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The Effect of Microscope Skills On The Observation Results Of Plant Tissue Preparations by Students Of SMAN 4 Tegal

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Abstract

Microscope skills is a skill that should be managed by the students in the laboratory works with a microscope. This research aimed to determine the effect of microscope skills on the observation results of plant tissue preparation by students of SMAN 4 Tegal. This is a Quasi Experimental research with Intact-Group Comparison design. Sample divided into three groups: (1) XI MIA 5 was given demonstration and microscopes instructions sheet; (2) XI MIA 4 was given microscopes instructions sheet only; and (3) XI MIA 2 neither given demonstration nor microscopes instructions sheet. The results of this research showed that the signification value of ANOVA test both on the microscope skills grades and observation result grades that was 0,000<0,05, which mean there was a average different grade between three group treatments. Furthermore, significance value of simple linear regression test was 0,000<0,05, which mean microscope skills affected the observation results. The raise of microscope skills grades followed by the raise of observation result grades. Correlation coefficients value (R) was 0,939 showed a very strong correlation and *adjusted* R *square* value (R^2) was 0,881 showed microscope skills affected the observation results for 88,1%. Therefore, it can be concluded that microscope skills positively affected the observation results of plant tissue preparation by students of SMAN 4 Tegal.

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INTRODUCTION

Based on senior high school biology syllabus of curriculum 2013, there are some labboratory activities that should be conducted by the students such as an observation. In such laboratory work students are required to use the microscope properly. The microscope is one of the laboratory tool that has a very important role in the biology subject, even in the development of science. The importance of microscope, makes the microscope skills important too. Mariana (2012) stated that there was a significant effect of microscope skills on students' practicum grades. The lower students' microscope skill, the lower students' practicum grades. But Mariana's study used the value of post-test and practicum students' grades as the dependent variables. They were not appropriate as the measure for students' microscope skills because posttest and practicum grades were not the indicators of the successful in mastering microscope. They were not directly related to mastery microscope skills.

Based on observation, the school has its own biological laboratory equipped with fairly complete infrastructure. Microscope light monocular was quite abundant in excellent condition and well-preserved complete preparations. Results of interviews with biology teachers stated that most students were still having difficulties when using the microscope. Students took a long time to find objects preparations in the field of view of the microscope, even some students could not find the object preparation. One of the factors that cause it was poorly trained students in using a microscope. Teacher only taught how to use a microscope at the beginning of first grade, while the laboratory works using the microscope are more intensive in second grade. Three of five biology teachers interviewed, did not repeat demonstration of how to use a microscope to students in second grade before doing practicum observation. Research about the influence of microscope skills on the observation results is still slightly, so it has not been known exactly how the effect of these variables yet.

Based on this background it is necessary to do a study about the effect of microscope skills on the observation results of plant tissue preparations. This study aimed to determine the the influence of microscope skills on observation of plant tissue preparations by students of SMAN 4 Tegal.

METHOD

This research was a Quasi-Experimental design with Intact-Group Comparison (Sugiyono, 2015) which has been modified. The population was all students of SMAN 4 Tegal academic year 2017/2018. The sample were three classes of eleven grades sciences program (MIA) taken by purposive sampling. These three classes were class XI MIA 2, XI MIA 4, and XI MIA 5.

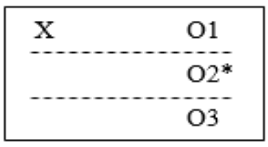

Figure 1. *Intact-Group Comparison* Design that has been modified from Sugiyono (2015).

Remarks:

X	: Treatments
O1	: Results of treatment 1 (class with demonstrations and microscope instuctions sheet).
O2	: Results of treatment 2 (class with microscopes instructions sheet only).
O3	: Results of treatment 3 (class neither with demonstration nor microscopes instructions sheet). This class as a control group.
*	: Modification (added one treatment that was treatment 2 that initially none).

Table 1. Classes and its Treatment

Class	Treatments
XI MIA 5	O1 (Was given demonstration and microscopes instructions sheet)
XI MIA 4	O2 (Was given microscopes instructions sheet only)
XI MIA 2	O3 (Neither given demonstrations nor microscopes instructions sheet)

Parameter in this studies were microscope skills and observation results. Both of these parameters were analyzed using One Way ANOVA and simple linear regression. Whereas the

condition of students that had been observed during the practicum as the supporting parameters. There were two kinds of observation results in this study: observation result from students' microscope field of view and observation results' that drawn by the students. One Way ANOVA test on microscope skills scores used to determine if there any average different in three treatments. One Way ANOVA test on observation results scores used to determine if there any average different grades in three treatments. Simple linear regression test was used to determine whether microscope skills effect the observed results or not. The value of R (correlation coefficient) shows how strong the correlation between variable X and variable Y, as well as adjusted R-square that shows how much the variable X influence variable Y. Value of R then fitted into the stage 2 to see how strong the level of correlation variable X on variable Y (Sugiyono, 2015).

Table 2. Guidelines for Interpretation of Coefficient Correlation.

Interval Coefficient	Level Correlation
0,00 - 0,199	Very Weak
0,20 - 0,399	Weak
0,40 - 0,599	Moderat
0,60 - 0,799	Strong
0,80 - 1,000	Very Strong

RESULTS AND DISCUSSION

Microscope Skills Of Students

ANOVA test results from the value of psychomotor skills mastery microscope by students are presented in the following Table.

Table 3. ANOVA Results of Microscope Skills On Three Treatments.

ANOVA

X

	Sum of *Squares*	Df	Mean *Square*	F	Sig.
Between Groups	7791,377	2	3895,689	53,416	,000
Within Groups	6345,039	87	72,931		
Total	14136,416	89			

Based on Table 3, the significant value was 0.000 <0.05, that mean there was a average different grades between the three treatments. Average grades microscope skills of all classes were 74.55. The highest average was 87.33 in class with treatment 1. Average microscope skills of treatment 2 class 70.88, lower than treatment 1 class but higher than control class. While the average microscope skills in treatment class 3 was 65.44. The prominent differences of microscope skills among these three classes was in treatment 1 and treatment 2 class. Students of treatent 1 class used the microscope with the right sequences according to the right microscope uses. While treatment 3's students used the microscope with very random sequences. In addition, students of treatment 1 required considerable time to find objects preparations. Meanwhile, students in treatment 3 took a long time to find objects preparations, exceed the given duration instead.

Treatment 1 class has the highest average microscope skills with 87.33 compared to other classes. This showed that giving demonstrations and microscope instruction sheets to students before practicum observation could increase the Microscope skills grades by the students. Not only how to use the microscope, but its parts and functions also were described again at the demonstration. All students in this class were observing with the correct sequence. When setting the slides, most of the students began with shifted both holders and then set the slide slowly and positioned it so the object was right in the middle of the stage hole. The right position of object preparations which in the

middle of the stage hole was one of the factors that determine the focus of observation results (Roger, 2009).

Treatment 2 class has the average microscope skills that lower than treatment 1 class, but higher than treatment 3 with 70.88. This grade indicated that giving microscopes instruction sheets could increase the microscope skills but still not high enough. The problems in this class was some students ignored the given microscope instruction sheets. At first, students followed the stages according to the microscope instructions sheets, but then they confused at certain stages. Stages that made students confused them was the diaphragm setting. Students also had difficulty adjusting the height of the stage such as when students had to raise the stage before observing through the eyepiece. Then descended it again before changing the magnification of the objective lens, and re-raised before observe again. Then descended again before the slide released. This repeatedly sequences made them confused.

Treatment 3 class has the lowest average microscope skills with 65.44. This showed that with no microscope instruction sheets and demonstrations, students tended to have the difficulties in using the microscope. Microscope instructions sheets only was not enough, teachers need to provide both. Teachers should explain stages of microscope uses step-by-step so that students understand properly. Teachers could not assume that students have been adept at using the microscope just because students ever been taught the use of microscope previously, at first grade. Students in this class, used the microscope not in the right order. Many students immediately put the slides on the stage when the observation started. Students did not descend the stage in advance, or checked the diaphragm, or the objective lens or adjusted the mirror. There were also students who did not check the diaphragm at all. This could be because students had forgotten the parts and functions of the microscope so they skip the diaphragm. Though the diaphragm is one of the keys that makes the light enter the stage hole maximized. The hole of aperture diaphragm determining the quality of observation results (Krasieva *et al*.,1998). The diaphragm is a disc that can rotate under the stage. The diaphragm had a hole with different sizes and used to vary the light intensity. As well as for pursing light projected upward to slide. The size of the diaphragm hole controls the angle of illuminating the specimen (Rottenfusser *et al.,*2017).

The next step, some students observed through the eyepiece without checked the objective lens magnification. In fact, many students incorrectly set magnification, the magnification of 10x thought as 4x and 40x thought as 10x. Observation should begin with the smallest objective lens magnification because it has smallest had the most extensive field of view (Roger, 2009). The large viewing area also makes it easier to position objects preparations in the most central position.

When pulling the stage up, students was pulling it while observing through the eyepiece carelessly. Pulling the stage up before observing through the eyepiece is important because of working distance. It is the distance of the objective lens which is being used into the surface of the slide when the objects are in sharp focus. If the observed slide without deck glass, the working distance is determined by measuring linear the objective lens into the surface of the specimen (Spring & Davidson, 2017). Working distance is getting shorter significantly with the increasing of magnification lens (Valeria, 2017). That is why the stage needs to be raised before observing through the eyepiece. Thereby find objects preparations easier. There were 7 students in XI MIA 2 (neither given demonstration nor microscope instruction sheets) couldnot found the object preparations in the field of view.

Based on the description, it was known that giving demonstrations and microscope instruction sheets can improve microscope skills of students significantly. This was in accordance with Handhika (2010) which stated that the demonstration method in teaching could provide an opportunity for students to observe carefully and gave an idea directly of what was being learned and cultivated scientific attitude. Simbolon *et al*., (2014) stated that teachers should explain the functions

and uses of lab tools and materials that will be used so that students have the knowledge to help them conducting the practicum well. Therefore, teachers should do a demonstration and give microscope instruction sheets before observation practicum made by students. Microscopes instructions sheets alone was not enough. Students still need guidance from teachers through the demonstration. Teacher modeling how to prepare microscope, then imitated by the students. Teacher modeling how to find the object, then imitated by the students and so on. To make the modeling performed by the teacher are directed, the teacher should use the instruments of observation sheets to guide her/him conduct modeling step-by-step in order of the aspects in the instrument (Gayatri, 2009). According to Rohendi *et al.*, (2010) the student's ability in the class that used demonstration was better than the conventional one. Demonstration was highly appropriate used in the learning when aiming to provide certain skills and helps students understand more clearly the course of a process (Amalia, 2010). Therefore, teachers should give a demonstration of how to use the microscope by standard operating procedures (SOP).

Shortcomings in this study that there was no assessment of the time that students need to find objects preparations individually. According to Fitch (2007) it should have been the length of time that students need to find objects preparations also become one of the criteria in the assessment of Microscope skills. Each of the students rated the time they used to successful find objects preparations in the field of view. But in this study has not been done this such individual assessment.

Category Of Microscope Skills Grades

Microscope skills grades and then made into a distribution frequency to look at the group category. There were 7 categories with category 1 as the class with highest grades range while category 7 as the class with the lowest range.

Table 4. Category of Microscope skills From All Class.

Category	Predicate	Description	* Microscope skills Grades	Frequency	FR(%)
1	A	Perfect	91,46-98,36	9	10,00
2	AB	Very Good	84,55-91,45	13	14,44
3	B	Good	77,64-84,54	14	15,56
4	BC	Good enough	70,73-77,63	18	20,00
5	C	Less	63,82-70,72	16	17,78
6	CD	Very Less	56,91-63,81	11	12,22
7	D	Extremely Less	50-56,9	9	10,00
			Jumlah Data (n)	90	

Based on these results, it was known that the largest frequency relative of microscope skills by the students of SMAN 4 Tegal in using the microscope was on predicate BC that equal to 20%. The grades were pretty well, but still need to be improved. Microscope skills grades of each class can be seen in Figure 2.

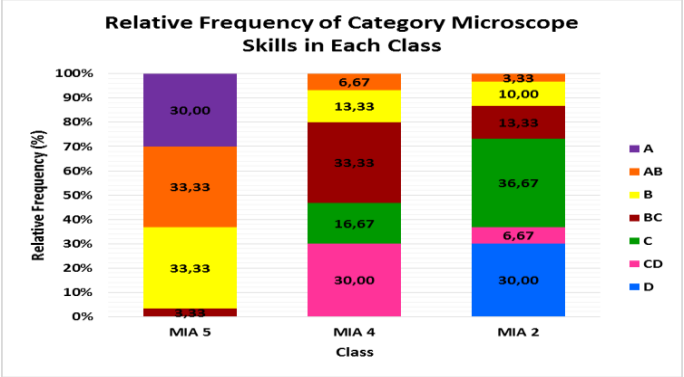

Figure 2. Relative Frequency of Category Microscope Skills in Each Class.

Students Observation Results

Students observation results grades were the average of the observation in the field of view and the observation results that students drawn. Each of two magnification of 40x and 100x. ANOVA test results of students observation results presented in Table 5.

Table 5. ANOVA Results of Students Observation Results On Three Treatments.

ANOVA

X					
	Sum of *Squares*	**df**	**Mean *Square***	**F**	**Sig.**
Between Groups	5271,685	2	2635,842	33,424	,000
Within Groups	6860,825	87	78,860		
Total	12132,510	89			

Based on table 5, significant value was 0.000 <0.05, meaning that there was a significant difference in three treatments. The average grades of student's observation results from all classes were 70.60.

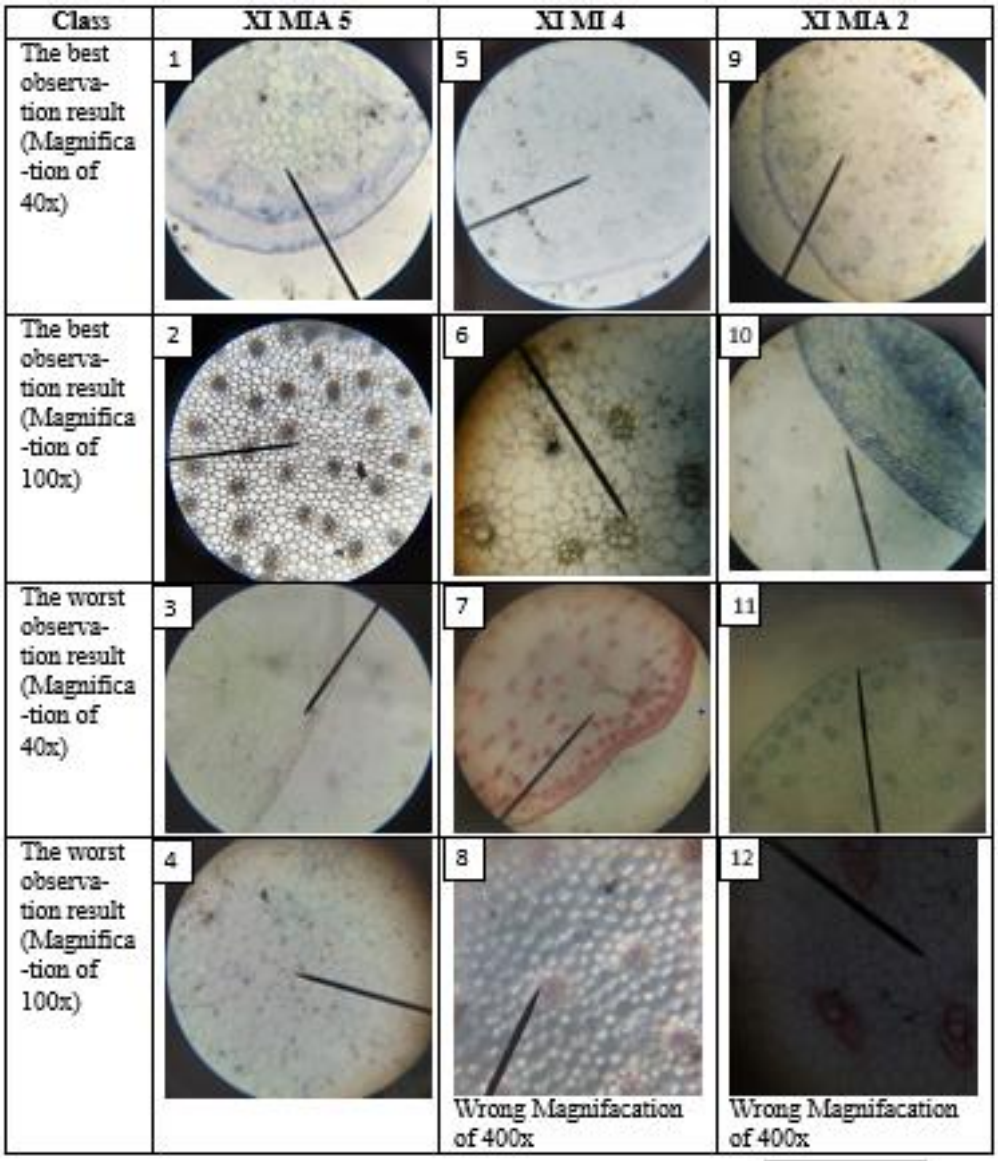

Figure 3. Student Observation Results On Field of View Microscope.
Remarks: XI MIA 5 treatment 1 (with demonstrations and microscope instruction sheets); XI MIA 4 treatment 2 (given microscope instruction sheets only); XI MIA 2 treatment 3 (neither with demonstration nor microscope instruction sheets).

The highest average grade in treatment 1 was 81.18 which students were given demonstration and microscope instruction sheets. The average grade in treatment 2 was 67.31 which students were given microscopes instruction sheets only, it lower than treatmen 1 but higher than control class. While the lowest average grade in control class was 63.32 that students neither given demonstration nor microscope instruction sheets. The observation result of treatment 1 class was much better than the two other classes. Objects preparations were enough light and focus on most parts. Object preparation fulfills the field of view. While the observation results in treatment 2 class, some had got quite good, but the rest was still not good enough.

Same with observation in the field of view, observation was drawn by students in XI MIA 5 with treatment 1 was better compared to other classes. One of the factors that cause this was sufficient time to draw the observation results. Students who successfully found object preparations

required slightly time compared to other classes so that, they could draw with more maximum. As seen in figure 4 most students drew with small circulars that much like composed of cells. The cells were tightly packed and neatly. In fact, their were students who drew the cells with resembles the shape of the original observation results which cells with multiple angles. The observation was drawn by students in XI MIA 4 with treatment 2 (given microscopes instruction sheets only) was pretty good, but the rest was still not good enough. Students drew the plant tissue with small circulars but these cells was not neat to one another. There was also students who drew the plant tissue with alot of cells but only on its edge, the heartwood part was empty. The plant tissue names were still wrong as well.

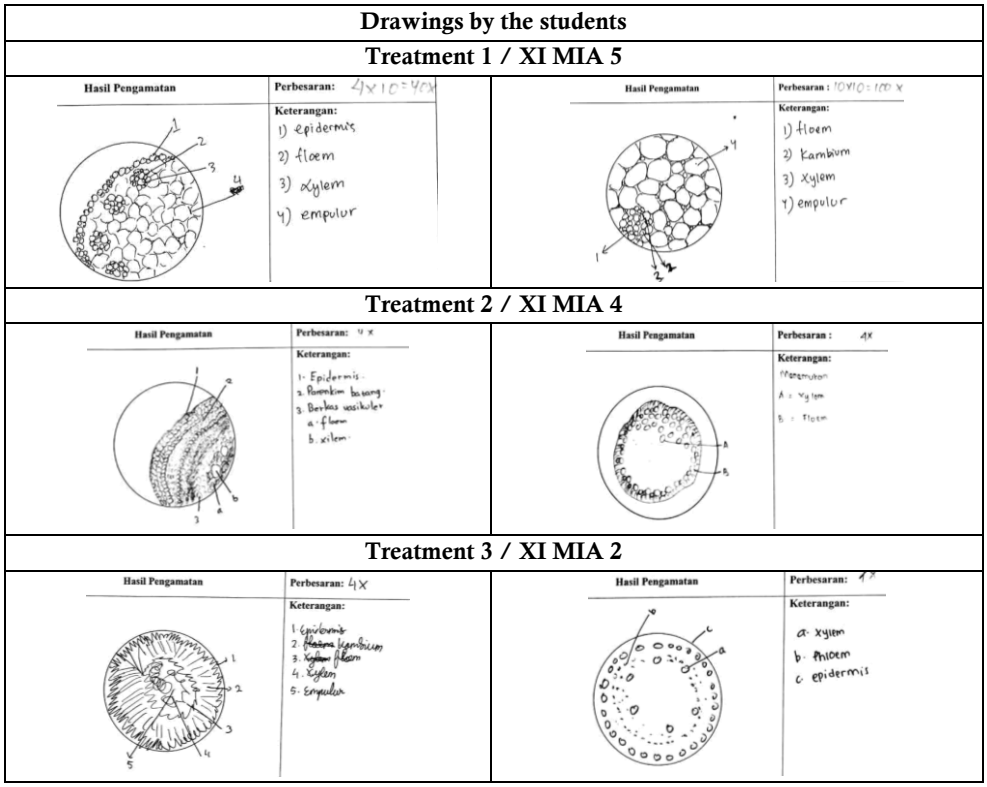

Figure 4. Observation Results Drawn by Students.
Remarks: Treatment 1 (with demonstrations and microscope instruction sheets); Treatment 2 (with microscope instruction sheets only); Treatment 3 (neither demonstration nor microscope instruction sheets).

Students in treatment 3 class drew the plant tissue with small circulars unlike composed of cells but with lines as the boundary of the one tissue with another. Even the boundary in these plant tissue seem unclear. In addition there were also students who drew circulars as the cells which was not neat each other, and empty at the heartwood as well. The image results were not separated from the availability of the time at the practicum. It took a long time for students to find objects preparations in the field of view of the microscope became the factors that lead students in treatment 3 class to be panic and ultimately can not draw maximumly. Observation results was the main point that will build up the discussion in a report. The minimal observation results lead to minimal discussions. It might even lead to missconcept of learning subject that was concerned. This was important for students to master the Microscope skills.

Effect of Microscope Skills on The Observation Results

Test Simple Linear Regression Results Of Microscope Skills on Observation Results is as Table 6.

Table 6. The Influence Value of Microscope skills on Observation Results.

Model Summary

Model	R	R *Square*	Adjusted R *Square*	Std. Error of the Estimate
1	,939[a]	,883	,881	4,02404

a. Predictors: (Constant), X

Based on table 6, it was known that the R value was 0,939. These values then matched in table 2 according to the coefficient correlation interpretation guidelines by Sugiyono (2015), then the degree of correlation Microscope skills on the observation results was very strong. R showed a positive, the increasing of Microscope skills followed by the increasing of observation results. Adjusted R-square Value was 0.883. This indicated that the variable X affects variable Y as much as 88.1%. This mean microscope skills affected the observation results as much as 88.3%. While the remaining 11.7% was influenced by other factors. Next was the output of the table ANOVA presented in Table 7.

Table 7. Significance Value of the Influence of Microscope Skills on Observation Results.

ANOVA[a]

Model		Sum of *Squares*	Df	Mean *Square*	F	Sig.
1	Regression	10707,539	1	10707,539	661,251	,000[b]
	Residual	1424,972	88	16,193		
	Total	12132,510	89			

a. Dependent Variable: Y, b. Predictors: (Constant), X

Based on table 7. significant value was 0.000 <0.05, that mean that Microscope skills significantly influenced on the observation results.

Based on all the results, it can be seen that the microscope skills significantly influenced the observation results. If teachers expect the good observation results from the students then they should improve the students psychomotor skills in using the microscope. Such improvements can be done by giving the microscopes instruction sheets and demonstrations before the practicum conducted. The demonstration made students understand how to operate the microscope properly, so that students more quickly find the objects preparations. In addition, teachers also need to assess students' microscope skills. According to Novitasari *et al*., (2015) psychomotor assessment instrument was divided into two, namely process and product performance. Therefore teacher must carry out both the assessment, assessment skills in using the microscope and assessment of observation results.

Teachers also need to consider other factors that may affect the students' observation results. According to Singer (1980) the physical condition, ability (abilities), learning styles, attitudes, emotions, and experiences of the past, which has links with the task studied the factors that gave them his influence on psychomotor abilities or skills. According to Mardapi (2008) psychomotor skills associated with limb or actions that require coordination between the nerves and brain. Coordination between the brain and nerves that can improve psychomotor skills. Skills that can be reached with repetitive exercises. In using a microscope, students need to be trained in the repetitive, not enough just once. Muspiroh (2012) stated that to improve the skills of observation using a microscope, need continuous training through a variety of practicum activities. This is why teachers can not assume that students have been adept at using the microscope just because they ever thought

the use the microscope at first grade. Giving student demonstrations at the beginning of every lab activities that use the microscope will further enhance students' skills in using a microscope. The more often students use a microscope the more honed students skills in using a microscope. Students will perform better if given more time to practice skills laboratory work (Maknun, 2012).

CONCLUSION

Microscope skills positively affected the observation results of plant tissue preparations by students of SMAN 4 Tegal. The raise of microscopy skills grades followed by the raise of observation results grade.

REFERENCES

Amalia, D. 2010. *Efektivitas Metode Demondtrasi Terhadap Pembelajaran Bidang Study Fiqih Pada Siswa Kelas VII Di MTS Al Falah*. Skripsi. Jakarta: Fakultas Ilmu Tarbiyah Dan Keguruan UIN Syarif Hidayatullah.

Fitch, G.K. 2007. A Rubric for Assessing a Student's Ability To Use the Light Microscope. *The American Biology Teacher*, 69(4): 211-214.

Gayatri, Y. 2009. Implementasi Pengajaran Langsung (Direct Instruction) Dalam Pembelajaran Biologi: Contoh Pengembangan Perangkat Pembelajaran. *Didaktis*, 8(2): 1-65.

Handhika, J. 2010. Pembelajaran Fisika Melalui Inkuiri Terbimbing Dengan Metode Eksperimen Dan Demonstrasi Ditinjau Dari Aktivitas Dan Perhatian Mahasiswa. *JP2F*, 1(1): 9-23.

Hartanti, I., Raharjo, & T, Purnomo. 2017. Pengembangan Perangkat Pembelajaran Penemuan Terbimbing Berbantuan Mikroskop Sederhana Untuk Melatihkan Keterampilan Proses Sains Dan Pemahaman Konsep Materi Sistem Organisasi Kehidupan Pada Siswa SMP. *Pendidikan Sains Pascasarjana Universitas Negeri Surabaya*, 7(1): 1397-1408.

Krasieva, T., B. Tromberg., A. Dvomikov., & M. W. Berns.1998.Illuminator Elements For Conventional Light Microscopes. *The Regents Of The University Of California, US* 5734498 A : 1-24.

Maknun, D. 2012. Evaluasi Keterampilan Laboratorium Mahasiswa Meng-gunakan Asesmen Kegiatan Laboratorium Berbasis Kompetensi Pada Pelaksanaan Praktek Pengalaman Lapangan (PPL). *Jurnal Holistik*, 13(1): 121-144.

Mardapi, D. 2008. Pedoman Umum Pengembangan Silabus. Jakarta: Depdiknas.

Mariana, A. 2012. Pengaruh Penguasaan Penggunaan Mikroskop Terhadap Nilai Praktikum Ipa Materi Pokok Organisasi Kehidupan Pada Siswa Kelas VII Di MTS Negeri Ketanggungan Brebes Tahun Pelajaran 2011-2012. Skripsi. Semarang: Fakultas Tarbiyah Institut Agama Islam Negeri Walisongo.

Muspiroh, N. 2012. Analisis Kemampuan Generik Sains Mahasiswa Calon Guru Biologi pada Praktikum Anatomi Tumbuhan. *Jurnal Scientiae Educatia*, 1(1): 1-15.

Novitasari, S. & Lisdiana. 2015. Pengembangan Instrumen Penilaian Ranah Afektif Dan Psikomotorik Pada Mata Kuliah Praktikum Struktur Tubuh Hewan. *Unnes Journal of Biology Education*, 4(1): 97-103.

Roger, K. 2009. Panduan Lengkap Mikroskop. Jakarta: Erlangga.

Rohendi, D., H. Sutarno, & M. A. Ginanjar. 2010. Efektivitas Metode Pembelajaran Demonstrasi Terhadap Peningkatan Hasil Belajar Siswa Kelas X Pada Mata Pelajaran Keterampilan Komputer dan Pengelolaan Informasi Di Sekolah Menengah Kejuruan. *Jurnal Pendidikan Teknologi Informasi Dan Komunikasi (Ptik)* 3(1): 1-3.

Rottenfusser, R., S. Martini, & M.W. Davidson. n.d. Field Iris Diaphragm Function. Tersedia di https://www.zeiss.com/microscopy/us/solutions/reference/all-tutorials/basic-microscopy/condenser-aperture-diaphragm-function.html [diakses tanggal 27 Agustus 2017].

Simbolon P.P., Hairida, & I. Harun.2014. Deskripsi Kemampuan Psikomotorik Siswa Praktikum Kelarutan dan Hasil Kelarutan (KSP) Kelas XI IPA. *Jurnal Program Studi Pendidikan Kimia FKIP UNTAN*.

Singer, Robert N. (1980). Motor Learning and Human Performance: An Application to Motor Skills and Movement Behaviors. Macmillan Pub. New York

Spring, K.R., & M.W. Davidson. 2017. Working Distance and Parfocal Length. Tersedia di https://www.microscopyu.com/microscopy-basics/working-distance-and-parfocal-length [diakses tanggal 27 Agustus 2017]

Sugiyono. 2015. Metode Penelitian Kuantitatif Kualitatif dan R&D. Bandung: Penerbit Alfabeta.

Valeria. 2017. Microlab. Tersedia di https://quizlet.com/73160161/microlab-flash-cards/ [diakses tanggal 27 Agustus 2017].