Scientific communication skills on mechanical wave concept using student facilitator and explaining model assisted schoology

L Hakim\textsuperscript{1} and F Alatas\textsuperscript{1}

\textsuperscript{1}Universitas Islam Negeri Syarif Hidayatullah Jakarta, Indonesia

E-mail: fathiah.alatas@uinjkt.ac.id

Abstract. This research aims to find out the improvement and achievement of students' scientific communication skills on the concept of mechanical waves using a cooperative model of student facilitator type and explaining assisted schoology. The research was conducted in the 2019/2020 school year in Man 2 Bekasi City. The sample taken was XI MIPA 3 as many as 34 students. The research method used pre experiment with the research design of the one group pre-test post-test design, sampling technique using purposive sampling. The instrument used is a test instrument in the form of an essay question as many as 9 questions and a non-test instrument to see the scientific communication of students at each meeting. The N-gain results, on the scientific communication skills (SCS) of students to find back relevant information from sources that have been read have the greatest increase. Then, based on the non-test results, it was found that the achievement of students' scientific communication skills had increased in communicating reports orally (presentations).

1. Introduction

One of the skills required in the 21\textsuperscript{st} century is scientific communication skills\cite{1}. The demands of the times require communication skills, communication used in educational basics such as correct speech, smooth reading, and clear writing as found in the indicators of scientific communication skills\cite{2}. SMA/MA physics payload competency requires scientific communication skills, to present and record results in the form of charts and tables and report them in writing or oral\cite{3}. In the process of learning physics should be designed to develop the competence of social and communication skills\cite{4}. The lack of scientific communication skills that students lack, makes it difficult for students to communicate, making it difficult for teachers to carry out discussion methods because not all students have good communication skills and are courageous and active in discussing and expressing opinions\cite{5}.

In a pandemic that uses only online learning to make students passive and the lack of interaction between students and teachers, the need for student interaction in the process of learning physics in order to build a close relationship between students and teachers so as to train students' communication skills\cite{6}. Observations and preliminary studies in the field show that the process of learning physics uses conventional models so that there is no discussion and interaction between students and teachers. Based on preliminary study questionnaires students consider that physics is a lesson that requires scientific communication skills. This is evidenced in the poll results of many students who cannot represent information into charts. Especially on mechanical waves, where
students are on this material. Although the phenomenon of mechanical waves can be found in everyday life[7]. According to Kennedy & De Bruyn the difficulty that occurred was understanding the concept of fast propagation and super wave position[8].

In order to gain an overall understanding in wave material, students' scientific communication skills are required in obtaining material parsing, concept study and relationship between concept sections to obtain proper understanding and understanding of the overall meaning[9]. In order to improve students' communication skills, a learning process is needed that is oriented towards discussing and expressing opinions[10]. Previous research has concluded that learning using the student facilitator and explaining model affects student activities such as daring to express opinions, actively participating students and solving problems by discussing, ideas and answering questions from teachers and friends[11]. Students are given the opportunity to express their ideas and opinions in response to concerns on the use cooperative models of student facilitator and explaining (SFE). SFE implemented activity-based learning so that students could actively participate and solve problems in the concept of mechanical waves. The expected learning is physics learning that can train students' communication skills.

Scientific communication skills are taken based on Ornit et.al (2008) both verbal and non verbal abilities in the context of physics learning[13]. The process of distance learning requires proper information and communication technology to facilitate communication and interaction between educators and students[14]. One of the interesting, and easy to use e-learning is schoology[15]. In previous research students who used e-learning schoology had higher learning outcomes and motivation levels compared to other e-learning uses[16].

2. Methods
This research uses a pre-experiment method with a one-group pretest-posttest design design. The study used a single class of experiments. Research in this design was created to look at the early scientific communication skills of students, then given the application of cooperative models of student facilitator type and explaining assisted schoology.

The population in this study is all students of grade XI MIPA MAN 2 Bekasi. The sample in this study used class XI MIPA 3 with a total of 34 students divided into 6 groups with each group consisting of 5-6 people. Students' scientific communication skills are measured through observations made by one observer in each group, and observations are made during the learning process using observation sheets. Students' scientific communication skills are seen through student activities both individually and in groups. Active and inactive students are spread across each group. Sampling techniques using purposive sampling with the help of physics subjects teachers. It is also assisted by the teacher of the physics subject in question, the physics teacher knows more about each student's activities during the physics learning process. Instrument trial results get 0.8 test reliability with very high category[17].

The achievement of students' scientific communication skills at each meeting is seen based on the calculation of nontest in the form of assessments from the observer in the learning process. The data is calculated using formulas

\[
\text{Score} = \frac{\text{score earned}}{\text{maximum score}} \times 100
\]  

(1)

Then categorized with criteria 91-100 highly skilled, 71-90 skilled, 61-70 quite skilled, and < 61 less skilled[18]. After the data is processed then categorized with these criteria and seen the achievement of the scientific communication skills of students each meeting.

To determine the improvement of students' scientific communication skills, n-gain tests are used on pretest and posttest results. Calculate normalized Gain score based on formula according to Hake using formulas

\[
N - \text{Gain} = \frac{\text{Score Posttest} - \text{Score Pretest}}{\text{Score Max} - \text{Score Pretest}} \times 100
\]  

(2)
3. Results and Discussion

3.1. Achievement of Students' Scientific Communication Skills (SCS) at Every Meeting

The students’ scientific communication skills (SCS) achievement using the observation sheet was assessed by the observer in each group. Indicators of students' scientific communication skills (SCS) are: 1) seeking information through references (scientific reading) & (information retrieval) (SCS 1); 2) group discussion (listening and observing) (SCS 2); 3) make conclusions based on guidelines (scientific writing) (SCS 3); 4) communicate the report orally (presentation) (knowledge presentation) (SCS 4). The results of the non-test calculation of students' scientific communication skills assessed by the observer were then classified on each SCS indicator. The results of the SCS achievements can be seen in Table 1.

| Indicator | Meet, 1 Classification | Meet, 2 Classification | Meet, 3 Classification |
|-----------|------------------------|------------------------|------------------------|
| SCS 1     | Less Skilled           | Less Skilled           | Quite Skilled          |
| SCS 2     | Quite Skilled          | Quite Skilled          | Skilled                |
| SCS 3     | Less Skilled           | Quite Skilled          | Skilled                |
| SCS 4     | Quite Skilled          | Skilled                | Skilled                |

Based on Table 1 above, at the first meeting, students’ average communication skills were in the less skilled category because students were not maximized and were still adapting to the use of schoology, so there were students who had difficulty when they wanted to start discussions.

The highest percentage of scientific communication skills is found in SCS 4, which is 78% in the third study. This is because at this stage of the presentation students are encouraged when viewing the results of presentations from other groups in an interesting schoology discussion group using a voice power point or video screen cam so that the group that at the first and second meeting only displays the presentation in handwriting or when at the third meeting tries to make an interesting presentation. This is in line with the advantages of the Student Facilitator and Explaining cooperative model which is to encourage students to be the best at explaining the material[20].

The percentage of different results is found in SCS 1 or looking for information by 66% with a fairly skilled category at the third meeting. The downside is that the SCS indicator 1 looks for information from references to low references because students only use references in the form of package books[21]. This is because students only use the learning resources they used during previous physics lessons such as school textbooks or internet resources and have not used journals or university textbooks.

3.2. Improved Scientific Communication Skills (SCS) of Students

Test instruments using indicators: 1) rediscover relevant information from read sources (SCS 1); 2) make conclusions based on phenomena or experiments (SCS 3); 3) represents information in the form of tables, graphs, and concept maps (SCS 5). Based on the results of analysis of student pretest and posttest data, improved scientific communication skills can be seen using the N-Gain test. Calculation results can be seen in Table 2.
Table 2. SCS improved.

| SCS Indicators | Score | N-Gain | Category |
|----------------|-------|--------|----------|
|                | Pretest | Posttest | Maximum |        |
| SCS 1          | 404    | 471    | 510      | 0.63   | Medium  |
| SCS 3          | 146    | 262    | 340      | 0.60   | Medium  |
| SCS 5          | 360    | 495    | 680      | 0.42   | Medium  |

The results of the N-Gain test showed that there was an improvement in the overall SCS in the moderate category. The problem in SCS indicator 1 which contains the application of contextual concepts where students are required to link events in daily life with concepts based on references that students have read. Based on the posttest results, the student's answer already uses the correct wave properties i.e. diffraction and explained that the gap as the source of the wave. This is because in the discussion stage students are given contextual videos related to the concept of waves and given questions from the video. In line with the research of Dwi Wahyuninget al. (2016), so it will produce meaningful learning, where the element of learning is meaningful through the association of material learned with materials in daily life [22].

The lowest increase occurred in the SCS 5 indicator which is the representation of information of 0.42. The problem in the SCS 5 indicator requires students to represent information in the form of graphs, tables, and concept maps. At pretest most students are less conscientious and do not write variables on the chart as well as the table is not explained by the unit. This indicator requires focus, and precision so as not to get it wrong when reading or writing charts [23]. When posttest students already use clear units and variables x and y are given information, this is because students can already represent information from experiments or phenomena in the form of charts and tables. Representation is instrumental in helping to understand a concept, and can also improve communication skills [24].

The relationship between the student facilitator and explaining model stages and the scientific communication capabilities in the mechanical wave concept in Table 3.

Table 3. Relationship model student facilitator and explaining, scientific communication skills, and mechanical wave concept.

| SFE Model          | Scientific Communication Skills                                      | Mechanical Wave Characteristics Concept |
|--------------------|---------------------------------------------------------------------|----------------------------------------|
| Delivering Competencies | Listening and Observing (SCS 2)                                     | Students are given a stimulus in the form of learning objectives that must be achieved at each meeting regarding the characteristics of mechanical waves. |
| Show Material      | Scientific Reading and Information Retrieval (SCS 1)                | Students are welcome to use Phet experiments then search and find relevant information from the mechanical wave characteristic experiments that have been conducted. |
| Students presenting | Knowledge Presentation (SCS 4)                                      | Students presented information related to the results of the wave characteristic experiment that has been conducted. |
| Concluding Ideas   | Scientific Writing (SCS 3)                                          | Students write and compare their own group results with others from presentation results. |
Explaining The Material that has been submitted Information Representation (SCS 5) Students represent the information the teacher provides in the form of tables, graphs, and concept maps.

Table 3 describes the relationship of SFE models, scientific communication capabilities, and the concept of mechanical waves. SFE's student-oriented model stages can assist students in improving scientific communication skills in understanding the concept of mechanical wave characteristics. In an active and student-centered learning process can help build students' scientific communication skills[25]. In previous research, learning using student facilitator and explaining models that were not followed by experiments and conceptual materials, then the number of observers was only one in the assessment of the learning process[26]. In this study using conceptual material then experiments on each student worksheet, then there was one observer who observed the discussion in each group. Implementation SFE model, there are advantages and disadvantages as in Table 4.

Table 4. Advantages and disadvantages of applying student facilitator and explaining model to scientific communication skills.

| SCS | Advantages of Students | Disadvantages of Students |
|-----|------------------------|--------------------------|
| Scientific Reading and Information Retrieval | Students search for information and discover new information from the internet or textbooks. | Students only use the internet such as Wikipedia and blogspot in using information. |
| Listening and Observing | Students can be given a stimulus in the form of a video about the phenomenon of mechanical waves in everyday life. | Not all students like learning using video. |
| Scientific Writing | Students write experiment results according to procedure and analyze experiment results. | Students rely solely on smart students to write experiment results and analyze experiments. |
| Knowledge Presentation | Students can dare to present the results of the experiment. | There are students who are passive and do not make presentations. |
| Information Representation | Students can analyze the information and then represent it into graphs, tables, and concept maps. | There are students who are still misrepresenting information in the form of graphs and tables. |

Based on Table 4, can be seen scientific communication skills are also defined as the ability to speak, read, and write about science. This ability requires special understanding and ability to describe and present their knowledge to others[27]. There are some students who still use blogspot in the search for information on the internet, do not use e-books or other reliable sources. There is an exchange of information during discussions because students have different sources of reading, according to previous research that the student facilitator and explaining (SFE) learning model is a learning model that can motivate students in learning so that students are actively involved in learning and increase student confidence, as well as encourage students to exchange more in-depth information[28]. Then from the provision of video links wave phenomenon in everyday life there are some students who have not opened the video, as evidenced at the time of the discussion there are some students who do not know the video shown. Meanwhile, students can be motivated to relate what they learn to their daily...
lives if the teaching approach is student-centered by supporting their development as independent learners[29]. In scientific writing indicators because it only collects one sheet containing the results of experiments and analyzes them students in the group rely on only one student in writing. There are some students who are passive at the first meeting to be active in conveying the results of the discussion but there are students who do not deliver the results of the discussion due to limited presentation time. Another study stated that students who had used the SFE-type cooperative model had a 51.83% increase in speaking courage from prior to the implementation of the SFE model of 48.17%[30]. Indicators of information representation can be reading or creating graphs, tables, and schema[31]. There are students who are still wrong in providing information on the x and y axes on the graph.

4. Conclusion
There is an improvement in students' scientific communication skills on the concept of mechanical wave characteristics, on all indicators with moderate categories. The highest increase in rediscover relevant information from read sources, then the lowest increase is in SCS indicator 5 which is information representation. The achievement of students' scientific communication skills at each meeting has improved. The highest increase is found in the SCS indicator 4 which is the presentation of knowledge at the third meeting with the skilled category, the lowest increase is found in indicator SCS 1 which is looking for information at the third meeting with a fairly skilled category.

During the learning process, teachers should pay attention to each group so that students actively participate in learning activities. Students prior to the use of schoology should be briefed on how to submit assignments, discuss, and open files in schoology. In the next study, we recommend using the control class as a comparison. Before using schoology students should be given instructions on how to send assignments, discuss, and open files in schoology. Then students' scientific communication skills should be trained in concepts that have minimal calculations.

Acknowledgment
Authors wishing to acknowledgement that thank to International Conference of Education in Muslim Society (ICEMS) 2020 FITK UIN Syarif Hidayatullah Jakarta for publication support.

References
[1] Sahin M C 2009 Instructional design principles for 21st century learning skills Procedia - Soc. Behav. Sci. 1 1464–8
[2] Triling B and Fadel C 2009 21st century skills: learning for life in our times (San Francisco, America: Jossey-Bass)
[3] Kemdikbud 2016 Peraturan Menteri Pendidikan dan Kebudayaan No.21 Tahun 2016 Tentang Standar Isi Pendidikan Dasar dan Menengah 4
[4] Sarwi S, Rusilowati A and Khanafiyyah S 2013 Implementasi Model Eksperimen Gelombang Open- Inquiry untuk Mengembangkan Keterampilan Implementation of Open Inquiry Experimental Wave Model to Develop Physics Students J. Pendidik. Fis. Indones. 9 123–31
[5] Patriot E A, Suhandi A and Chandra D T 2018 Optimize scientific communication skills on work and energy concept with implementation of interactive conceptual instruction and multi representation approach Journal of Physics: Conference Series 1013 1–6
[6] Radu M C, Schnakovszky C, Herghelegiu E, Ciubotariu V A and Cristea I 2020 The impact of the COVID-19 pandemic on the quality of educational process: A student survey Int. J. Environ. Res. Public Health 17 1–15
[7] Küçüközer A 2010 Prospective Science Teachers’ Misconceptions Concerning Wave J. Turkish Sci. Educ. 7 66–78
[8] Kennedy E M and De Bruyn J R 2011 Understanding of mechanical waves among second-year physics majors Can. J. Phys. 89 1155–61
[9] Sandhy A K 2018 Pengaruh Model Inkuiri Untuk Meningkatkan Keterampilan Argumentasi Peserta Didik terhadap Materi Getaran dan Gelombang J. Pendidik. dan Pembelajaran Khatulistiwa 7 1–9
[10] Maryanti S, Zikra Z and Nurfarhanah N 2012 Hubungan antara Keterampilan Komunikasi dengan Aktivitas Belajar Siswa J. Pendidik. dan Pembelajaran Khatulistiwa 1 1–9
[11] Prastyo E 2010 Pengaruh Model Student Facilitator and Explaining Terhadap Aktivitas Dan Hasil Belajar Siswa Materi Invertebrata di SMA I Boja
[12] Malik A, Vitriani V and Chusni M M 2018 Improving Students’ Critical-Thinking Skills Through Student Facilitator and Explaining Model in Momentum and Impulse Topic J. Penelit. Pendidik. Fis. 4 55–64
[13] Spektor-Levy O, Eylon B S and Scherz Z 2008 Teaching communication skills in science: Tracing teacher change Teach. Teach. Educ. 24 462–77
[14] Kemendikbud 2020 Peraturan Menteri Pendidikan dan Kebudayaan No. 21 Tahun 2016
[15] Hasanah N, Suyanto E and Suana W 2016 E-Learning dengan schoology sebagai suplemen pembelajaran fisika materi elastisitas dan hukum Hooke J. Pembelajaran Fis. 4 64–75
[16] Tigowati T, Efendi A and Budiyanto C W 2017 E-Learning Berbasis Schoology Dan Edmodo: Ditinjau Dari Motivasi Dan Hasil Belajar Siswa SMK Elinvo (Electronics, Informatics, Vocat. Educ. 2 49–58
[17] Arikunto S 2013 Prosedur Penelitian Suatu Pendekatan Praktik ( Jakarta: Rineka Cipta)
[18] Kunandar K 2013 Penilaian Autentik
[19] Hake R R 1999 Analyzing Change Gain Scores (Dept. of Physics, Indiana University)
[20] Fauzi M N and Jati N H D 2016 Penerapan Model Pembelajaran Student Facilitator and Explaining (SFE) Berbasis Mind Mapping untuk Meningkatkan Kreativitas Siswa Seminar Nasional Matematika dan Pendidikan Matematika pp 523–32
[21] Badriyah L 2010 Pengaruh Sumber Belajar terhadap Prestasi Belajar Siswa pada Mata Pelajaran Ekonomi di Smp Bakti Mulya 400 Pondok Pinang Jakarta Selatan
[22] Aisyah D W, Gipayana M and Djatmika E T 2016 Mengembangkan Kebermaknaan Belajar dengan Rancangan Pembelajaran Tematik Bercirikan Quantum Teaching Seminar Nasional Mahasiswa Kerjasama Direktorat Jendral Guru dan Tenaga Kependidikan Kemdikbud, pp 1–7
[23] Qodry I, Nuroso H and Susilawati S 2016 Pengaruh Model Pembelajaran Problem Based Learning melalui Pendekatan Saintifik terhadap Kemampuan Berkomunikasi Ilmiah pada Kelas X di SMA Negeri 1 Rembang J. Penelit. Pembelajaran Fis. 7 34–42
[24] Yuniarti Y 2013 Peran Guru dalam Meningkatkan Kemampuan Representasi Matematik dalam Pembelajaran Matematika Eduhumaniora 5
[25] Dewi I N, Poedjiastoeti and Binar K P 2017 ElSII Learning Model Based Local Wisdom To Improve Students’ Problem Solving Skills and Scientific Communication Int. J. Educ. Res. 5 107–18
[26] Hasanudin H, Sitompul S S and Hamdani H 2015 Penerapan model pembelajaran SFE untuk meningkatkan hasil belajar dan aktivitas fisika siswa di SMA J. Pendidik. dan Pembelajaran Khatulistiwa 4 1–13

[27] Divan A and Mason S 2016 A programme-wide training framework to facilitate scientific communication skills development amongst biological sciences Masters students J. Furth. High. Educ. 40 543–67

[28] Nopearti M, Yelniati Y, Azmi J and Abdullah A 2016 The Implementation of Cooperative Type Student Facilitator and Explaining (SFAE) Learning Model Use The Concept Map Media to Increase Students Achievement in Reduction and Oxidation Reaction Topic at X MIA SMAN 2 PEKANBARU Proceeding of the 1st Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL) pp 315–8

[29] Scherz Z and Spektor-Levy O 2008 Learning Skill for Post-16 Science Introduction (Gatsby Technical Education Projects)

[30] Witarsa F I, Effendi R and Mulyadi A 2017 The Effect of Cooperative Learning With Student Facilitator and Int. J. Pedagog. Soc. Stud. 2 1–4

[31] Malik A, Setiawan A, Suhandi A, Permanasari A, Dirgantara Y, Yuniarti H, Sapriadil S and Hermita N 2018 Enhancing Communication Skills of Pre-service Physics Teacher through HOT Lab Related to Electric Circuit Journal of Physics: Conference Series 953 pp 1–9