Development of Chemistry Practicum Guidelines with the Support of STEM (Science, Technology, Engineering, and Mathematics) Integrating Character Education

Mahniar Sinaga¹*, Ramlan Silaban¹, Iis Siti Jahro¹
¹Chemistry Education Graduate Program, Universitas Negeri Medan, Indonesia

*sinagamahniat@gmail.com

Abstract. The implementation of the STEM-based learning approach is able to shape student character. One of them is using a chemistry lab guide based on the STEM approach. The purpose of this study was to determine the feasibility level of a chemistry lab guide based on the integrated STEM approach to character education based on the criteria of the National Education Standards Agency (BSNP) and the character level of students after using a validated practicum guide. This type of research uses the Research and Development (R & D) method with the ADDIE model development stages (Analysis, Design, Development, Implementation, and Evaluation). The data collection instrument consisted of a practicum guide validation sheet based on BSNP criteria and student character observation sheets. The data source in this study was 40 students of class XII SMA N 1 Tanjungbalai academic year 2020/2021 using purposive sampling technique of collecting samples. The results showed that the validation test for chemistry lab guides by expert validators stated that the chemistry practicum guidance based on the integrated STEM approach to character education was valid with an average value of 3.53 from a maximum scale of 4 which means it is feasible and does not need to be revised. Furthermore, the results of observations of the character level of students using a practical guide based on the STEM integrated approach to character education are very good with an average of 85.8%. Based on the results of character validation and observation, it shows that chemistry practicum speakers based on the STEM integrated approach to character education are feasible to be implemented in schools.

1. Introduction
The development of science and technology which is increasingly rapid in the present has a very real impact. It can be seen from the advanced technologies that help us in various aspects of life. Currently, Indonesia is faced with the era of the industrial revolution 4.0. An era where technology plays an active role in controlling human activities. The development of information technology is getting bigger and bigger, the wave of changes is leading to the use of internet networks, such as e money and e toll. The latest technology that we have in helping our daily lives indicates that this cannot be separated from the development of human capabilities in the field of science.

In the future, Indonesia needs to increase its competitive ability so that it can compete globally, both in the mastery of science or technology. Innovations in science and technology, changing needs of individuals and societies, teaching and learning theories and innovative approaches, as well as state
development affect the role of humans or individuals in survival. Therefore, science education always tries to overcome someone's anxiety in following the developments of his time. This is the reason for the need for the development of learning activities which include science, technology, engineering, and mathematics, commonly abbreviated as STEM [1].

STEM is an interdisciplinary approach to studying various academic concepts juxtaposed with the real world by applying the principles of science, mathematics, engineering and technology and having the ability to compete in the new economic world. STEM education plays an important role in modern education for countries to stay abreast of the competition in the global economy [2], STEM education also aims to enable students to study world problems and solve problems they will face in the future and enable students to acquire knowledge in a way that is more holistic and global [3].

Learning that is designed with a STEM approach that is applied in ideal classrooms, besides being able to increase student proficiency in science, technology, engineering, and mathematics which provides a real component of life, it also fulfills the goals of the school curriculum, namely interdisciplinary character disciplines so as to help schools develop community learning environments larger/entrepreneurship that produces a particular product [4].

Chemistry is a science that requires students to think scientifically and think critically in a practical activity. So that the STEM-based approach in chemistry learning can be integrated because it can stimulate students to think critically, actively and provide opportunities to develop student competencies in accordance with the demands of the current national curriculum [5].

Active student involvement in learning which is packaged in practical activities can improve mastery of learning material and develop student character values [6]. In addition, practicum activities can help students to work more independently so that students are more experienced in their learning activities. This is because learning through experiences will be felt more so that it will last longer in the memory or memory of students [7].

In practicum activities, it cannot be separated from the practicum guide. Practicum guide is a practicum implementation guideline that contains procedures for preparation, implementation, data analysis and reporting prepared by a person or group of teaching staff who handles practicum and follows the rules of student scientific writing [8]. The practicum guide is used to make it easier to find practicum steps, where the guide consists of the procedures practiced in the laboratory on each material, a brief theory, and the safety of using laboratory practicum [9].

Referring to the objectives of the national education curriculum in Indonesia, namely to foster student character, scientific attitudes, develop thinking skills and experience in formulating problems, proposing and verifying hypotheses, communicating experimental results, mastering concepts, principles and developing science and technology, the practicum guides are developed. based on the STEM approach it is very well implemented in schools. STEM learning activities based on problem-based learning have succeeded in developing analytical thinking skills and attitudes towards science learning, STEM learning affects students' skills and attitudes [10]. The implementation of STEM-based learning can develop disciplinary, curiosity, communicative, and cooperative characters [11]. STEM education is able to hone skills in problem solving, critical thinking, analytical, creative, collaborative, and communication skills [12-14]. STEM learning experiences can also prepare students to face the competitive global economy of the 21st century today [15-16]. Based on the results of interviews conducted at SMA N 1 Tanjungbalai, they have not developed a chemistry lab guide based on the STEM approach that includes character education. Therefore, the researcher wants to develop a chemistry lab guide based on an integrated STEM approach to character education in elemental chemistry.

2. Methods

This study uses an R & D (Research and Development) approach with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. These steps include: (1) Analysis (analyzing the feasibility of an existing practicum guide), (2) Design (understanding and compiling the initial product or product design), (3) Development (developing a product design), (4) Implementation (the
This research was conducted at SMAN 1 Tanjungbalai. The population in this study were students of class XII at SMAN 1 Tanjungbalai in the academic year 2020/2021, totaling 40 students using purposive sampling technique. The research instrument used to collect data was the validation sheet of the practicum guide based on the BSNP criteria and the student character observation sheet. The validation process of the practicum guide was carried out by 3 expert validators. The method used in this research is a one-shot case study design. In this design, there is one class for a limited test of the practicum guide that has been validated by expert validators to measure the level of student character using the practicum guide that has been developed.

3. Results and discussion

This study aims to determine the feasibility level of a chemistry lab guide based on the integrated STEM approach to character education and the character level of students using a practicum guide that has been developed. Before being tested on students, the practicum guide is validated by 3 expert validators. The instrument used to determine the feasibility of the developed chemistry lab guide is an instrument based on the BSNP criteria consisting of 3 eligibility criteria, namely content eligibility, language eligibility, and presentation feasibility. The eligibility criteria for character education based on the STEM integrated chemistry lab guide are presented in Table 1.

| Average  | Eligibility Criteria |
|----------|----------------------|
| 3.26 – 4.00 | Very Feasible |
| 2.51 – 3.25 | Feasible |
| 1.76 – 2.50 | Less Feasible |
| 1.00 – 1.75 | Not Feasible |

The results of the feasibility test of a chemistry lab guide based on the integrated STEM approach to character education on chemical elements based on the BSNP standard obtained the content feasibility of 3.92 (very feasible), 3.80 language feasibility (very feasible), and 3.40 presentation feasibility (very feasible). The results of the feasibility test for a chemistry lab guide based on the STEM integrated character education approach can be seen in Figure 1.
(1) content feasibility test of 3.92 (very feasible); (2) language feasibility test of 3.80 (very feasible); and (3) presentation feasibility test of 3.40 (very feasible). Thus, overall the results of the analysis of chemistry lab guides based on the integrated STEM approach to character education have an average value of 3.53 which belongs to the very feasible category and does not need revision. These results indicate that the chemistry lab guide based on the integrated STEM approach to character education in chemical elements is very suitable for use in chemistry lab work in schools [17-18].

After the chemistry lab guide is validated, an assessment of the student's character level is carried out using an observation instrument. Character observations were made when students did a chemistry lab guide trial in the laboratory. The interpretation of the percentage of student characters used the criteria in Table 2.

| Table 2. Interpretation of Student Character Criteria |
|-----------------|-----------------|
| Score           | Criteria        |
| 85-100          | Very good       |
| 69-84           | Good            |
| 53-68           | Pretty good     |
| 37-52           | Poor good       |
| 21-36           | Not good        |

The observer consists of four chemistry teachers at SMA N 1 Tanjungbalai. The characters studied were 5 elements of attitude that were adapted to learning elemental chemistry. The five elements of this attitude include curiosity, cooperation/collaboration, critical thinking, responsibility, and communication, as shown in Table 3.

| Table 3. Average Student Character Score |
|-----------------|-----------------|
| Character       | Value           | Criteria     |
| Curiosity       | 85.6%           | Very good    |
| Collaboration   | 90.6%           | Very good    |
| Critical thinking | 83.1%         | Good         |
| Responsibility  | 89.3%           | Very good    |
| Communicative   | 80.6%           | Good         |

In Table 3, the researcher presents the student character scores in percent. The results of the character observation analysis showed that the average score of the character of the four observers was curiosity 85.6%, cooperation / collaboration 90.6%, critical thinking 83.1%, responsibility 89.3%, and communicative 80.6%. So that when averaged from the five character attitudes, it is obtained 85.8% in the very good category. Chemistry practicum guidance based on the integrated STEM approach to character education is able to develop student character. The formation of student character values during the practicum is due to the presence of character content in the chemistry lab guide based on the STEM approach that has been developed. This is confirmed by the results of research that the implementation of STEM-based learning can develop disciplinary, curiosity, communicative, and cooperative character [19-20].

4. Conclusion
Based on the results of data analysis, it can be concluded that the chemistry lab guide based on the integrated STEM approach to character education on chemical elements is very suitable for use in chemistry lab work in high schools. And from the results of measuring the character level of students
in using the chemistry guide it is known that it is very good at developing student character such as curiosity, cooperation/collaboration, critical thinking, responsibility, and communicative.

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