



Analysis of High Level Thinking Skills, Character and Skills of Science Process of High School Students in Project Based Learning

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Abstract

This study aims to analyze higher order thinking skills, character, and science process skills of high school students on plant tissue material through the Project Based Learning (PPA) model. This research method uses Pre-Experimental Designs. This research was conducted in Muhammadiyah 1 Karanganyar high school. The research sample used was 78 students. The instruments used were multiple choice questions and observation sheets. Student learning outcomes data were analyzed using the N-Gain technique and the minimal classical completeness test to determine higher order thinking skills (HOTS). The results showed that the Project Besed Learning (PjBL) Model was effective in improving students' high-order thinking skills (HOTS) with an average N-Gain of 0.52 in the "medium" category. Effectively growing student character with an average score percentage of 70.36% is included in the "good" category. The character of students that grows includes disciplinary responsibility and cooperation. And it is effective in growing students' science process skills with an average score of 74.73% of science process skills in the "good" category, the science process skills that grow are observing, planning experiments, carrying out experiments, and communicating.

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INTRODUCTION

In this globalization era, Indonesian education is faced with various challenges and opportunities. According to Wijaya *et al.* (2016), students must have key competencies to be able to take part in real life in the 21st century. Through the Ministry of National Education, the Government has one of the main programs to improve the quality of education processes and outputs at the primary and secondary education levels, namely the development of character education, HOTS skills and abilities in students. Curriculum 2013 revised 2017 curriculum changes are focused on improving the linkage between core competencies (KI) and basic competencies (KD). As well as the need to meet not only four kinds of things: Strengthening the Character Education (PPK); Literacy in the context of the school literacy movement; 4C (Creative, Critical thinking, Communicative, and Collaborative); and Higher Order Thinking Skill (HOTS) so that teachers need creativity in designing it (Wulandari & Mardiyah, 2018).

In biology learning, gaps were found in assessment techniques. The assessment process that has been carried out is only able to reveal in one area only, which should be able to develop the competence of attitudes, knowledge and skills (Sari *et al.*, 2015 & Sadia, 2013). Many students still do not get 21st century skills when carrying out learning in schools due to transferring knowledge from teachers to students through the lecture method and dominating learning so that teacher-centered learning. (Mayangsari *et al.*, 2016).

The next challenge is to develop *higher order of thinking* (HOT) in science learning. In fact, learning is still oriented towards developing and testing memory, thinking abilities of learners so that learners are reduced and simply understood as the ability to remember, (Yen & Halili, 2015; & Yani, 2016). Students are required to have character qualities that are in accordance with the demands of 21st century skills, so efforts are made to strengthen character education (Kemendiknas, 2011).

Then students are also required to have science process skills to use scientific methods in developing science and acquire new knowledge or develop existing knowledge and involve intellectual, manual and social skills (Dahar, 2011). These three

aspects that are owned by students will be facilitated to develop when students take an active role in the learning process. These roles include being a discussion participant, experimenter, presenter of discussion and experiment results, project implementer, and others.

In the 2013 Curriculum, biology learning activities use a scientific approach (scientific approach), although in fact it's not new. This scientific approach emphasizes the activeness of students in learning, and provides opportunities for students to build concepts in their knowledge independently, familiarize students with formulating, dealing with, and solving problems found (Marjan, 2014). This approach is able to improve the HOTS character, skills and abilities of students in learning, because it directly involves students in multiplying and finding concepts based on facts found individually or in groups.

Learning models that can train 21st century skills must have criteria that are student-centered, teamwork, and learning related to the context of everyday life so that problems encountered in everyday life can be used as learning topics. One learning model that meets these criteria is the *problem-based learning* (PPA) learning model (Mayasari *et al.*, 2016). The existence of Project Based Learning learning on plant tissue material, students can do project-based practicum and can make preparations and observe directly.

The purpose of this study was to analyze the ability of high school students in higher order thinking (HOTS), character, and science processes of high school students in biology learning through the *Project Based Learning* (PJBL) model.

METHODS

This study uses the *Pre-Experimental Designs* method with the research design of *One-Shot Case Study*. This study menggunakan two classes with the same treatment and starting capabilities similar assumptions. The results were observed by being given a *post test* for each class at the end of the lesson. The sample used in the study was two classes for the experiment with a total of 78 students. The data collected were in the form of students' higher order thinking skills (HOTS), student character and student science process skills. The research data were obtained from multiple

choice questions with HOTS question type and observations on the character and science process skills of students during the PjBL learning process.

Types of data, data collection techniques, instruments and data analysis techniques can be seen in table 1.

Table 1. Types of Data, Data Collection Techniques, Instruments, Data Analysis Techniques.

| Type of Data | Data Collection Techniques | Instrument | Data analysis technique |
|---|----------------------------|---------------------------|--|
| Students' higher order thinking skills (HOTS) | Test | Multiple choice questions | N-Gain Minimal Classical Completeness Test |
| Student character | Observation | Observation sheet | Descriptive Percentage |
| Science process skills | Observation | Observation sheet | Descriptive Percentage |

RESULTS AND DISCUSSION

The data in this study were in the form of students' ability in high-order thinking (HOTS), character, and science process skills of class 11 students as many as two classes on learning plant networks at Muhammadiyah 1 Karanganyar high school for the 2019/2020 academic year. Assessment of science process skills (psychomotor) and character development (affective) is carried out by direct observation during the learning process. And for HOTS (cognitive), it was done by pretest and posttest covering plant tissue material. Submaterials include identifying types of tissue in

plants, explaining totipotential properties and tissue culture and analyzing the structure and function of tissues in plants.

High Order Thinking Skills (HOTS) of High School Students

Students' high order thinking skills (HOTS) were carried out using HOTS questions about plant tissue during the *pre-test* and *post-test* with the Minimum Completion Criteria (KKM) ≥ 75 . The number of questions tested was 20 multiple choice questions. The results of the *pre test* and *post test* are presented in Table 2

Table 2. Results of High Order Thinking Skills (HOTS)

| Data | Nilai | N-Gain | Criteria |
|---------------------------|-------------|--------|----------|
| Pre test mean score | 42.76 | | |
| Post test mean score | 73.08 | 0.52 | Moderat |
| The number of students | 78 students | | |
| Students complete | 62 students | | |
| Students are not finished | 18 students | | |
| Lowest pre test score | 15 | | |
| Highest pre test score | 65 | | |
| Lowest post test score | 25 | | |
| Highest post test score | 90 | | |

Based on Table 2 , information can be obtained that the overall average value has increased, it can be seen in the results of the N-Gain calculation, namely 0.52 with moderate criteria. This shows that the PjBL model is effective in improving the knowledge aspect. In this study, the *pre-test* was carried out before the learning activities were carried out to determine the extent to which students understood the material to be studied using the PjBL model. The results of the students' *pre-tests* showed that all students had not reached the specified KKM, meaning that none of the students had completed the initial test before learning with an average pre-test score of 42.76. And the *post test* is

carried out after the learning activity uses the PjBL model. The *post test* results showed an increase in learning outcomes, as many as 62 students who completed the total number of students as many as 78 students. This shows that the PjBL model is able to provide an effect in the form of increasing student knowledge outcomes .

Higher order thinking skills (HOTS) are needed by students to increase students' creativity in science, such as synthesis and evaluation skills (Saido, 2015). Improving student learning outcomes is not only from seeing or reading theory, but also by carrying out applied learning activities so that students can relate their knowledge contextually,

like working on a project on the PjBL model. Thus students can know directly the plant tissue and can distinguish parts of plant tissue.

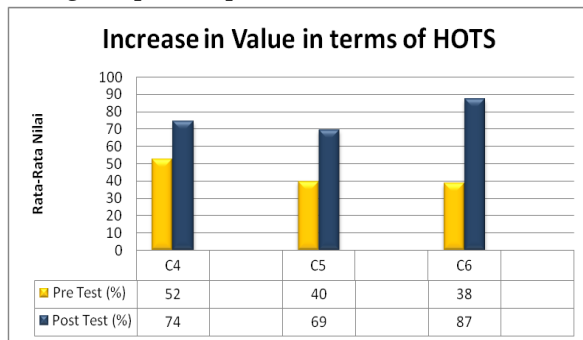


Figure 1. Increase in Value Viewed from the HOTS Point of View.

The questions made included high-order thinking skills (HOTS) and science process skills (KPS) in accordance with contextual learning on plant tissue material and the questions presented in the test emphasized the application questions. At high level thinking skills (HOTS), the questions are used at level 3 (reasoning level), including the dimensions of the thinking process to analyze (C4), evaluate (C5), and create (C6) (Kemendikbud, 2017). Each dimension at the level of reasoning has increased before and after learning (Figure 1). The analyzing dimension (C4) has the highest percentage, namely 77% in the "very good" category. Problem type C4 demands the ability of students to specify aspects / elements, describe, organize, compare, and find implied meanings. Meanwhile, the types of questions C5 and C6 had a similar percentage, namely 68% and 65% in the "good" category. In the C5 type question (evaluating), it requires the ability of students to formulate hypotheses, criticize, predict, assess, test, justify or blame. And about type C6 (creating), demands the ability of student participants to design, build, plan, produce, discover, renew, perfect, strengthen, beautify, compose. HOTS questions at the reasoning level are not always difficult questions.

Problems with the HOTS type are characterized as containing interesting stimuli to encourage students to read, contextual stimuli such as pictures / graphics, text, visualization and others according to the real world, and on questions measuring cognitive aspects of reasoning such as analyzing, evaluating and creating / creating).

This is in accordance with the research conducted by Sambite *et al.* (2019) state that learning using the PjBL model shows the percentage of classical completeness in cycle 2 has reached the research target. Students have started to get used to working on HOTS questions which consist of questions in the realm of analyzing (C4), evaluating (C5) and creating (C6) seen from the increase in the average score in the HOTS domain. This project based learning can improve students' higher order thinking skills (Rahayu, *et al.*, 2017; Fitri, *et al.*, 2018; Eliyasni *et al.*, 2019; & Takiddin, *et al.*, 2020).

The increase in higher order thinking skills in students during the learning process through the project based learning (PjBL) model, occurs when students are actively able to understand factual, conceptual, and procedural knowledge of application and connect new information with information already stored in their memory and combine knowledge and developing information obtained to achieve goals or find solutions to situations that are difficult to solve with their experience (Deluca, 2011; Anderson & Krathwohl, 2015; & Kurniati, *et al.*, 2016). Teacher guidance contributes to this during the learning process by preparing a series of well-planned and well-planned activities (Zerihun *et al.* 2012).

High School Student Character

The results of observations on student character obtained during learning activities, from project planning, project implementation, product manufacturing, to product presentation. The results of the character of high school students can be presented in Table 3.

Table 3. High School Student Character

| Value of each Character | | |
|-------------------------|-----------|----------|
| Character | Score (%) | Category |
| Responsible | 67.77 | B |
| Discipline | 76.44 | SB |
| Cooperation | 66.88 | B |
| Average | 70.36 | B |

In the character (affective) aspect, it is assessed through observation during the learning process, based on project implementation and product creation, in accordance with the PjBL model. The characters observed include responsibility, discipline and cooperation, each

indicator is adjusted to the activities to be carried out, such as during discussions, practicum and presentations. When conducting observations, it was found that the average percentage of student character results was 70.36% in the "good" category (Table 3). The highest discipline character among other characters is in the "very good" category with a percentage of 76.44%. Discipline indicators include, 1) orderly carrying out project activities according to the schedule made; 2) collect products / reports on time; 3) following project / experimental steps; 4) return the project / experimental equipment to its original place . The highest indicators are 3 and 4, because at the time of observation students follow the experimental steps in accordance with the experimental planning and teacher guidance, and students return practical equipment such as microscopes and others after completing experiments in the school laboratory. The lowest indicator is 2, because students, at the time of project planning and assignment collection, do not collect on time and some do not collect assignments in the form of project planning and reports.

The character of responsibility has an average percentage of 66.88% with the "good" category , the highest indicator is preparing the tools and materials for the project / experiment, when the learning process takes place to conduct an experiment, students seem interested and want to participate so that each group shares the tools and materials to be used for group members. While the lowest is in the sub-indicators of completing group assignments, in the learning process students are required to complete student worksheets such as planning experiments and implementing experiments, and making reports. The character of cooperation has an average percentage of 67.77%, the highest indicator is active in group work, seen when students are active in experimenting when making preparations and during group discussions.

While the lowest sub-indicator is unity in completing project tasks, seen when assignments are not collected on time and some do not collect assignments. At the time of the learning process are contained kegi a tan pratikum, tersebut can foster students' character (Ardianto & Priyono, 2014 ; & Goddess & Setyaningsih, 2016) . And student character can grow through the learning process with the PjBL model (Hendikawati, *et al.*, 2016 &

Setiono, *et al.*, 2020) . Anggriani *et al.* , 2019 stated that the *Project Based Learning* model can also foster various characters, such as the character of discipline, responsibility and mutual cooperation. P Education characters that are integrated in the learning of biology is able to provide meaningful experience for the students, because they understand, internalize and download gaktualisasika nnya through p r OSeS learning, and can be absorbed naturally through daily activities and can be achieved through the emotions and habits of students (Aisyah , 2014 & Machin, 2014).

Student character can grow during the learning process through the *project based learning* (PjBL) model, which occurs when students have the willingness to follow and pay attention selectively to instructions that are given by themselves during their learning activities. Then with students who actively participate in the learning process, students are able to accept existing life values that are shown through student attitudes and are able to show character through student actions or actions. Students begin to build a consistent value system within themselves. Then the consistent, consistent and predictable behavior of students in their activities makes students unique characteristics (Herman & Yustiana, 2014).

The character that develops is not only seen from the results, but also in the process. Therefore, the teacher has a duty to be morally responsible for shaping the moral values of the teacher and facilitating students with each step of their learning by deliberately sharing habitual and consistent charitable actions (Hardiwinarto, 2010 & Abu, 2015).

High School Student Science Process Skills

The results of observations on students' science process skills obtained during learning activities, from project planning, project implementation, product manufacturing, to product presentation. The results of high school students' science process skills can be presented in Table 4.

Table 4. High School Student Science Process Skills

| The value of each KPS | | |
|-------------------------|-----------|----------|
| Science Process Skills | Score (%) | Category |
| Observing / Observation | 84.29 | SB |
| Planning an experiment | 64.53 | B |
| Carry out an experiment | 89.22 | SB |

| The value of each KPS | | |
|------------------------|-----------|----------|
| Science Process Skills | Score (%) | Category |
| Communicating | 60.90 | B |
| Average | 74.73 | SB |

In the aspect of science process skills (psychomotor), it can be observed through observation during the learning process, based on project implementation and product manufacturing, which is in accordance with the PjBL model (Table 4). PjBL is effective against students 'science process skills (KPS), this can be seen from the average percentage of students' science process skills scores 75% with the "good" category. In KPS observing / observations in the "very good" category. The highest indicator of observing / observation is doing experiments on preparations, when doing experiments, this is the first experience of some students in observing plant tissue, so that students are still awkward in observing, but students have a curiosity and want to try doing experiments in make preparations. Students can also collect and use relevant facts about plant tissue material based on observations during the experiment and sources obtained from books and the internet. And students can make observations according to the facts in the field on the preparations that have been made.

At KPS planning experiments and communicating in the "good" category. In KPS planning experiments, indicators determine the tools and materials to be used and determine the steps in carrying out the project / experiment, students are able to plan and write down what activities will be carried out. While the indicators determine the schedule of activities carried out until the product is finished, students still do not understand in determining the schedule of activities because in the learning process the PjBL model is rarely used. At the KPS communication, indicators describe / describe and convey the results of the observation / project reports, students are able to describe and convey the results of their observations through presentations in front of the class even though there are some students who have not submitted them because the results of the reports have not been completed. PjBL also has an effect on students 'communication skills, such as improving students' skills to present their projects in class (Saenab *et al* , 2018). And on the indicators of compiling reports systematically and clearly, each

group did not understand the mathematics of report preparation even though it had previously been explained by the teacher, only a few groups were systematic in preparing reports. According to Nawawi *et al.* (2017) revealed that students' communication skills were increasingly visible because students completely experimented .

The highest student's science process skill was conducting an experiment in the "very good" category. The highest indicator is carrying out the steps in project activities, when carrying out the experimental process students carry out the steps according to the experimental planning that has been made and teacher guidance. Students can make project products in the form of plant tissue preparations, but some students do not record the experimental results because students are more focused on observing the preparations through a microscope. Djamarah (2010) states that through practicum students can experiment during the learning process so that students experience firsthand the material being studied and familiarize students with using science process skills and can learn individually or in groups .

Besides having a positive effect on cognitive abilities and science process skills, practicum can also motivate students to learn, and students become active in the learning process by making experiments (Muamar *et al.* , 2017). Practical activities in the *project based learning* (PjBL) model can improve students' science process skills , because the assessment is carried out during the activity process and not only on the final product (Sarlivanti, *et al.*, 2014; Chasanah, 2016; Rofiqoh, *et al.*, 2015 & Varadela, *et al.*, 2017).

On Lestari *et al.* (2018) found that by doing practicum / experiments able to grow science process skills, including observing / observing, planning experiments, and communicating in the "enough" category and conducting experiments in the "good" category. In its implementation, it is able to provide motivation in exploring knowledge, arouse interest in learning and improve science process skills. Learning *Project Based Learning* influence on science process skills, students are able to design and conduct experiments on materials that have been taught, and capable of designing and conducting experiments on any material. (Asmi, *et al.*, 2014 ; & Kusumaningrum & Djukri, 2016 ;).

Students' science process skills can grow during the learning process through the *project based learning* (PjBL) model, which occurs when students use their sensory tools to stimulate awareness, select or select relevant assignments and interpret cues from an action performance. Indirectly, students do mental, physical, and emotional preparation. Students mimic or repeat the actions exemplified by the teacher and identify appropriate responses. Then the learned responses become students' habits and are carried out based on ability. The abilities that have been obtained make skills that can be developed properly so that students can modify movement patterns according to special requirements. Then students have the ability to create creativity using very high skills (Herman & Yustiana, 2014).

High School Student Products

Project assignments carried out by students produced products in the form of plant tissue preparations and reports. In high school student products, there are several stages in the product-making process, such as stage 1 is planning, stage 2 is a manufacturing process consisting of preparation of tools and materials and manufacturing techniques. Stage 3 is the end which consists of

making preparations and making reports. Preparation consists of slicing the material properly, laying the material on top of the slide, and observing the preparation being made. And in the making of the report consists of compiling a report, describing the results of plant tissue preparations, giving information on the results of the image preparations, and giving an explanation of the pictures. The results of the product manufacturing stages are presented in Table 5.

Based on Table 5 , it shows that the highest percentage of results in the product manufacturing stage is to make preparations in the "very good" category, while making lower reports with the "good" category. This is in accordance with Chasanah (2016) that the PjBL model is effective in improving students' skills when doing practical activities, because the assessment is not only on the final product but is carried out during the PjBL model activity process. As well as the assessment is carried out by making observations in each group, using indicators at each stage. Likewise, the stages of making preparations include indicators of slicing the material properly, placing the material on the glass preparation, and observing the preparations made.

Table 5. Results of Product Manufacturing Stages

| Stages | Average (%) | Category |
|---|-------------|----------|
| Planning Stage | 66.67 | B |
| Manufacturing Process Stage | 79.2 | SB |
| Preparation of tools and materials | 83.33 | SB |
| Manufacturing technique | 75.00 | SB |
| Final Stage | 71.27 | B |
| Making Preparations | 80.56 | SB |
| Slice ingredients properly | 75.00 | B |
| Putting material on the glass preparation | 91.67 | SB |
| Observe the preparations made | 75.00 | B |
| Make a report | 61.98 | B |
| Prepare reports | 52.08 | B |
| Describe the results of the preparations | 66.67 | B |
| Annotate the results of the preparation image | 70.83 | B |
| Give an explanation in the picture | 58.33 | B |
| Average | 72.09 | B |

In making preparations and reports (Table 5), students make products through several stages until they reach the final stage in the form of a product. The percentage of results making preparations is greater, namely 80.6% with the

"very good" category, while the percentage of results making reports is 62% in the "good" category. When students understand and implement science process skills in learning, science becomes more interesting and increases a positive attitude

towards science (Zeidan & Jayosi, 2015). Learning biology will be meaningful if students are actively involved intellectually, manually and socially. The development of science process skills as a process and a product needs to be developed through direct experience, as a learning experience and to realize it when activities are ongoing (Suryaningsih, 2017, Varadel *et al.*, 2017, Royani *et al.*, 2018).

The *project-based learning* (PPA) model can train 21st century skills that are centered on students, teamwork, and learning related to the context of everyday life so that problems encountered in everyday life can be used as learning topics (Mayasari *et al.*, 2016). Through *PjBL*, the *inquiry* process begins by raising a guiding *question* and guiding students in a collaborative project that integrates various subjects (materials) in the curriculum. If a teacher is successful in managing teaching-learning interactions, success will be seen in the form of student learning achievement (Gusti, 2017).

CONCLUSION

Based on the research, the ability of students at Muhammadiyah I Karanganyar high school in high-level thinking (HOTS) on plant tissue material can be increased through the Project Based Learning (PjBL) model. As well as student character and science process skills (KPS) students at the Muhammadiyah I Karanganyar high school on plant tissue material can grow through the Project Based Learning (PjBL) model.

REFERENCES

- Abu, L, Mokhtar, M., Hassan, Z. & Suhan, S.T. (2015). How to Develop Character Education of Madrasa Students in Indonesia. *Journal of Education and Learning*. Vol. 9(1) pp. 79-86.
- Aisyah. (2014). The Implementation of Character Education Through Contextual Teaching and Learning at Personality Development Unit in the Sriwijaya University Palembang. *International Journal of Education and Research*, Vol. 2 No. 10, 203-204.
- Anderson, L.W. & Krathwohl, D.R. (Eds). 2015. *Kerangka landasan untuk pembelajaran, pengajaran, dan asesmen: revisi taksonomi pendidikan*. Yogyakarta: Pustaka Pelajar.
- Anggriani, F., Wijayati, N., Eko Budi Susatyo, E. B., & Kharomah. (2019). Pengaruh *Project Based Learning* Produk Kimia terhadap Pemahaman Konsep dan Keterampilan Proses Sains Siswa SMA. *Jurnal Inovasi Pendidikan Kimia*, Vol 13, No 2, 2404 – 2413.
- Asmi, S., Hasan, M., & Safitri, R. (2017). Penerapan Model Pembelajaran Berbasis Proyek pada Materi Suhu dan Kalor untuk Meningkatkan Keterampilan Proses. *Jurnal Pendidikan Sains Indonesia*, Vol. 05, No.01, 20-26.
- Chusnani, D. (2013). Pendidikan Karakter Melalui Sains. *Jurnal Kebijakan dan Pengembangan Pendidikan*, Volume 1, Nomor 1.
- Dahar, R. W. (2011). *Teori-teori Belajar dan Pembelajaran*. Jakarta: Erlangga.
- Deluca. 2011. The GRIDc Project Developing Students's Thinking Skills in a Data-Rich Environment. *Journal of Technology Education*. Vol 23.
- Djamarah, Syaiful Bahri dan Aswan Zain. (2010). *Strategi Belajar Mengajar*. Jakarta: Rineka Cipta.
- Eliyasn, E., Kenedi, A. K., & Sayer, I. M. (2019). Blended Learning and Project Based Learning: The Method to Improve Students' Higher Order Thinking Skill (HOTS). *Jurnal Iqra' : Kajian Ilmu Pendidikan* 4(2): 231–248.
- Fitri, H., Dasna I. W, & Suharjo. (2018). Pengaruh Model *Project Based Learning* (PjBL) Terhadap Kemampuan Berpikir Tingkat Tinggi Ditinjau dari Motivasi Berprestasi Siswa Kelas IV Sekolah Dasar. *BRILIANT: Jurnal Riset dan Konseptual Volume 3 Nomor 2*, 201-212.
- Gusti, S. W. (2017). Analisis Hasil Implementasi Kurikulum 2013 dalam Aspek Sikap, Pengetahuan dan Keterampilan pada Mata Pelajaran Biologi SMA di Kabupaten Sleman Yogyakarta. *Jurnal Prodi Pendidikan Biologi*, Vol 6 (5), 312-322.
- Hadiwinarto. (2010). *Karakter dan Budi Pekerti*. Solo: PT Bahana Media Wirayuda.
- Hendikawati, P., Sunarmi & Mubarak, D. (2016). Meningkatkan Pemahaman dan Mengembangkan Karakter Mahasiswa Melalui Pembelajaran Kolaboratif Berbasis Proyek. *Kreano, Jurnal Matematika Kreatif- Inovatif*, 7(2), 123-130.
- Kemendikbud. (2017). *Modul Penyusunan Soal Higher Order Thinking Skill (HOTS)*. Jakarta: Kementerian Pendidikan dan Kebudayaan.
- Kemendiknas. (2011). *Panduan Pelaksanaan Pendidikan Karakter*. Jakarta: Kementerian Pendidikan dan Kebudayaan.
- Kurniati, D., Harimukti, R., & Jamil, N. A. (2016). Kemampuan berpikir tingkat tinggi siswa SMP di Kabupaten Jember dalam menyelesaikan soal berstandar PISA. *Jurnal Penelitian dan Evaluasi Pendidikan*, 20(2), 142- 155.
- Kusumaningrum, S., & Djukri, D. (2016). Pengembangan Perangkat Pembelajaran Model *Project Based*

- Learning* (PjBL) untuk Meningkatkan Keterampilan Proses Sains dan Kreativitas. *Jurnal Inovasi Pendidikan IPA*, 2 (2), 241 - 251.
- Lestari, M.Y & Diana, N. (2018). Keterampilan Proses Sains (KPS) pada Pelaksanaan Pratikum Fisika Dasar I. *Indonesian Journal of Science and Mathematics Education 01 (1)* 49-54.
- Machin, A. (2014). Implementasi Pendekatan Saintifik, Penanaman Karakter dan Konservasi pada Pembelajaran Materi Pertumbuhan. *Jurnal Pendidikan IPA Indonesia*, 3 (1), Hal: 28-35.
- Marjan, J., Arnyana, I. B. P., & Setiawan, I. G. A. N. (2014) Pengaruh Pembelajaran Pendekatan Saintifik Terhadap Hasil Belajar Biologi dan Keterampilan Proses Sains Siswa MA Mu'allimat NW Pancor Selong Kabupaten Lombok Timur Nusa Tenggara Barat. *e-Journal Program Pascasarjana Universitas Pendidikan Ganesha*, Vol. 4.
- Mayasari, T., Kadarohman A., Rusdiana, D., & Kaniawati, I. (2016). Apakah Model Pembelajaran Problem Based Learning dan Project Based Learning Mampu Melatihkan Keterampilan Abad 21. *JPFK*, Vol. 2 (1). 48 – 55.
- Muamar, M.R., Rahmi. (2017). Analisis Keterampilan Proses Sains DAN Keterampilan Kognitif Siswa melalui Metode Pratikum Biologi pada Sub Materi *Scizophyta dan Thallophyta*. *Jurnal Pendidikan Almuslim*, Vol. V No.1, 1-10.
- Nawawi, S., Amilda, & Sari M. P. (2017). Pengaruh Model Pembelajaran Berbasis Proyek terhadap Keterampilan Proses Sains pada Materi Pengelolaan Lingkungan. *Jurnal Pena Sains*, Vol. 4, No. 2, Hal: 88-96.
- Rahayu, H., Purwanto, J. & Hasanah, D. (2017). Pengaruh Model Pembelajaran Project Based Learning (PjBL) terhadap Kemampuan Berpikir Tingkat Tinggi. *Jurnal Ilmiah Pendidikan Fisika-COMPTON*, Volume 4, Nomor 1, 21-28.
- Rofiqoh, W. E. Y., & Nana Kariada Tri Martuti, N. K. T. (2015). Pengaruh Pratikum Jamur Berbasis Keterampilan Proses Sains terhadap Hasil Belajar Biologi Materi Jamur. *Unnes Journal of Biology Education 4 (1)*, 9-15.
- Royani, R., Mirawati, B., & Jannah, H. (2018). Pengaruh Model Pembelajaran Langsung Berbasis Pratikum Terhadap Keterampilan Proses Sains dan Kemampuan Berpikir Kritis Siswa. *Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, Vol. 6, No, 2, 46-55.
- Sadia, I.W., Arnyana, I.B.P., & Muderawan, I.W. (2013). Model Pendidikan Karakter Terintegrasi Pembelajaran Sains. *Jurnal Pendidikan Indonesia*, Vol. 2, No. 2, 209-220.
- Saenab, S., Yunus, S. R., Saleh, A. R., Virninda, A. N., Hamka L., & Sofyan, N. A. (2018). Project-based Learning as the Atmosphere for Promoting Students' Communication Skills. *Journal of Physics: 2nd International Conference on Statistics, Mathematics, Teaching, and Research*.
- Saido, G.H., Siraj, S., Nordin, A.B.B., Omed Saadallah Al_Amedy, O.S. (2015). Higher Order Thinking Skills Among Secondary School Students in Science Learning. *The Malaysian Online Journal of Educational Science*, Volume3, 3, 13-20.
- Sambite, F. C. V., Mujasam, M., Widyaningsih, S.W., & Irfan Yusuf. (2019). Penerapan *Project Based Learning* berbasis Alat Peraga Sederhana untuk Meningkatkan HOTS Peserta Didik. *Berkala Ilmiah Pendidikan Fisika*, Vol 7 No 2, 141-147.
- Sari, E. N., Rosyidatun, E. S., & Juanengsih, N. (2015). Profil Penilaian Otentik pada Konsep Biologi di SMA Negeri Kota Tangerang Selatan. *Jurnal Penelitian dan Pembelajaran IPA*, Vol 1. 26-41.
- Sarlivanti, Adlim, & Djailani. (2014). Pembelajaran Pratikum Berbasis Inkuiri Terbimbing untuk Meningkatkan Keterampilan Berpikir Kritis dan Keterampilan Proses Sains pada Pokok Bahasan Larutan Penyangga. *Jurnal Pendidikan Sains Indonesia*, Vol. 02, No.01, 75-86.
- Setiono, P., Yuliantini, N. & Dadi, S. (2020). Meningkatkan Nilai Karakter Peserta Didik melalui Penerapan Model Pembelajaran *Project Based Learning*. *Jurnal Pendidikan Guru Sekolah Dasar*, 13 (1) : 86 – 92.
- Suryaningsih, Y. (2017). Pembelajaran Berbasis Pratikum Sebagai Sarana Siswa untuk Berlatih Menerapkan Keterampilan Proses Sains dalam Materi Biologi. *Jurnal Bio Education*. Vol 2, No 2, 49-57.
- Takiddin, Jalal, F., & Neolaka, A. (2020). Improving Higher Order Thinking Skills Through Project-Based Learning in Primary Schools. *Tarbiya: Journal of Education in Muslim Society*, 7(1), 16-28.
- Varadela, I. A., Saptorini, & Susilaningih, E. 2017. Pengaruh Pratikum Berbasis Inkuiri Terbimbing Bantuan Lembar Kerja Pratikum terhadap Keterampilan Proses Sains. *Chemistry in Education*, 6 (1), 33-39.
- Wijaya, E. Y., Sudjimat, D.A. & Nyoto, A. (2016). Transformasi Pendidikan Abad 21 sebagai Tuntutan Pengembangan Sumberdaya Manusia di Era Global. *Prosiding Seminar Nasional Pendidikan Matematika 2016 ~ Universitas Kanjuruhan Malang*. Volume 1. 263-277.
- Wulandari, E. & Mardiyah, S. U. K. (2018). Kesiapan Guru Produktif Kompetensi Keahlian Otomatisasi dan Tata Kelola Perkantoran dalam Melaksanakan Pembelajaran berdasarkan Kurikulum 2013 Edisi Revisi 2017 di SMK Kabupaten Sleman. *Jurnal Pendidikan & Ekonomi*. 673-682.

- Yani, A., Muhsyanur, Sahriah, Haerunnisa, & Salmawati, S. (2016). Efektifitas Pendekatan Saintifik dengan Media Booklet Higher Order Thinking terhadap Hasil Belajar Biologi Siswa SMA di Kabupaten Wajo. *Jurnal Biology Science & Education, Vol. 7(1), 1-12.*
- Yen, T. S., & Halili, S. H. (2015). Effective Teaching of Higher Order Thinking (HOT) in Education. *The Online Journal of Distance Education and e-Learning, Vol 3(2), 41-47.*
- Zeidan, A.F. & Jayosi, M.R. (2015). Science Process Skills and Attitudes toward Science among Palestine Secondary School Students. *World Journal of Education, Vol. 5, No. 1, Hal: 13-24.*