ANALYSIS OF THE IMPLEMENTATION OF BIOLOGY PRACTICUM AND ITS RELATIONSHIP WITH STUDENT HIGHER ORDER THINKING SKILLS AND LEARNING OUTCOMES

Muhammad Alfaraby[1], Herbert Sipahutar[2]

[1,2] *Jurusan Biologi Unimed, Jalan Willem Iskandar Psr. V, Medan Estate*

[*]Correspondence: herbert_sipahutar@yahoo.com

ARTICLE INFO:

ABSTRACT

This study aims to find out whether the implementation of biology practicum has a relationship with higher-order thinking skills and learning outcomes of class XI IPA students of SMA Negeri 3 Tanjung Balai in the academic year 2021/2022. All students of class XI IPA, totaling 137 students, were used as research samples. The research instrumentswere consisted of a questionnaire (for practicum implementation), an essay test(for higher-order thinking skills), and a multiple choice test(for student learning outcomes). The data were analyzed in a quantitative descriptive manner by presenting the answers of the respondents regarding the research on implementing practices, higher order thinking skills, and student learning outcomes. The results of this study indicate that the implementation of biology practicum is included in the good category with a percentage of 77%. Students' high-order thinking skills in biology learning are included in the good category with a percentage of 78%, and student learning outcomes in biology learning are included in the good category with a percentage of 76%. This also meets the KKM standard (Minimum Completeness Criteria).

INTRODUCTION

Science is knowledge obtained through data collection by experimentation, observation, and deduction to produce a reliable explanation of a symptom (Permendiknas, 2006). Thus science is not only concerned with mastering facts, concepts, or principles but also a process of discovery. Science is needed in human life through identifiable problem solutions.

Practicum develops the basic scientific skills in conducting experiments. Experimental activities are activities that are mostly carried out by scientists in their findings. To conduct experiments, some basic skills are required, such as observing, estimating, measuring, comparing, manipulating laboratory equipment, and other scientific skills. Practicum develops problem-solving skills and a deeper understanding of the concepts and principles of science, especially biology, for students. Through the practicum, students will appreciate the theories produced in previous research and can help students understand the material that has been studied in the classroom (Munandar, 2016). Practicum provides an opportunity for students to get a real picture of what is obtained in theory and sense contact occurs. In practicum activities, students not only observe directly but must appreciate, be involved in the making and take responsibility for the results (Hastuti, 2013).

Higher-order thinking skill (HOTs)is a thought process that is not just memorizing and relaying known information and the ability to connect, manipulate, and transform existing knowledge and experience to think critically and creatively to make decisions and problem solving in new situations (Rofiah *et al.*, 2013). On the one hand, HOTs have not received adequate attention in the field of education; on the other, HOTs are one of the main assets for students in studying science, especially biology. Students need certain HOTS to solve the problem of phenomena that are contained in problems found in biology.

The government then implemented the 2013 curriculum with the perspective of facing the demands of education in this globalization era. The theme of curriculum development is said to be a curriculum that can produce productive, creative, innovative, and effective Indonesians through the strengthening of positive values, skills, and integrated knowledge. The learning system contained in the 2013 curriculum emphasizes HOTs (Lusyana & Wangge, 2016). HOTS are defined as using the mind more broadly to find new challenges. This skill requires a person to apply new information or previous knowledge and manipulate information to reach possible answers in new situations (Heong *et al.*, 2011).

Student learning outcomes is still far from satisfactory (Astriyani, 2016). Seeing this condition, it is necessary to make efforts to improve student learning outcomes. The low student learning outcomes are influenced by various factors, including inadequate HOTs. There was a relationship between practicum implementation and HOTs (Angraini & Sriaty, 2019). Activities such as analyzing the causes of a problem, designing an activity such as a practicum in the laboratory, conducting discussions or debates, providing an explanation of a case or problem can support the development of HOTS. Arianty *et al.*, (2015) reported a positive relationship between the implementation of practicum and the biology science learning outcomes of class XI IPA students.

Preliminary observations made at research schools, SMA Negeri 3 Tanjung Balai, revealed that there were obstacles to carrying out practicum in the even semester of class XI IPA. Only a small part of the subject that can be carried out in laboratory practicum, namely the digestive system and the respiratory system. Most of the remaining topics (excretory system, regulatory system, reproductive system, and the body's defense system) cannot be done in practice at all due to laboratory limitations. The Covid 19 pandemic forced lectures and practicum activities to be carried out online. As a result, the practicum itself cannot run optimally. Consequently, the learning scores of class XI IPA students in SMAN 3 Tanjungbalai in odd semester are still far below expectations.

Based on the background of the problem above, this study aims to find out whether the implementation of biology practicum has a relationship with higher-order thinking skills and learning outcomes of class XI IPA students of SMA Negeri 3 Tanjungbalai academic year 2021/2022.

METHOD

This research was conducted on August until October 2021 at SMAN 3 Tanjungbalai, Jln. SMAN 3, Kelurahan Gading, Kecamatan Datuk Bandar, Kota Tanjungbalai, North Sumatra. The population in this study was all students of 4 class XI IPA students SMA Negeri 3 Tanjungbalai, totaling 139 students and 2 teachers of biology.The samples in this research are chosen by using *total sampling* technique because the population in this study is relatively small, sampled by the entire populations. The sample used is all class XI IPA, totaling 137 students and 2 biology teachers.

The instruments used in the study were questionnaire, essay test and multiple choice tests. The instrument was validated first by an expert validator. After that it was tested on students outside the research sample. After the instrument has been validated and is suitable for use, the instrument is given to students of class XI IPA at SMA Negeri 3 Tanjungbalai.

The research procedure is to provide a questionnaire analysis of the practicum implementation with 52 questions, the essay test has 10 questions and a multiple choice test has 25 questions. The distribution of questionnaires and essay was carried out to the sample, namely all students of class XI IPA at SMA Negeri 3 Tanjungbalai through the *Google form*.

In the final stage, the result has been obtained and analyzed by a quantitative descriptive method by describing the respondents' answers. Each student's answer to the questionnaire was scored into 4 categories, namely very good, good, not good, and very bad. Each student's answer on the essay and multiple choice was scored into 5 categories, namely very good, good, enough, not good, very bad. After all the data has been collected as a whole, it is then analyzed by using *product moment* statistical tests using Microsoft Excel.

RESULT AND DISCUSSION
Result
Implementation of Practicum

Scores (in %) of each aspect of the practicum implementation in learning biology on digestive and respiratory systems are shown in Table 1.

Tabel 1 Precentage Value of Implementation Practicum

Indicator	%
Intensity/practicum frequency	75
Laboratory condition	74
Students' interest in practicum implementation	75
Time for practicum	75
Preparation and practicum implementation	80
Practical report and evaluation	82

The frequency/intensity of practicum (score of 75%), laboratory conditions (score of 74%), student interest in practicum activities (score of 75%), time available in the implementation of biology practicum (score of 75%), preparation and implementation of the practicum (score of 80 %), reports and evaluations (score of 82%). The data obtained is following the percentage range of the

practicum implementation assessment. The average value of the implementation of student practicum is 77%, still achieving good criteria. Can be seen in Table 2

Table 2. Percentage Range of Practicum Implementation Level

No	Research Interval	Criteria
1.	81 % - 100 %	Very Good
2.	61 % - 80, 99 %	Good
3.	41 % - 60, 99 %	Not Good
4.	< 40 %	Very Bad

Students' High Order Thinking Skills

The score (in %) of each cognitive aspect of higher order thinking skills is shown in Table 3.

Table 3. The Percentage of High-Order Thinking Skills Based on The Cognitive Domain

No	Cognitive Domain	Average score per Domain (%)	Category
1.	Analysis (C4)	61%	Good
2.	Evaluation (C5)	51%	Quite Good
3.	Creation (C6)	53%	Quite Good

From the percentage of higher order thinking skills based on the cognitive domain of class XI IPA, it was found that the achievement of analysis was (score of 61%), evaluation (score of 51%), and creating (score of 53%). From this explanation, it can be seen that the achievement of students' higher order thinking skills in this school is in the good category.

Data on students' higher order thinking skills regarding the digestive system and respiratory system are presented in Table 4.

Table 4. Percentage Value of High Order Thinking Skills

Class	Percentage value (PV)
XI IPA 1	81%
XI IPA 2	77%
XI IPA 3	82%
XI IPA 4	71%
Average PV (%)	78%

From the percentage value of each class, XI IPA 1 obtained score of 81%, XI IPA 2 obtained score of 77%, XI IPA 3 obtained score of 82%, XI IPA 4 obtained score of 71%. The average score for higher order thinking skills is 78%, still achieving very good criteria. Data obtained is also following the percentage range of the criteria for the average value of the level of understanding. Can be seen in Table 5

Table 5. Criteria for Mean Values of Understanding Level

Percentage	Category
90 - 100%	Very Good
61 - 80%	Good
41 - 60%	Quite Good
21 - 40%	Not Good
< 20	Very Bad

Students Learning Outcomes

Students' learning outcomes based on the cognitive domain regarding the digestive system and respiratory system, the data obtained can be seen in Table 6.

Table 6. The Percentage of Students Learning Outcomes Based on The Cognitive Domain

No	Cognitive Domain	Average score per Domain (%)	Category
1.	Understanding	81%	Very Good
2.	Applying	79%	Good
3.	Analysis (C4)	83%	Very Good
4.	Evaluation (C5)	81%	Very Good
5.	Creation (C6)	76%	Good

understanding is obtained (score of 81%), applying (score of 79%), analysis (score of 83%), evaluation (score of 81%), and creation (score of 76%). From this explanation, it can be seen that the achievement of student learning outcomes in this school is in the very good category.

Data on students' learning outcomes regarding the digestive system and respiratory system are presented in Table 7.

Table 7.Percentage Value of Students Learning Outcomes

Class	Percentage Value (PV)
XI IPA 1	80%
XI IPA 2	75%
XI IPA 3	80%
XI IPA 4	70%
Average PV (%)	76%

From the percentage value of each class, XI IPA 1 obtained score 80%, XI IPA 2 obtained score 75%, XI IPA 3 obtained score 80%, and XI IPA 4 obtained score 70%. Data obtained is also following the percentage range of the criteria for the average value of the level of understanding.

Relationships between Implementation of Biology Practicum and Higher Order Thinking Skill and Learning Outcomes

The practicum implementation data obtained from student questionnaires are then correlated with higher-order thinking skills and learning outcomes using the 'Product Moment' correlation formula.

$$r_x = \frac{n\sum X - (\sum Y)\,(\sum Y)}{\sqrt{\{n\sum X^2 = (\sum X^2)\}\{n\sum Y^2 - (\sum Y^2)\}}}$$

(r_x= The correlation coefficient between the scores of practicum implementation and student learning outcomes scores, X= Scores of practicum implementation, Y= High-order thinking skills scores and biology learning outcomes, n = Amount on sample)

The correlation coefficient obtained by this formula is compared with "n" respondents at a significant level of 5%.

Based on data on higher order thinking skills, the correlation coefficient is 0,173. Because $r_x > r_t$ (0,173 > 0,167) that means H_{a1} is accepted and H_{01} is rejected which indicates that the practicum has a positive relationship to the students' higher-order thinking skills.

Then based on the learning outcomes data obtained a correlation coefficient of 0,181. Because $r_x > r_t$ (0,181 > 0,167) that means H_{a2} is accepted and H_{02} is rejected which indicates that the practicum has a positive relationship to the students' learning outcomes.

Discussion
Practicum Implementation in Biology Learning

Based on the results of data analysis regarding the frequency/intensity of practicum implementation by students of class XI IPA SMA Negeri 3 Tanjung Balai showed a percentage of 75% with good criteria.

Practical activities are important for biology science lessons because they can provide opportunities for students with experience, generate and maintain students' scientific attitudes and interests, develop scientific thinking, problem-solving skills, and conceptual understanding and develop practical skills (designing and conducting investigations, observations, recording data, analyzing and interpreting).According to Siburian et al (2017) practicum provides opportunities for students to deepen their understanding of teaching materials that will be obtained through teaching and learning activities in the classroom and will provide a new foundation for students to be more creative in carrying out practicals.

Based on the results of the laboratory data analysis, it shows the acquisition of a percentage of 74% which is classified as good criteria. SMA Negeri 3 Tanjungbalai already has its biology

laboratory, which is equipped with a main room/practice room, preparation room, and storage room for tools and materials. Epy (2017) said that the laboratory should be divided into three parts, namely the main part is used for practicum activities, the second part is used as a preparation room and the third part is used as a storage room for laboratory tools and materials. The availability of tools and materials in the biology laboratory is very complete based on the results of observations and existing inventory books.

Students' interest in practical activities on the digestive system and respiratory system material at SMA Negeri 3 Tanjung Balai is classified as good (75%) it shows that students are enthusiastic and interested in carrying out biology practicum activities. Hasruddin & Rezeqi (2012), in the teaching and learning process, students' attention to the material provided will greatly affect the success or failure of the teaching and learning process. More intensive student attention to the subject matter provided by the teacher will cause the transfer of knowledge to occur more easily so it is hoped that the teaching and learning process will be more successful.

Based on the result of data analysis obtained, it shows that the time of the practical implementation of the digestive system and respiratory system material at SMA Negeri 3 Tanjung Balai is in a good category (75%). According to Adisendjaja (2008), in general, the obstacle in implementing practicum is that it is very time consuming, schools usually already have a definite schedule for each subject and do not consider practicum time.

Based on the results, the preparation and implementation of practical material on the digestive system and respiratory system at SMA Negeri 3 Tanjung Balai showed good results with a percentage of 80%.

In the preparation and implementation of a practicum, there are still many factors that influence the success of a good and correct practicum. Practicum preparation is the first step that must be thoroughly prepared before carrying out practicum activities. This is done so that from the beginning to the end the implementation of the practicum runs safely, comfortably and produces good research, and is following the expected results (Nurhidayati, 2016).

Based on the results of data analysis, reports and evaluations of the biology practicum at SMA Negeri 3 Tanjung Balai are included in very good criteria (82%). This is in line with research conducted by Dewi (2014) which said practicum is a form of activity that aims to strengthen students'

knowledge of subject matter through application, analysis, synthesis, and evaluation of theories carried out both in the laboratory and outside the laboratory.

High Order Thinking Skills

Based on the data, it is known that the higher-order thinking skills in SMA Negeri 3 are generally in the good category. Students' high-order thinking skills on the material of the digestive system and respiratory system are divided into 3 indicators namely C4 (analyzing), C5 (evaluating), and C6 (creating)

In analyzing indicators, many as 61% of students were able to answer questions well. This shows that students can analyze the questions. Students can analyze and explain the structure and organs along with the functions that make up the digestive system, students are also able to describe the mechanism/process of diffusion between oxygen and carbon dioxide. This is in line with research conducted by Widihastuti (2014) which states that students can reason logically, systematically, and analytically.

In evaluating indicators, 51% of students were able to answer questions quite well. This shows that students are quite capable of assessing and checking things that are relevant to things that are not relevant. As it relates to the digestive system, students are able to plan preventive measures against disorders of the digestive system. It also relates to the respiratory system, students are able to check ventilation and respiratory rate and compare metabolic processes and respiratory rate, and are able to make conclusions that are in accordance with the data presented from the questions. This is in line with research conducted by Widihastuti (2014) which says that students at the evaluating level mean that they can solve problems correctly and quickly, and can make appropriate decisions.

In creating indicators,53% of students were able to answer questions quite well. Students who can answer questions of type C6 are considered to have been able to plan a procedure that must be done to solve a problem or create a new product. For example, students are able to plan, design/design a 4 healthy 5 perfect food menu for 7 days 3 times in 1 day. This is in line with the research that has been done by Hasruddin et al (2016) which says that higher-order thinking can be in the form of curiosity, open thinking, and skills such as analyzing, drawing conclusions, and creating, namely producing a new product by

organizing several elements into shapes or patterns different from before.

Based on the data, it is known that the higher-order thinking skills in SMA Negeri 3 are generally in the good category. This is because the *Student Center Learning* concept has been implemented in biology learning.

Learning Outcomes

Learning outcomes can be said to be successful if they have achieved educational goals. In the teaching and learning process, this cognitive aspect is the most prominent and can be seen directly from the test results. Here education is required to carry out all these goals. This can be done by education by incorporating these elements into the questions given. Questions given to students must meet the objective elements in terms of cognitive ability so that students can achieve the expected learning objectives. In this study, researchers used 5 indicators, namely: C2 (Understanding), C3 (Applying), C4 (Analyzing), C5 (Evaluating), C6 (Creating).

In the understanding indicator, 81% of students were able to answer the questions very well. This shows that students can understand the problem. Students can explain the structure of organs and their functions, and students can describe the factors that affect the frequency of the respiratory system.

In the applaying indicator, 79% of students were able to answer the questions well. This can be seen in the students' ability to answer questions. Students can explain the organs that make up the digestive system, and apply it in daily activities. For example, don't eat while talking because it can cause choking because food blocks the respiratory tract.

In the analyzing indicator, 83% of students were able to answer the questions very well. This can be seen from the students' ability to analyze questions. Students can explain the substances contained in food ingredients, and students can explain the structure of organs and their functions.

In the evaluating indicator, 81% of students were able to answer the questions very well. This shows that students are quite capable of assessing and checking things that are relevant to things that are not relevant. Students can evaluate, correctly describe the sequence of the digestive tract of food and the function of vitamins in the digestive system.

In the creating indicator, 76% of students were able to answer the questions well. Students who can answer this question are considered to be able to plan or create a new product. Students can conclude so that they can create something new.

For example, designing a smoke-free workplace atmosphere, and designing preventive measures against tuberculosis.

Based on the data, it is known that the students' learning outcomes in SMA Negeri 3 are generally in the good category. The results of this study are in line with Sumanto (2014) who says that cognitive is a mental process related to abilities in the form of general recognition that is mental and is characterized by the representation of an object in one's mind. Such as symbols, responses, ideas or ideas, and values or judgments. Therefore, cognitive factors have an important role for the success of learning, because most of the activities in learning are always related to remembering and thinking.

CONCLUSIONS

Practicum implementation on the material on the digestive system and respiratory system is included in the good category with a percentage of 78%, higher-order thinking skills are included in the good category with an average value of 78%, and learning outcomes are also included in the good category. with an average score of 76% also fulfill the minimum learning requirements (KKM) with a score of 75.

REFERENCES

Adisendjaja, (2008). *Kegiatan Praktikum dalam Pendidikan Sains*. Bandung: Universitas Pendidikan Indonesia

Angraini, G. & Sriyati, S. (2019). Analisis Kemampuan Berpikir Tingkat Tinggi Siswa SMAN Kelas X di Kota Solok Pada Pembelajaran Biologi, *Jurnal of Education Informatic and Science*, 1(1): 114-124

Arianty, W., Har, E. & Deswati, L. (2015). Pelaksanaan Praktikum Dan Hubungan Dengan Hasil Belajar Biologi Kelas XI IPA SMA Muhammadiyah Padang Panjang.*Jurnal FKIP Universitas Bung Hatta*,

Astriyani, A. (2016). Peningkatan Hasil Belajar Peserta Didik Dengan Penerapan Model Pembelajaran Problem Solving. *Jurnal Pendidikan*, 2(2):1-7

Astuti, N.W. (2019). Hubungan Praktikum dan Keterampilan Proses Sains Terhadap Hasil Belajar Materi Ekosistem. *Journal Bioterdidik*, 7(5):53-56.

Beddu, S. (2012). Analisis Hubungan Pelaksanaan Praktikum dengan Keterampilan Proses Sains dan Hasil Belajar Biologi Siswa di SMA Negeri di Kota Bulukumba, *Jurnal Pemikiran dan Pengembangan Pembelajaran,* 1(3):71-84

Dewi, S.I., Sunnariyanti, S. & Neneng, L. (2014). Analisis Kendala Pelaksanaan Praktikum Biologi Di SMA Negeri Se-Kota Palangkaraya, *Edusains*, 2(1):14-26

Epy, M. (2017). Analisis Sarana dan Pemanfaatan Laboratorium Biologi dalm Pembalajaran Biologi di SMA Negeri Se-Kabupaten Pakpak Bharat Tahun Pembelajaran 2016/2017. *Skripsi.* Medan: Fakultas Ilmu Pengetahuan Alam Unversitas Negeri Medan.

Hasruddin., Harahap, F., Mahmud. (2016). Pengembagan Perangkat Pembelajaran Mikrobiologi Berbasis Kontekstual untuk Meningkatkan Kemampuan Berpikir Tingkat Tinggi Mahasiswa, Proceeding Biologi Education Conference, 13(1):509-514

Hasruddin & Rezeqi, S. (2012). Analisis Pelaksanaan Praktikum Biologi dan Permasalahannya di SMA Negeri SeKabupaten Karo. *Jurnal Tabularasa PPS UNIMED,* 9(1): 17-32.

Hastuti, A. (2013). *Penerapan Pembelajaran Berbasis Praktikum Untuk Meningkatkan Motivasi dan Hasil Belajar Biologi Materi Pokok System Reproduksi Manusia. Skripsi*. Yogyakarta: UIN SUKA

Heong, Y. M., Othman, W.D., Md Yunos, J., Kiong, T.T., Hassan, R., Mohamad, M.M (2011). The Level of Marzano Higher Order Thinking Skills among Technical Education Students. *International Journal of Social Science and Humanity*, 1(2): 121-125

Hidayati, N. (2012). Penerapan Metode Praktikum dalam Pembelajaran Kimia untuk Meningkatkan Keterampilan Berfikir Tingkat Tinggi Siswa pada Materi Pokok Kesetimbangan kimia Kelas XI SMK Diponegoro Banyuputih Batang. *Skripsi*. Semarang: Fakultas Tarbiyah IAIN Wali Songo.

Laite, L & Luis, D. (2013). Laboratory Activities, Science Education and Problem Solving Skills. *Procedia Social and Behavioral Sciences*

Lusyana, E. & Wangge, M. (2016). Increasing Higher Other Thnking Skill to Build Student's Character by Using Mathematical Reasoning. *Proceeding of 3rd International Conference Of Research, Implementation and Education of Mathematic and Sciences*. Yogyakarta

Nurhidayati (2016). Analisis Pelaksanaan Praktikum pada Pembelajaran Biologi Peserta Didik Kelas XI di SMAN 7 Bandar Lampung Tahun Pelajaran 2015/2016. *Skripsi*. Fakultas Tarbiyah dan Keguruan

IAIN Raden Intan Lampung. Lampung: IAIN Press.

Munandar, K. (2016). *Pengenalan Laboratorium IPA-BiologiSekolah*. Bandung: Refika Ditama.

Permendiknas (2006). *Permendiknas Nomor 22 Tahun 2006 tentang Standar Kompetensi dan Kompetensi Dasar Kurikulum Tingkat Satuan Pendidikan*. Direktorat Jenderal Manajemen Pendidikan Dasar dan Menengah: Jakarta.

Rofiah, E., Aminah, N.S. & Ekawati, E.Y. (2013). Penyusunan Instrumen Tes Kemampuan Berpikir Tingkat Tinggi Fisika Pada Siswa SMP. *Jurnal Pendidikan Fisika*, 1(2):17-22.

Rofiqoh, W.E.Y. (2015). Pengaruh Praktikum Jamur Berbasis Keterampilan Proses Sains Terhadap Hasil Belajar Biologi. *Journal of Biology Education,* 4(1):9-15

Rustaman N.Y., Soendjojo D., Suroso A.Y., Yusmin A., Ruchji S., Mimin N.K. (2003). *Strategi Belajar Mengajar Biologi*. Bandung: Jurusan Pendidikan Biologi FMIPA UPI.

Saadah, L., Ningsih, K. & Yeni, L.F. (2014). Efektifitas Praktikum Berseting Numbered Head Together Terhadap Penguasaan Konsep Siswa SMP Sub Materi Zat Makanan. *Jurnal Pendidikan dan Pembelajaran*.

Siburian, F., Sinambela, M. & Septie. (2017). Analisis Pelaksanaan Praktikum Pada Mata Pelajaran Biologi Di Kelas X SMA Negeri 16 Medan. *Jurnal Pelita Pendidikan*, 5(2): 21-31.

Sumanto (2014).*Psikologi Perkembangan Fungsi dan Teori.* Yogyakarta: Center for Academic Publishing Service.

Widihastuti (2014). Pentingnya Higher Order Thinking Skills Bagi Mahasiswa Bidang Tekstil dan Busana dalam Pengembangan Ekonomi Kreatif Menuju MEA 2015, Makalah Seminar Nasional PTBB FT UNY.