Optimize scientific communication skills on work and energy concept with implementation of interactive conceptual instruction and multi representation approach

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Abstract. The ultimate goal of learning in the curriculum 2013 is that learning must improve and balance between soft skills and hard skills of learners. In addition to the knowledge aspect, one of the other skills to be trained in the learning process using a scientific approach is communication skills. This study aims to get an overview of the implementation of interactive conceptual instruction with multi representation to optimize the achievement of students’ scientific communication skills on work and energy concept. The scientific communication skills contains the sub-skills were searching the information, scientific writing, group discussion and knowledge presentation. This study was descriptive research with observation method. Subjects in this study were 35 students of class X in Senior High School at Sumedang. The results indicate an achievement of optimal scientific communication skills. The greatest achievement of KKI based on observation is at fourth meeting of KKI-3, which is a sub-skill of resume writing of 89%. Allmost students responded positively to the implication of interactive conceptual instruction with multi representation approach. It can be concluded that the implication of interactive conceptual instruction with multi representation approach can optimize the achievement of students' scientific communication skill on work and energy concept.

1. Introduction
The ultimate goal of learning in the curriculum 2013 is that learning must be able to improve and balance between soft skills and hard skills of learners. These skills are includes attitude, skills and knowledge aspects. In addition to the knowledge aspect, one of the other skills to be trained in the learning process using a scientific approach is communication skills. This is clearly listed in the learning steps of observing, asking, trying, reasoning, creating and communicating.

The skills of communicating science are trained to the students to make students can express scientific ideas they have. It is disclosed that there is an increase in the average mastery of student physics concepts resulting from the influence of science communication skills [1]. The importance of student communication in physics learning can change the learning situation towards the better so that the interaction between students with students, students with teachers and students with the environment in conveying the process of thinking. The knowledge that students have actively formed is not only passively accepted by the teacher but also must communicate their thought processes both orally and in writing [2].
Communication is an important part of scientific activity, especially in scientific activities in the field of science. Science is referred to as new ideas, concepts, experiments or products that are in one way or another acquired and tested according to methods known and acceptable to society in general [3]. Communicate about science also allows scientists to share insights into the nature of the world [4]. The meaning of scientific knowledge is not only built by internal quality or the resulting method, but it depends on how scientific knowledge can be communicated [5].

Science communication in physics learning emphasizes learning to understand and learn the scientific language through the application of learning principles, namely: assessing initial understanding, linking facts with conceptual frameworks, metacognitive monitoring, establishing performance, and providing feedback [6]. The study of physics in the concept of communication is the transfer of knowledge and methods into the minds of others [7]. Another thing is explained that an important element of learning physics is to understand concepts and experimental steps and can communicate that knowledge. The statement shows that, physics learning in addition to learning knowledge and conducting experimental activities, it is also necessary to be able to communicate that knowledge. Communication related to scientific activities is also referred to as communication science or scientific communication.

Based on the results of interviews with one of the physics-related teachers, one of the obstacles felt by teachers is the lack of ability to communicate students orally. Students are difficult to communicate so that teachers feel difficulty in carrying out the method of discussion because not all students have good communication skills and courageous and active in discussing and expressing opinions. Some factors that cause this problem arise due to several things, namely: 1) Teachers rarely give demonstration of a phenomenon and practice related to the material being taught, 2) Availability of tools in the laboratory that is not too complete so that teachers are constrained in practicing the practicum, 3) trained students in solving calculation problems without giving prior cultivation and reinforcement, and 4) Teachers rarely do group discussions so students are not accustomed to verbal communication. If in the learning of passive students and communication interaction is low, then the difficulties experienced by students about the material being taught will not be obvious. This will certainly affect the students themselves in understanding the concept and solve the physics problem. The success of students in learning activities can be seen from the level of understanding and mastery of the given material and the ability of students in communicating ideas to solve existing problems [8].

Referring to the above problems, then it should be applied a conceptual learning for high school students. The expected learning is the learning of physics that can train students’ scientific communication skills. An alternative lesson that can be emphasized is interactive conceptual learning. Interactive conceptual instruction (ICI) is a learning that has four characteristics: focusing on conceptual focus, prioritizing classroom interactions, using research-based materials, and using text (use of texts) [9]. The use of multi representation approach learning is also intended to be able to trained students' scientific communication skills. In scientific communication skills there are sub-skills that according to classify the ability to communicate to: 1) searching information; 2) scientific reading; 3) listen and observe; 4) scientific writing; 5) represent information; and 6) Knowledge presentation. Scientific communication skills are intended is the ability of students to communicate the concept and are understood both verbally and non-verbally but still in the context of physics learning [10].

2. Methods
This research was conducted on 35 students class XI in one of SMA Negeri in Sumedang, West Java academic year 2016/2017. Each student was observed by three observers with 2 cameras to record the classroom learning process. This research uses descriptive research to find out the optimizing achievement of scientific communication skills on work and energy concept. The observation data analysis is done descriptively by calculating the percentage of the total score of students from every observed aspect of performance then categorizing the students' scientific communication skills.

In this study, researchers took only five aspects of scientific communication skills. Aspects of scientific communication skills to be selected to be measured through the process of physics learning
are 1) searching information; 2) scientific writing; 3) group discussion; 4) represent information, and 5) knowledge presentation [11]. The application of interactive conceptual learning with multi-representation approach is done through four stages: 1) orientation stage that is directing students to the subject matter and learning objectives through apperception and motivation, 2) stage of conceptualization with multi-representation that is reveal, construct and reconstruct student conception with multi-representation, 3) strengthening the concept of strengthening the concept continuously through experimentation, problem solving exercises in different contexts using multi-representation, and 4) stage review that review the concepts learned and follow-up. The assessment of communication skills in physics learning uses an observation sheet consisting of several indicators of achievement on each aspect of scientific communication skills. Based on test result with test-retest obtained that reliability of scientific communication skill test equal to 0.88 with very high category.

3. Results and Discussion

3.1. A subsection

The students' scientific communication skills observed include: 1) searching for information through references to references; 2) group discussion; 3) Arrange the resume according to the guidelines (writing); and 4) Communicate the report orally (presentation). Each component or aspect of the scientific communication skill is shown by each indicator of achievement in work and energy learning activities. Table 1 below show that the category of scientific communication skills values.

| Value     | Category          |
|-----------|-------------------|
| ≥81       | Very skilled      |
| 66 – 80   | Skilled           |
| 46 – 65   | Enough skilled    |
| ≤45       | Less skilled      |

Table 1. Category of scientific communication skills values

The following is the data of scientific communication skill achievement based on the categorization results in table 1 listed earlier.

| Learning Meeting | Percentage of Observation Results (%) |
|------------------|---------------------------------------|
|                  | KKI-1          | KKI-2          | KKI-3          | KKI-4          |
|                  | VS  S  ES  LS  | VS  S  ES  LS  | VS  S  ES  LS  | VS  S  ES  LS  |
| I                | 64  21  6   9  | 15  21  0   64  | 45  39  9   6  | 36  0   0   64  |
| II               | 65  26  3   6  | 44  9   18  29  | 35  29  15  21  | 24  18  12  47  |
| III              | 71  29  0   0  | 34  26  31  9  | 80  14  0   6  | 40  34  14  12  |
| IV               | 78  6   3  13  | 44  41  13  3  | 81  19  0   0  | 31  34  34  0   |

Note : VS = Very skilled
S = Skilled
ES = Enough skilled
LS = Less skilled

Table 2. Data of Scientific Achievement Communication Skills Students by Category
3.2. Discussion

The students’ scientific communication skills are measured through observations made by two observers who make regular observations during the learning process. In addition, there are two cameras used in the learning process so that for some aspects of scientific communication skills are overlooked by observers who do not observe some students. The students’ scientific communication skills are seen through student activities either individually or in groups. In the group division, students already with active and inactive division of students are scattered within each group. It is also assisted by the physics teacher concerned given that physics teachers know more about the activities of each student during the other physics learning process. Group X class MIA 1 is divided into 6 groups with each group consisting of 5-6 people.

Based on the observation in the class, the highest percentage of achievement of scientific communication skill is found in KKI-1, that is 82%, the students bring some adequate reference sources according to what they used during the previous physics lesson. Most students fall into the highly skilled category with a percentage of 64%. The second largest percentage of achievement is KKI-3 of 76% through indicator that is students make resume according to writing guidance. A percentage of 45% of students fall into the highly skilled category for writing material resumes. This data indicates that most students have made a resume in accordance with the guidelines for writing a resume provided only the students’ quality of the discussion and completeness of the material presented students through a varied resume. According to Santrock (2008) states thinking reasoning and arguing skills can strengthen the skills of scientific communication. Critical thinking and scientific communication can be developed through field activities or inquiry laboratory projects, by assigning students to report scientifically. But in this case, students only make resumes as a form of one form of students' notes in absorbing knowledge about energy-energy material through teacher concept planting and discussion conducted in groups.

The percentage of different outcomes of scientific communication skills is shown in KKI-2 and KKI-4 by 33% and 31%. This is due to the fact that very few students contribute to group discussions so that some sub-skills of scientific communication cannot be measured through observation of classroom learning activities. At the first meeting, students who are not active are more relied on some other students who are more contributing in the group. Based on the results of interviews with the physics teacher concerned that the students' previous learning was accustomed only to the lesson using the lecture method and working on the problem. The teaching by telling method is not very effective for the students so that the students tend to be passive or no interaction of learning communication between students and teachers, so that the students become passive and afraid to ask, opinions, and working on
the board [12]. So at the first meeting, students are still difficult to adjust to follow the learning stage with interactive conceptual context.

The results of the percentage achievement in each of these scientific communication skills show that, students have increasingly skilled scientific communication skills. In order for students to learn independently, they must be able to apply high-level skills successfully [13]. However, some researchers and educators claim that students' abilities and abilities develop spontaneously throughout the various learning experiences during their studies [14]. Others claim that skills development can only be achieved through explicit, guided, and well-planned learning opportunities. Most studies do not support the first approach to acquiring spontaneous skills. In fact, such research shows that students find it difficult to get their own skills and therefore require direct supervision and instruction [15]. Thus, teachers need to equip with learning methods and materials that foster adequate skill development.

Associated with the implementation of learning, students get multi-representation of multi-represent conception during the learning process of work and energy concept. Multiplication-assisted conceptualization is applied through demonstrations, Phet (image and graphic) simulations which ultimately lead students to fill questions related to work and energy representation through ALPS (active learning problem sheets). One of the supporting media used by researchers in instilling the concept of work and energy in students. At the stage of conceptualization, students are asked to make a translation a representation of the concept of potential energy springs into other representational forms of verbal, graphic, mathematical equations as well as energy bar charts. In its implementation, students are given the opportunity to use this virtual simulation in their respective groups and be guided by each observer. Directly, students can see and understand what energy is in the spring during the up and down movement and know the energy of each bigger through the bar chart. After going through the stages, students are also given reinforcement of the concept through mini quizzes that support the deepening of students' ability to represent each of their answers in various representations.

This is understandable given the use of various representations in a conceptual explanation can help facilitate students in understanding the concept. When using a representation, if the students' concept of understanding is not good, then the use of other representations will help to understand students about the concept. Thus understanding students' concepts will be more profound. Multiple representation can support the construction of a deeper conceptual understanding. In the context of applying learning to all students, the use of multi-representation is also very supportive [16]. As has been previously stated that each learner has a different specific capabilities with each other, there is a more prominent verbal ability, there is a more prominent spatial and quantitative abilities, and even more prominent visual and graphic abilities. The appearance of various representations in the explanation of a concept will certainly give each student the opportunity to understand the concept of various representations in accordance with the specific capabilities [17].

4. Conclusion
The achievement of students' scientific communication skills based on observations generally increases at each meeting. The greatest achievement of KKI is at the fourth meeting of KKI-3 which is a sub-skill of resume writing of 89%. Implication based on the findings in this study is to achieve optimal results from the application of interactive conceptual learning with multi representation approach is necessary to practice scientific communication skills to familiarize students in discussions, resume writing, presentations and others. Another thing to note is the effective time conditioning in the implementation of the learning process. Because the learning steps during concept-building activities through demonstrations and group discussions take considerable time to enable students to explore the skills of understanding and communication skills.

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