

Development of an Open-inquiry Experiment to increase Students Social Character Aspects and Scientific Communication

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Abstract- *The purpose of this research is to describe the social character and scientific communication skills and to determine the relationship between communication skill and mastery of waves concept. The research was conducted by the developmental research. Data included score of social character, scientific communication, and mastery of waves concept. The assessment and observation sheets, and tests are used for data collection. The results are: 1) description of the social character included eight characters are disciplined, honest, democratic, courtesy, curiosity, self-reliance, hard work, and cooperation with mean score of 81, 2) description of scientific communication skills include library access and utilize of modern literature, contribute ideas, prepare reports, and communicate verbally report the mean score of 80. The relationship between communication skills and mastery of waves concept is showed $r = 0.714$ ($\alpha = 5\%$) with $p = 0.0012$. There is no relationship between the social character and mastery of waves concept significantly. It can be concluded that this research is the development of an open-inquiry experiment effectively improve of the social character and communication skills in the course of the waves.*

Key words- *scientific communication , social character , waves concept*

I. INTRODUCTION

Development of a physics laboratory at the present time is directed at types of laboratory inquiry. Experimental activity is the main activity that serves to exercise and increase student engagement in learning. Laboratory activities, either in the form of demonstrations and experiments, can be classified into activities that are laboratory verification (deductive) and laboratory inquiry (inductive) (Trowbridge & Bybee, 1990)^[1]. Verification laboratory activities is a series of observation or measurement, data processing, and conclusion aimed to prove the concept that has been learned first. According to Trowbridge and Bybee (1990)^[1] in the activities of inquiry, prepared learning environment to facilitate student-centered, which gives an opportunity in the discovery of scientific concepts.

Standard for Science Teacher Preparation (NSTA and AETS, 1998)^[2] declared open inquiry learning, emphasizing teacher then explained the context of problem solving learners identify, formulate, propose design solutions, and solve problems individually or in groups and independently evaluated. Implementation of inquiry can be conducted through field work and laboratory projects (inductive).

Some sources (NSTA and AETS, 1998^[2]; National Research Council/NRC, 2000^[3]) states inquiry involves the development and use of high level thinking to solve the open problem. Inquiry capabilities often associated with the investigation or experimentation activities. On inquiry activities, students can construct knowledge through questioning, designing, and connecting in the form of investigative, analytical skills, and communicate findings. One of the main principles of inquiry, which students can construct their own knowledge by doing activities both emotionally and intellectually active in learning. With regard to the process of learning, inquiry is used as a model that facilitates students actively investigate knowledge. Experiments open-inquiry have the same characteristics with the open-ended lab students are faced with the open-problem.

Learning in the 21st century is starting secondary school level required soft skills though with different complexity. Another case, learning at the university level must demand soft skills courses. Soft skills are part of a person's skills are subtlety and sensitivity feelings towards the environment. The impact can be observed in the form of polite behavior, discipline, courage, honesty, collaboration, critical thinking, creative thinking, caring people and others. The development of soft skills that every person is not the same, resulting in soft skills possessed levels of each are different. Learning that includes soft skills to develop character education student.

While, Levy et al. (2008)^[4] Scientific communication skills in physics include several indicators, such as: identifying the ability to obtain information, clarify ideas and physical tasks in the manufacture of products / reports, and communicate the results of the product or the work / reports. Scientific communicate both orally and in writing to improve social skills in character include logical reasoning, developing intellectual courage, and a substantial write down in the report (Elder & Paul, 2005)^[5]. The development of social skills and character of scientific communication can be facilitated through laboratory project or laboratory inquiry induction (open-inquiry).

The purpose has been achieved in this study: a) to describe the ability of scientific communication and b) describe the social aspects of character, in the activities of open-inquiry experiments waves, and c) determine the relationship between scientific communication skills and mastery of the concept of waves. Targeted benefits are accounted for valid experimental device that facilitates the activity of an open-inquiry course on waves, as an alternative material to develop curriculum related to the competence of pedagogy in physics education courses.

This study implemented a wave of open-inquiry experiments to carry out lectures waves in the laboratory. Problem solving open-inquiry done by making students design experiments, execute and make reports, experimental reports and presentations. Through these projects will be developed of the character social aspects and scientific communication. The design of experiments that made each group of students to different method and depth, the main goal is achieved competency. Thus, students can understand the intent and purpose of the design is made. Through this experimentation activities students work together in a group to produce the best solution. The student group will work effectively in experiments if the number of members is a few student (Slavin, 2005)^[6].

Some studies include, Noe (2007)^[7] gave the project an optical laboratory with the conclusion that the students can develop learning collaborate to design experiments, investigations and discoveries about physics phenomena individually in life. Likewise, through the physics laboratory (Planinsic, 2007)^[8] have uncovered about the development of science process skills through a first year physics student laboratory projects. Inquiry laboratory activities require a lot of effort and independence of students to resolve open issues. The results Turner and Parisi (2008)^[9] have uncovered differences in student achievement of competence in the use of the tool kit between experimental physics at home and in college. Thus students can be actively involved in the activities demanded more controlled experiments and concepts independently and creatively to accomplish a task or exercise.

Character education is a system of cultivation of character values to students that include components of knowledge, awareness or volition, and actions to implement those values. In character education in the educational institutions, all of the components (stakeholders) should be involved, including the educational components of curriculum content, learning, and assessment techniques should include the value of the character. Some understanding of character education, among others, the character means a stable personal attitudes consolidation process results in a progressive and dynamic integration of statements and actions (Khan, 2010)^[10]. While, Koesoema (2010)^[11] states that the character is a dialectical movement of individual dynamic consolidation process resulting in a stable personality trait. Character education emphasis on the psychosocial correlated with education and environmental context. Character education can broaden learners about the moral and ethical values that they can make a decision morally and responsibly.

One of the learning strategies that can be used as a vehicle for character education (Khan, 2010)^[10], is a learning strategy Inquiry. This approach uses mental processes to discover scientific principles and enhance the intellectual achievement. Type of inquiry as applied to science is guided inquiry. The teacher's role during the learning process as a teacher, instructor, facilitator, and dynamist.

The social aspect of character that will be developed in this research is divided into two components, are component of personality (disposition) and component of performance. Component of the personality shown by indicators such as: discipline, honest, democratic and self-confidence. Component of performance is shown by the indicator: curiosity, self-reliance, hard work, and cooperation. While, Levy et al. (2008)^[4] stated that scientific communication skills in physics includes several indicators, namely: 1) identify the ability to obtain information, (2) can claim a daily occurrence in the language or the symbols of physics, (3) to contribute ideas in group work, and (4) explain the idea and physical tasks in the writing of reports, and (5) communicating the product or work/reports. Social skills character and scientific communication skills have a strong relationship. In scientific communication in writing (paper) were required the ability to think logically and analytically, concluded based on scientific data processing. Students character social aspects and scientific communication can be facilitated through field activity or laboratory project inquiry.

II. RESEARCH METHODS

This study is designed to use developmental research, which is a research program at the start of needs analysis, then arranged a program of development and testing its effectiveness as proposed by Walter Dick and Lou Carey (Gall et al., 2003^[12]; Sugiyono 2006^[13]). This article is part of results of this research which consists of four stages. The first phase of the pilot study included a literature review and field surveys. The second stage of the design phase include providing topics and manual guide (english), laboratory implementation guide inquiry and assessment. The third stage of the development phase includes validation expert, limited testing, and implementation of the model and to test its effectiveness. The fourth stage includes the stages of dissemination seminar on the results or writing articles in scientific journals. Subjects were participants of the course students

wave at Physics Education Study Program Faculty of Mathematics and Natural Sciences in 2011/2012 were determined by purposive sampling technique. The data collected are social character and scientific communication skills of students. Data processing was done by using descriptive-percentage, average calculation, and standard deviation, and visualization with diagrams and pictures with SPSS for Windows v. 16.

III. RESULTS AND DISCUSSION

III.1 Result

The results are grouped into two parts: 1) a description of scientific communication skills and social character, 2) information about the relationship the wave concept mastery with scientific communication skills and social aspects of character. Scientific communication skills students collected by assessments and observations, students carry out experiments waves. Learning is done through open-inquiry experiments on subjects waves to the implementation group. Open-inquiry experimental data includes designing, implementing, reporting and presenting reports. Wave experiments conducted five titles, are vibration (2 types), mechanical and electromagnetic waves (2 types), and the interference and diffraction light (1 type). Data communication skills which includes four components are presented in Table 4.1.

Table III.1 Data of the Four Components of Scientific Communications for Group 1 and Group 2 (%)

Group	K-1	K-2	K-3	K-4	Average
Group_1	78	81	80	80	80
Group_2	78	79	79	78	78

(Note: K1: access and utilize modern literature, K2: contribute ideas in group work, K3: preparing your reports as scientific reports, K4: communicating the product or report verbally)

The results of research on the social aspects of the character appearances include components: 1) discipline, 2) be honest, 3) democratic, 4) communicative, 5) curiosity, 6) self-reliance, 7) work hard, and 8) cooperation. Social performance of the character data presented in the following part. Data on the social aspects of the character appearances which include eight indicators, it was presented in the illustration below. Data showing the four components of personality that the character is presented in Table 4.2.

Table III.2 Data Personality Social Aspects Four Components of Character

Group	K1-a	K1-b	K1-c	K1-d	Average
Group_1	84	82	80	79	82
Group_2	82	81	78	77	80

(Note: K1-a disciplined, K1-b honest, K1-c democratic, K1-d: courtesy)

Data characterized by four components of the social aspects of work performance is presented in Table 4.3.

Table III.3 Data social character of the four components of performance

Rombel	K2-a	K2-b	K2-c	K2-d	Rata2
Rombel_1	78	79	80	78	79
Rombel_2	78	77	78	77	78

(Note: K2-a curiosity, K2-b independence, K2-c endeavor, K2-d partnership)

III.2 Discussion

Based on the findings in this study are grouped into two parts, namely scientific communication skills and social development of student character during the course of open-inquiry wave experiments. Subject matter experiments include vibration, mechanical waves, electromagnetic waves, interference and diffraction of light. Based on Table 4.1 can be explained that the mean score of the three indicators advanced component library for accessing source experimental group (group-1) and control group (group-2) in an open-inquiry experiment wave i.e. 78 and 77 (scale of 100). This suggests that the ability to access and utilize cutting modern literature both groups are relatively still minimum. The ability to select and utilize the primary literature and low quality. Only about twenty percent (20%) students who use primary literature sources adequately. Ability to

write correctly in a script library is still not optimal. Noe (2007)^[7] gave the project an optical laboratory with the conclusion that the students can develop learning collaborate to design experiments, investigations and findings on physical phenomena individually in life.

The second component of scientific communication is to contribute ideas in group work. Mean score obtained on the indicator of involvement in completing tasks and indicators to explain the theory in design experiments in groups by the two groups (group-1 and group-2) there is a significant difference in the 82 and 80; 81 and 79. The two scores for the two different levels of indicator weights. The weight of the scores obtained by the experimental group was 3.5 (AB), while the second score obtained the control group was 3.0 (B). Thus, the two groups reached a quite different abilities to contribute ideas on the components in the group. However, the mean score of the second indicator that contributes to the design and answer questions at the oral examination is achieved by the two groups is almost the same, namely 80 and 79 (equal in weight to the value of 3.0). Experimental group that received additional tutorials with provision so much more motivated and strive to achieve the best results.

Score scientific communication third component which is preparing a report, in your scientific report obtained by the mean score of 80 (group-1) and 79 (group-2). The fourth component scores of scientific communication that communicates product or reports with presentations. Overall mean score components communicate products or reports contained enough significant differences are 79 and 77.

Work small groups (2-3 people) to show the skills of cooperation and independence, and generate higher-order thinking such as analysis, summarize and evaluate the concepts of physics. Through the work of a small group (2-3 people), they can do a collaboration between members of the group (cooperation), knowledge sharing, and learn to communicate, and appreciate ideas others. Thus the use of experimental inquiry can raise and conceptual competencies critical thinking and creative thinking. While, the value of the course includes the mean wave of scientific communication in open-inquiry wave experiments (NL), the semester exam scores (NS), and the final value (NA) obtained student tutorial group-1 were respectively 80, 76, and 76 (scale of 100). For students without a tutorial group-2, scores obtained respectively by 78, 75, and 74 (scale of 100).

Data overall mean score for each component of scientific communication within the two groups is 80 (experimental) and 78 (control). In the first component (access and utilize modern literature) both groups achieved the same score that is 78. This suggests that the ability and efforts of students less than the maximum, as it is still categorized as good (grade B). The second and the fourth component, the mean scores obtained by the two groups is quite distinct though small are 81 and 80 for the experimental group and 79 and 78 for the control group. These two components obtained scores differ by two points (scale of 100).

Referring to the opinion Levy et al. (2008)^[4] the dominant scientific communication skills students can be performed, were: 1) to contribute ideas in the group, (2) explain the idea and physical tasks in the making of the product or report, and (3) communicate the results of the product or report. Conclusion The results of this study can be stated that the implementation of open-inquiry experiments can provide a very conducive climate for the development of critical thinking skills in order to master and resolve problems in matter waves. More explicit statement that the impact on these results, the open-inquiry experiments to develop a high level of conceptual thinking skills so they are better able to understand the concept of waves. Collaborate on problem-solving model to improve engagement activity in the critical thinking and knowledge sharing with friends learning partner. The results of the analysis of wave problems through open-inquiry wave experiments revealed that critical thinking skills can be performed by students through the formulation of specific goals, the exposure of the basic theory (cognitive), carry out experiments (affective, psychomotor), prepared a report (cognitive), and the presentation of the report (cognitive , affective).

Furthermore, the data component of the development of social character personalities in open-inquiry experiments obtained mean score group-1 is 82, while for group-2 is 80 (scale of 100). The mean score showed quite different, because of the different categories those of the more good (AB) and the good (B) categories. This suggests that the ability to show different aspects of personality self, which in terms of discipline, honest, democratic, and polite. Mean score performance components performance earned two groups, are 79 and 78, which are both in either category. In parts curiosity both groups achieved the same score that is 78. In the two-component of self-reliance and hard work is smaller differ significantly. Obtaining the mean score for all components of the social aspects of work performance characteristic not shown optimal results. Both groups only reached values in both categories (79 and 78). Thus, students group-1 and group-2 have the capability of affective aspects are relatively the same, which means the maturity of students from both groups same.

At age (17-19 years old) students are not all in category the same degree of high-level thinking, including decision. According to Norris and Ennis stated that the critical thinking aspect of the personality traits that decision problem or task with maturity psychic. In addition, the problem or responsibility given by the lecturers resolved with a decision in terms of the various aspects. In deciding the issue always try hard and keep critical

open to information from a variety of reliable sources (Stiggins, 1994)^[14]. Furthermore, the stated approach to develop critical thinking skills is by giving a number of questions or tasks, which reveals the thought process or procedural thinking that mastery of concepts can be measured holistically. The results of the data analysis can be stated also that the laboratory model inquiry through open-inquiry experiments effective to achieve mastery learning wave. The results obtained by the research supporting Turner and Parisi (2008)^[9], which states that the use of experimental kit at home is more effective than on-campus students in achieving competence. The process of implementation of the experiments at home is to use a loosely so that students can develop research, measurement, and reporting skills, and the ability to give reasons based on the theory used in the literature. With regard to the method of open-inquiry experiment, Wright (1996)^[15] suggest the use of this method can increase the power of reason and the student concept mastery of subject matter.

While, the results of the analysis of the correlation between the mean scores of scientific communication skills (80) and the mean score of the final value/semester (76) by the implementation of the program (group-1) correlation coefficient $r = 0.714$ ($p = 0.0012$) with a contribution of 51%. The results of both analyzes indicated that a strong relationship between the variables of scientific communication skills and the final value. It provides information that scientific communication skills are very important in mastering the subject matter waves. According to Bers (2005)^[16] stated instructional design that facilitates the development of students' social character must use a variety of models to transfer skills to new situations. While, according to Hassoubah (2007)^[17] states that students think critically also have character, such as: 1) provide examples or arguments about experimental results that explain the new situation, and 2) be able to locate and describe the relationship between problem discussed with problems or other relevant experience.

Factors that supports research that support the head of physics laboratory positively, provision of an LCD projector, and the motivation and active participation of the students in the course. The factor constraints experienced is the time scedule of lecture at 13.00 p.m. affect morale and student performance during the course (less of attention) and seating that use a high chair quite influential in the rapid exhaustion.

IV. CONCLUSIONS AND SUGGESTIONS

Conclusions are drawn from the discussion of the research results have produced a guidance device is laboratory activities have the characteristics of open inquiry experiments small groups (2-3 student) which includes designing and implementing experiments, writing the reports and presenting them individually. Description of the social aspects of character include eight characters are disciplined, honest, democratic, courtesy, curiosity, self-reliance, hard work, and cooperation with the average score of 81. Description of scientific communication skills include proficiency to access and utilize the modern literature, contribute ideas in group work, writing reports as guidelines scientific reports, and communicate product/report verbally with a mean score of 80. The relationship between scientific communication and mastery of concepts wave (semester value) showed $r = 0.714$ or 51% with $p = 0.0012$. There is no relationship between the social character and understanding wave concept significantly. Suggestions submitted by the results of that discussion for college students experiment for physics teacher candidates should be designed to develop the character of independence, curiosity more depth, as well as critical and creative attitude, that determines the quality of the decision making.

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