

Analysis of Needs for Inquiry-Based Model Development Integrated Project Assignments in High School Chemistry Teaching

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Abstract. *The aim of the research is to determine the analysis of student and teacher needs in developing an inquiry-based model integrated with project assignments in high school (SMA) chemistry teaching. The research method is qualitative and quantitative with the research subjects being class XII students majoring in science in the city of Lhokseumawe, Aceh Province. The instruments used in this research were questionnaires, observation sheets and interviews. Several needs analysis data were obtained that support learning media and teachers' tendencies to use the inquiry learning model. Survey data was obtained from students and teachers as follows which shows that the needs of students are (1) students find it difficult to understand chemistry material 62.5%, (2) students feel happy if teachers use models in learning 70%, (3) students want real (contextual) learning 90%. The data also shows that the needs needed by teachers are (1) teachers understand the use of the 100% learning model, (2) teachers often use the 60% inquiry model, (3) teachers experience difficulties in implementing the 80% inquiry model. data on the use of the inquiry model by teachers shows (1) teachers are familiar with the use of the inquiry model 60%, (2) teachers have applied the inquiry model in class 95%, (3) teachers experience difficulties in carrying out learning using the inquiry model 80%. The conclusion of the needs analysis through a survey of students and teachers for the development of an inquiry-based model integrated with project assignments on teaching materials or active learning resources that can be connected to the real world (contextual) was that the percentage of student needs was 95% and the percentage of teacher needs was 89%.*

Keywords: *analysis of student and teacher needs, inquiry-based model, integrated project assignments*

1. Introduction

The Education System in Indonesia, apart from running an education system in accordance with state principles and with the spirit of Pancasila, the 1945 Constitution is also the foundation used in this curriculum. Characteristics such as the direction of activities towards increasing skills and intelligence, as well as developing a strong and healthy body (Priantini et al., 2022). The implementation of the 2013 Curriculum is characterized by very fundamental changes in the learning process, namely learning that focuses on active learning. In accordance with Minister of Education and Culture Regulation no. 65 of 2013 (Permendikbud, 2013). concerning Process Standards, the 2013 Curriculum uses a scientific approach as the main approach that needs to be strengthened with discovery-based learning, inquiry learning, and project-based learning. The success of implementing the curriculum is largely determined by the teacher's success in developing learning based on the active learning approach or model (Prihadi, 2014).

The renewal of the Education Unit Level (KTSP) curriculum was perfected through the application of the 2013 Curriculum with several aspects to be used as the main reference for assessment including cognitive aspects, skills aspects, as well as behavioral and attitudinal aspects. The 2013 curriculum contains several subjects that have been

streamlined, but some have been developed. The 2013 curriculum will be refined again with a new breakthrough launched by the Ministry of Research, Technology and Higher Education. This breakthrough is in the form of an independent curriculum and an independent teaching platform. The Merdeka Curriculum was developed to improve the quality of Indonesian education. The independent curriculum can be adapted to the needs and characteristics of students which can make it easier for students to learn without having to feel burdened by learning activities. Implementation of learning using the independent curriculum is more in-depth, fun and independent. The implementation of the independent curriculum is supported by the Merdeka Mengajar Platform. Independent platforms are applications that can be accessed (Priantini et al., 2022).

The curriculum that can be used in learning in this research is the active learning curriculum which has been integrated in the 2013 curriculum and the independent curriculum or other curricula which are active learning with active learning resources. The curriculum development that continues to be carried out by the government aims to align itself with the international world in the field of education. Curriculum development is also carried out to train students' abilities in independent, open problem solving with broad thinking. The broad thinking referred to is the development of a mindset that trains students to be able to think at a high level critically and analytically. The learning carried out so far still relies on low and medium level thinking patterns, so that it influences learning patterns and also the process of taking student exams. The learning readiness factor is also an influencing factor, so far not all students carry out learning in a state that is ready to carry out learning. Sometimes the learning that students do is just passing the time without producing the expected results according to the learning objectives.

Looking at reference data from the 2022 LTMPPT (Institute for Higher Education Entrance Tests) (LTMPPT, 2022). on the graduation results of class %, according to this data, it means that there are still many students who do not pass the SBMPTN exam. This data shows that there is a learning relationship experienced by students so far which is still at a low level in the learning process as long as the student is still in school. The learning process undertaken so far also contributed to the emergence of the graduation rate. This means that the learning process carried out has not been optimal in honing students' thinking patterns to train students in solving problems when giving assignments by the teacher, so that it affects students when answering questions at a high level of thinking, or the current term is called problem solving HOTS (Higher Order Thinking Skills). The learning process carried out by teachers is certain to achieve learning objectives in accordance with the demands of the ongoing curriculum, but in implementation in the field there are many obstacles experienced by teachers. Obstacles often experienced by teachers include students being less enthusiastic in the learning process because motivation is still low, learning is less enjoyable so students feel it is difficult to understand the learning and this definitely affects learning outcomes. The problems felt by teachers and students in the field are problems that arise in the learning process, thereby hindering the achievement of learning goals. In addition, with the demands of the curriculum in the current learning process, students must have 21st century skills, namely having 4C skills which improve students' high-level thinking skills (HOTS). Teachers also make efforts in the process of implementing learning in accordance with curriculum demands to achieve learning objectives, including by using various strategies, methods and learning models.

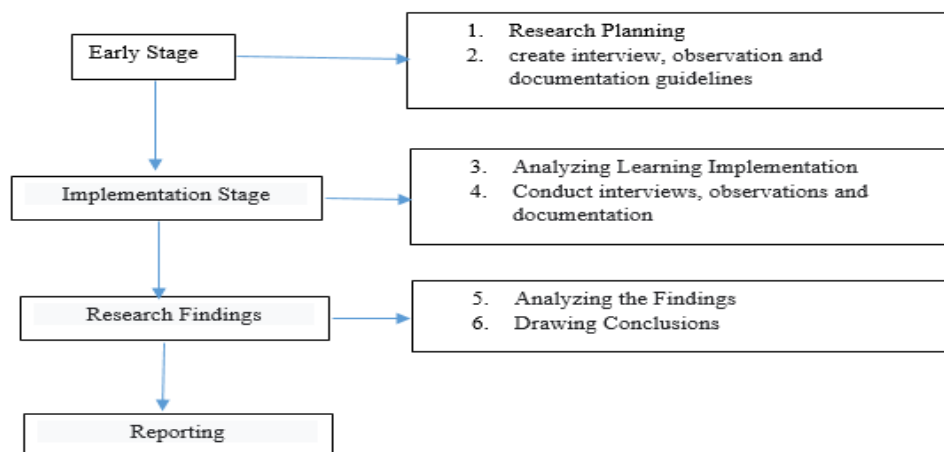
Many studies refer to sharpening the development of thought patterns, such as that carried out by (Ismono et al., 2018). who stated that Higher Order Thinking Skills

(HOTS) are really needed by chemistry education students, because they will become teachers who will teach HOTS to their students. This research is an analysis of the needs for developing an inquiry-based concept map learning model to train students' high-level thinking skills. Other research also supports the research stating that chemistry is the center of science. Sufficient chemical knowledge is also an important need for humans living in the modern era (Ibnu & Rahayu, 2020). In other research that has been carried out to analyze needs for model development, it requires collecting information into initial data which is very important for decision making. The next step is to carry out literature studies and empirical data as well as field activities. The literature review is also related to the analysis of initial data for other components that support producing a design for the next research stage which includes various supporting factors and facilities and infrastructure that support the product that will be produced in the form of model development and learning tools (Sujanem, 2015).

Based on several limitations in the packaging of learning resources in the form of modules and stages of inquiry-based learning, it is necessary to improve the packaging of learning resources and their stages. The inquiry-based model integrated with project assignments that will be developed in this research is an analysis of the needs for developing an inquiry-based model integrated with project assignments in high school chemistry teaching. The aim of preliminary research (needs analysis) in developing an inquiry-based model integrated with project tasks is to conduct literature studies and field studies. Literature study activities relate to (a) analysis of essential and strategic redox and electrochemical concepts, (b) analysis of the characteristics of inquiry-based models integrated into project assignments in high school chemistry teaching. Field study activities relate to (a) the use of essential and strategic redox and electrochemical concepts in learning, (b) facilities and infrastructure for carrying out project tasks that support learning and ICT that are available in high school, (c) references as available learning resources, (d) methods/models usually applied by teachers, and (e) obstacles faced by teachers and students in learning.

2. Method

The research subjects in this needs analysis are Senior High Schools (SMA) in Lhokseumawe City, Aceh Province. This information was collected through literature studies and empirical data from field studies. Literature studies relate to the analysis of documents and other materials that support product design. Field studies were carried out to collect information related to supporting factors for learning, including chemistry textbooks, student worksheets (LKS), practicum facilities, ICT, and the internet. The data needed for field study activities are learning support facilities, teaching strategies, and obstacles in implementing chemistry learning. The data sources for this field study activity are chemistry teachers and students. The data collection instruments used questionnaires/ fill-in lists, observation sheets, and interview guidelines. The data collection method is by giving questionnaires/ fill-in lists to chemistry teachers and students to make observations and interview. The research method is qualitative and quantitative with the research subjects being class XII students majoring in science and chemistry teachers in the city of Lhokseumawe, Aceh Province. The instruments used in this research were questionnaires, observation sheets and interviews. Several needs analysis data were obtained that support the development of learning models and media as well as teachers' tendencies to use inquiry learning models. The research procedures carried out by researchers are presented in Figure 1 below.

**Figure 1.** Research Procedure

There are 3 data collection techniques used by researchers to obtain data in the field, namely: (1) filling out questionnaires, (2) observation and interviews and (3) documentation. Interviews were conducted randomly with teachers and students of class Data analysis in this research refers to the qualitative and quantitative methods stated by Milles and Hubberman. The stages used in conducting data analysis are: data reduction, data display, conclusion and verifying (Miles & Huberman, 1984).

3. Results and Discussions

The research study process was carried out through the following steps. (1). Formulate the problem. The skills required are problem awareness, problem recognition and problem formulation. (2). Develop a hypothesis. The skills required to develop this hypothesis are testing and classifying available information, researching and formulating logical connections and formulating hypotheses. by researchers (3). Test sample answers. The skills required are identifying relevant events, gathering information and evaluating data, and data preparation, which involves translating, interpreting, and classifying data. (4). Data analysis, which consists of looking at relationships, identifying similarities and differences, and identifying trends, sequences, and patterns. (5). Draw conclusions. The skills required are looking for patterns and meaning in relationships and drawing conclusions. (6). Application of conclusions and generalizations (Aprilya, 2020).

Data collection was carried out using data collection techniques in the field, namely: (1) filling out questionnaires, (2) observation and interviews and (3) documentation. Interviews were conducted randomly with teachers and students of class Data obtained in the field based on surveys of students and teachers, both through filling out questionnaires, observations and interviews, obtained the following summary as shown in Table 1.

Table 1. Results of survey analysis of student

No	Analysis Result Data	Answer Percentage
1	Students find it difficult to understand chemistry material	62,5%
2	Students feel happy if the teacher uses models in chemistry learning	70%
3	Students want real (contextual) chemistry learning and carrying out practicum/project assignment	90%
4	Students need learning materials or active learning resources that can build HOTS that connect material with the real world (Contextual) in redox and electrochemical material	95%

In Table 1, some data is shown which states that students think chemistry material is difficult to understand, students feel happy if the teacher uses models in learning, students want real learning and according to students they have prepared themselves to learn, but the lesson is still difficult to understand, so students state requires modules/learning materials or active learning resources that can stimulate students' HOTS which can connect the material with the real world in redox and electrochemical materials. Below is also shown the data from the field survey, which is related to teachers, shown in Table 2.

Table 2. Results of survey analysis of teachers

No	Analysis Result Data	Answer Percentage
1	Teachers understand the use of learning models	100%
2	Teachers often use the inquiry model in class	60%
3	Teachers experience difficulties in implementing learning using the inquiry model	80%
4	Teachers need learning materials or active learning resources that can stimulate HOTS that connect material with the real world (Contextual) in redox and electrochemical material	89%

Table 2 shows some data obtained from observations, interviews and filling out questionnaires which states that teachers understand the use of models in learning, teachers often use inquiry learning models, but teachers find it a little difficult to apply inquiry models in class, teachers also apply HOTS in learning, So the teacher states that he needs modules/teaching materials or active learning resources that can connect the material with the real world (contextual) in redox and electrochemistry material which is designed to be integrated with student project assignments.

The problems felt by teachers and students in the field are problems that arise in the learning process, thereby hindering the achievement of learning objectives. In addition, with the demands of the curriculum in the current learning process, students must have 21st century skills, namely having 4C skills which improve students' high-level thinking skills (HOTS). Teachers also make efforts in the process of implementing learning in accordance with curriculum demands to achieve learning objectives, including by using various strategies, methods or learning models. The following can be seen from the results of observations, interviews and the results of filling out questionnaires by chemistry teachers from high schools in the city of Lhokseumawe, Aceh province, the data obtained as follows in Figure 2.

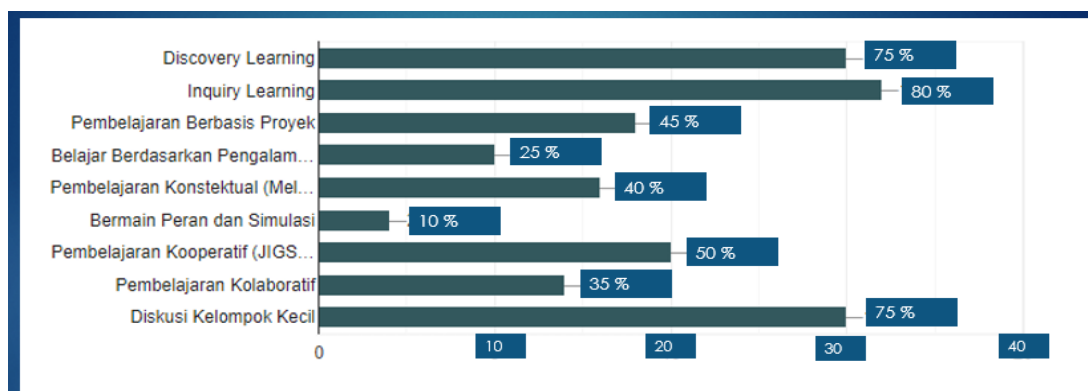


Figure 2. Learning models that teachers have practiced

Teachers' understanding of the use of learning models, if seen in Figure 1, can be seen in the graph, teachers already understand or are familiar with learning models, but why problems still occur in the field during the implementation process, this is what makes researchers want to study more deeply why there is still low motivation and results. Study. From the graph, it can be seen that around 80% of teachers use the inquiry learning model. Based on this data, based on a survey of teachers, researchers want to develop an inquiry-based model, which means that teachers are familiar with the use of this model, but do not yet have the right tricks for using the inquiry learning model. By combining survey data obtained from observations, interviews and filling out questionnaires with students, data analysis results also showed that around 62.5% of students still had difficulty understanding chemistry material. The model used most frequently or with the highest percentage is the model of taking notes in textbooks in notebooks shown in Figure 3. Below, survey data was also obtained from students in implementing the development of active learning models, one of which is inquiry-based learning. Below, the graph also shows the learning model data experienced by students in the class which is shown in Figure 3 as follows:

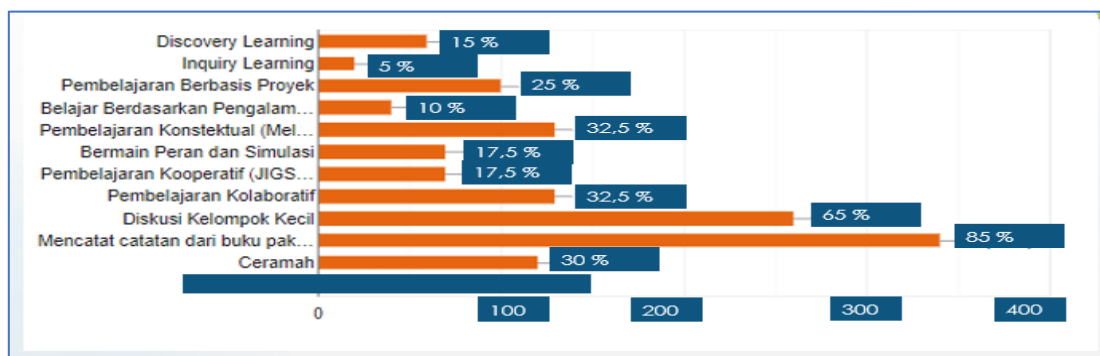


Figure 3. Learning models experienced by students in class

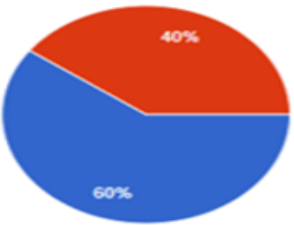
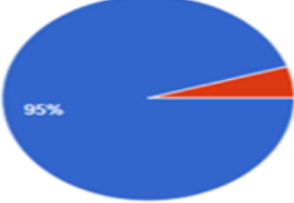
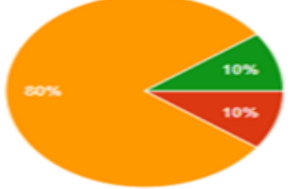
The graphic data was obtained from observations, interviews and filling out questionnaires. It can be seen that the highest percentage figure is the method of taking notes from textbooks, around 85%, and it can be seen that the use of the inquiry learning model experienced by students is only 5%, this shows the learning process experienced by students. There are still not many who apply the inquiry learning model. Teachers have not implemented learning that can build students' higher order thinking skills (HOTS). The learning that is experienced is just transferring notes from the textbook to the students, but the teacher does not invite students to learn to solve problems independently and will also receive assistance from the teacher as a reflection on learning. The use of any learning model will still require assistance and guidance to prevent misconceptions or conceptual errors from occurring.

The following is shown in the diagram from Table 3 of the results of the analysis regarding the use of the inquiry model in the classroom by teachers so far.

Regarding field research, the following is information obtained from survey results and interviews with chemistry teachers. (a) Important and strategic redox and electrochemical concepts are studied in research in accordance with the chemistry curriculum in the 2013 National Curriculum. The basic concepts applied are basically the same as those listed in Table 3. However, the concepts and principles studied have not been applied to improve thinking skills high level and problem solving skills. (b) Practical facilities and infrastructure for contextual or everyday redox and electrochemical

concepts such as voltmeters, zinc metal, iron metal, stopwatches, copper wire, battery solution, vinegar solution and other tools and aids for conducting experiments. ICT-related infrastructure includes data on the number of computers, computer technical data, available electrical power, intranet computer networks, available internet networks. Information about the availability of educational materials is also obtained, for example: collections of educational media, for example animations, simulations. The obstacles faced by teachers in inquiry learning and innovative use of ICT are limited time, creating problems, only smart students can solve problems. Chemistry teachers must optimize the use of ICT (Computer Information and Technology) because although there is still limited use of internet access, teachers and students must be able to adapt learning according to the current technological era which refers to sources in ICT-based learning.

Table 3. Analysis results regarding the use of the inquiry model by teachers in teaching chemistry

Number	Questions	Analyst Data
1	Teacher Familiar with inquiry learning model	 ● Ya, sedikit ● ya, banyak ● tidak
2	The teacher has applied the inquiry learning model in class	 ● Pernah ● Belum
3	Is the use of the inquiry learning model difficult to implement in the classroom?	 ● sangat sulit ● sulit ● sedikit sulit ● tidak sulit

Based on a study of the 2013 National Curriculum high school chemistry material and in synergy with the Merdeka Curriculum, Erlangga publisher chemistry book, (Sudarmo, 2013). Erlangga publisher chemistry book (Sudarmo, 2018). The essential and strategic concepts and principles of redox and electrochemistry are obtained as in Table 4. Strategic chemical concepts and principles are intended as chemical concepts and principles which, if the concepts and principles are mastered by students, then they will be able to Learn other concepts and principles for yourself.

The inquiry learning model is used as a solution because this model is a series of learning that emphasizes critical and analytical thinking to search for and find answers to a question (Sanjaya, 2010). The inquiry learning model is a model that can encourage students to actively participate in learning, inquiry learning is learning where students are encouraged to learn through their own active involvement with concepts and principles, and teachers encourage students to gain experience and carry out experiments that allow

students to discover the principles. principles for themselves (Aris, 2014). The exploratory learning model is a series of learning activities that emphasize student activity to gain learning experience based on the problems faced in discovering material concepts that are integrated with project assignments.

Table 4. Class XII chemistry material in KD redox and electrochemistry material

Basic Knowledge Competencies	Basic Competency Skills	Inquiry Based Integrated Project Task
3.3. Balancing reaction equations	4.3. Determine the order of oxidizing or reducing power based on experimental data	Project Assignment 1
3.4. Analyze the processes that occur in Volta cells and explain their uses	4.4. Designing a Volta cell using nearby materials	Project Assignment 2
3.5. Analyze the factors that influence the occurrence of corrosion and how to overcome it	4.5. Propose ideas to prevent and overcome corrosion	Project Assignment 3
3.6. Applying redox reaction stoichiometry and Faraday's law to calculate quantities related to electrolysis cells	4.6. Presents a design for the procedure for gilding metal objects with a certain layer thickness and area	Project Assignment 4

Table 5. Essential and strategic redox and electrochemical concept

KD	Konsep-konsep Redoks dan Elektrokimia yang Essensial dan Strategis
3.3	Penyetaraan Reaksi Redoks
4.3	Daya Desak Logam
3.4	Sel Volta
3.4	Potensial Elektrode Standar (Deret Volta)
4.4	Sel Volta Baterai Penyimpan Listrik
3.5/4.5	Korosi
3.5/4.5	Sel Elektrolisis
3.5/4.5	Reaksi Elektrolisis Elektrode Inert
3.6	Reaksi Elektrolisis Elektrode non Inert
3.6	Aspek Kuantitatif Elektrolisis (Hukum Faraday)
3.6	Stoikiometri Elektrolisis
3.6	Penggunaan Elektrolisis dalam Industri
4.6	Elektroplating dan Galvanisasi

The results of data collection analysis through observation, interviews and filling out questionnaires show that around 89% of teachers need model books that build student HOTS in learning and around 95% of students need learning model books that can build student HOTS that can hone students' critical and analytical thinking skills. Based on problem analysis, the aim of this research is to analyze and describe the needs of teachers and students in implementing learning using the development of an inquiry-based learning model integrated with project assignments. The infrastructure related to the development of an inquiry-based learning model integrated with project assignments available at Lhokseumawe City High School, Aceh Province is quite adequate, however there are not yet available active learning resources for teachers and students that facilitate the development of an inquiry-based model integrated with project assignments both in terms of content, media and learning design.

4. Conclusions

The results of the data collection analysis through observation, interviews and filling out questionnaires show that the results obtained from the analysis of student and teacher needs are that several data are obtained that support learning media and teachers'

tendencies to use the inquiry learning model. Survey data was obtained from students and teachers as follows which shows that the needs of students are (1) Students find it difficult to understand chemistry material 62.5%, (2) Students feel happy if teachers use models in learning 70%, (3) Students want real (contextual) learning and 90% practicum/project assignments. The data also shows that the needs needed by teachers are (1) Teachers understand the use of the 100% learning model, (2) Teachers often use the 60% inquiry model, (3) Teachers experience difficulties in implementing the 80% Inquiry model. Data on the use of the inquiry model by teachers shows (1) Teachers are familiar with the use of the inquiry model 60%, (2) Teachers have applied the inquiry model in class 95%, (3) Teachers need learning support media because they experience difficulties in carrying out learning using the inquiry model 80 %. The conclusion of the needs analysis through a survey of students and teachers on the development of an inquiry-based model integrated with project assignments as teaching materials or active learning resources that can build student HOTS that can be connected to the real world (contextual) is that the percentage of student needs is 95% and the percentage of teacher needs is 89%.

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6. References

- Aktas, G. S., & Unlu, M. (2013). Critical thinking skills of teacher candidates in elementary mathematics. *Procedia-Social and Behavioral Sciences*, 93, 831-835. <https://doi.org/10.1016/j.sbspro.2013.09.288>
- Aprilya, A. P. (2020). *Penggunaan Model Inquiry Learning dalam Pembelajaran*. Ahlimedia Book.
- Aris, S. 2014. *68 model pembelajaran inovatif dalam kurikulum 2013*. Yogyakarta : Ar-Ruzz Media.
- Ibnu, S., & Rahayu, S. (2020). The effectiveness of new inquiry-based learning (NIBL) for improving multiple higher-order thinking skills (M-HOTS) of prospective chemistry teachers. *The Effectiveness of New Inquiry- Based Learning (NIBL) for Improving Multiple Higher-Order Thinking Skills (M-HOTS) of Prospective Chemistry Teachers*, 9(3), 1309-1325.
- Ismono, I., Poedjiastoeti, S., & Suyoto, S. (2018). Implementation of Learning Model Map Concept with Inquiry Strategy in an Effort to Train High- Order Thinking Skills of Chemistry Education Students. *Atlantis Highlights in Engineering (AHE)*, Vol. 1. Atlantis Press.
- Lembaga Tinggi Masuk Perguruan Tinggi, (LTMPPT). (2022).
- Miles M, B., & Huberman, M, A. (1984). Qualitative data analysis: A sourcebook of new methods. *Beverly Hills: Sage Publications*.

Peraturan Menteri Pendidikan dan Kebudayaan RI Nomor 65 Tahun (2013) tentang *Standar Proses Pendidikan dasar dan Menengah*.

Priantini, D. A. M. M. O., Suarni, N. K., & Adnyana, I. K. S. (2022). Analisis kurikulum merdeka dan platform merdeka belajar untuk mewujudkan pendidikan yang berkualitas. *Jurnal Penjaminan Mutu*, 8(02), 243-250.

Prihadi, B. (2014). Penerapan langkah-langkah pembelajaran dengan pendekatan saintifik dalam kurikulum 2013. *House Traning Implementasi Kurikulum 2013 di SMPN 8 Kota Pekalongan*, 4.

Sanjaya, S. (2010). Peningkatan kualitas perkuliahan mata kuliah Kimia Fisika I melalui penerapan metode kelompok kecil. *Kognisi 1*, 1-8.

Sudarmo, U. (2013). *Kimia 3 untuk SMA Kelas XII. Revisi K-13*. Jakarta: Erlangga.

Sudarmo, U. (2018). *Kimia 3 untuk SMA Kelas XII. Revisi K-13*. Jakarta: Erlangga.

Sujanem, R. (2015). Analisis kebutuhan pengembangan model Pro-BBL untuk meningkatkan ketrampilan-keterampilan berpikir kritis siswa dalam pembelajaran Fisika SMA. In *Prosiding Seminar Nasional MIPA*.