.

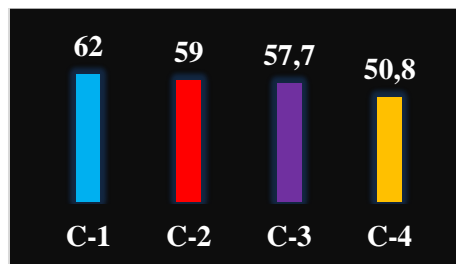


Figure 5. 4C skills measurement results.

From the graph above, it can be seen that the order of 4-C skills content on the Student Worksheet made by prospective science teachers from highest to lowest is critical thinking skills (C-1) with a score of 62 in the high category, creative thinking skills (C-2) with a score of 59 is in the medium category, communication skills (C-3) with a score of 57.7 is in the medium category and collaboration skills (C-4) with a score of 50.8 is in the medium category.

4. Conclusion

Based on the analysis that has been carried out on student worksheets made by prospective professional physics teachers, it can be concluded that the content of 4C skills consisting of critical thinking skills is in the high category, while creative thinking skills, communication skills and collaboration skills are in the high category. medium category. Critical thinking skills (C-1) is the highest skill, while collaboration skills (C-4) is the lowest skill contained in the student worksheet created by 10 prospective physics teachers at one of the State Universities in West Sumatra.

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