

Measurement of the Skills of Turkish University Students in Using Microscopes and the Analysis of the Problems Faced in this Process

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Abstract: One of the most effective current methods of science education is laboratory method. When we cast a look at recent studies, we can see that teachers do not usually have sufficient knowledge and skills about making use of laboratories and doing experiments. They also seem to have some deficiencies in recognizing and using the equipments. One of the most important of these instruments is microscope. It's been determined that there are some problems with using microscopes and students generally have difficulties in finding the specimen image. In this study, students were given the tasks of doing the biological experiments of investigating onionskin, blood cell, intraoral epithelium, the stoma in leaves, the observation of potatoe, wheat and rice in order to measure the skills of using microscope.

Key words: Science and Technology Instruction • Microscope Usage • Science Laboratory Usage

INTRODUCTION

The fundamentals of science and technology knowledge are presented to students as early as elementary education and students' attitudes towards science start to take shape in this period. Science teachers who love science are thought to be the primary prerequisite of raising students who have positive attitudes towards science. Bringing up good teachers will enable them raise good students. This can be achieved only through supporting student teachers with not only theoretical foundations of science but also with its laboratory applications.

The development of science is attributed to the development of laboratory education [1]. An experiential instruction in laboratory will promote using all senses. In addition, it will also provide the opportunity to combine psycho-motor and mental skills because of the obligation to establish cause-effect relationship and making interpretation. Therefore, it can be characterized as a permanent educational method [2]. Laboratory tasks are aimed at students' realizing conceptual learning, demonstrating effective learning products and acquiring technical and inquiry skills. In this way, students may perform authentic observations and definitions at the end of experiments, improve their abilities in using laboratory materials, increase their self-confidence, confirm their

previous and theoretical knowledge, learn different solutions for the problems they faced and thinking logically [3].

Laboratory tasks are salient activities in biology education and they help understanding scientific facts. Light microscopes are among the most common tools used in biology laboratory tasks. Because, most biological materials are below the visual limit of human eye, therefore most of these experiments can be carried out only with the help of a microscope [4]. One of the most needed skills in biology is developing effective microscope using [5]. When we look at related literature, it can be observed that there are scarce studies on the skills of using microscope. In this sense, this study is thought to contribute to the literature.

The Aim of the Study: In this study, students were given the tasks of doing the biological experiments of investigating onionskin, blood cell, intraoral epithelium, the stoma in leaves, the observation of potatoe, wheat and rice in order to measure the skills of using microscope. Thus, our research problem was identified as "measurement of the skills of Turkish university students in using microscopes and the analysis of the problems faced during this process". Accordingly, the following sub problems were investigated in the context of this study.

For students studying their 2nd year in class teaching program:

- What is the level of achievement at the phases of arranging the prepare and the microscope in the process of using microscope?
- What is the level of achievement of students at the level of finding the specimen image during the process of using microscope?
- What are the possible causes of problems faced during working out the prepare and finding the specimen image in the process of using microscope?

MATERIALS AND METHODS

Research Model: Qualitative Case Study Method was used in the study. This approach enables the use of both qualitative and quantitative techniques. One of the most important advantages of this approach is that it allows the use of all kinds of data collection methods [6]. In this study, students were allowed to perform a number of experiments in the context of Science and Technology-I course, during 2009 - 2010 academic year. The experiments which involve students' use of microscope were selected among all experiments to obtain a focus point. Moreover, in order to increase students' interest towards laboratory and to promote their scientific skills (Alkaslassy, 1998), they were asked to write experiment reports.

Study Group: Among purposive sampling methods, criteria sampling was used in this study. The basic principle of criteria sampling is studying all the cases that comply with a number of predetermined criteria. These criteria may be determined by the researcher or a ready list of criteria may be used [7]. The main criteria in the selection of sampling in this study were determined as "being a 2nd year Class Teaching Program student" and "attending the course Science and Technology Laboratory – II". Following these basic criteria, the study was conducted with total 160 volunteers studying their 2nd year in Kırıkkale University, Faculty of Education, Class Teaching Program during 2009 – 2010 academic year.

Data Collection Tool and Procedures: The students in the study were assessed using the control list named "*Student Assessment Table in the Process of Using Microscope*". First of all, students were told to collect preliminary information about and then to run the tasks of doing the biological experiments of investigating onion skin, blood cell, intraoral epithelium, the stoma in

leaves, the observation of potatoe, wheat and rice in order to measure the skills of using microscope. The "*Student Assessment Table in the Process of Using Microscope*" was prepared by the researchers in order to control the activities that will be performed by the students. In this control list, there are 20 items in 2 basic categories. These items were prepared by consulting to expert views. The control list consists of two sections. The first section includes statements such as "The Process of Preparing the Prepare and the Microscope". In the second section, there are statements such as "*The Process of Students' Finding The Specimen Image*". Furthermore, in the third sub problem of using the microscope in the process of preparing the prepare and finding the specimen image, the findings regarding the possible reasons of the problems faced by the students were analyzed independently by the researchers, evaluated and then grouped.

Data Analysis: The control list developed by the researchers was prepared in a way that can monitor and assess the activities of the study group during the study. The data obtained from the interview form which consisted open ended questions developed by the researchers were evaluated using the content analysis method. Content analysis was performed in order to identify certain words or concepts in a text or texts. Researchers identify the existence of these words and concepts, their meanings and relations and make some interpretations regarding the message embedded in the texts [8]. The control list filled in by the researchers were evaluated and the answer "yes" was scored with 1(one) point and the answer "no" was scored with 0 (zero) point. Therefore, students' level of carrying out the activities were examined and a general conclusion was derived with the help of the checklist.

Findings

The Findings regarding the Achievement Levels of the Students at the Phases of Preparing the Prepare and Microscope in the Process of Using the Microscope:

The findings regarding the assessment of the students in the process of preparing the prepare and microscope in using microscope.

Since the sampling consists of 160 persons, if the assessment of all students were "yes" than the maximum total score is calculated as $160 \times 1 = 160$ points. Since 160 points show the achievement, the assessment of each item was performed according to percentages. The assessment of the students according to each item was carried out using the checklist and the students were

Table 1: The Assessment of the Students during the Process of preparing the Prepare and Microscope in Using Microscope

| Assessment Phases and Items | | Student Statuses | | | |
|--|--|-------------------|----------|---------------------|----------|
| | | <i>Successful</i> | | <i>Unsuccessful</i> | |
| | | <i>f</i> | <i>%</i> | <i>f</i> | <i>%</i> |
| Prepare and Microscope in Using Microscope | 1. Correct specimen could be accessed | 144 | 90.00 | 16 | 10.00 |
| | 2. Could distinguish slide and lamella | 80 | 50.00 | 80 | 50.00 |
| | 3. Could use slide and lamella correctly | 70 | 43.75 | 90 | 56.25 |
| | 4. Could use cross-sectioning methods for the specimen appropriately | 74 | 46.25 | 86 | 53.75 |
| | 5. Could use 45 degree rule between slide and lamella | 98 | 61.25 | 62 | 38.75 |
| | 6. Could use appropriate method for the sharpness of image | 63 | 39.37 | 97 | 60.63 |
| | 7. Could prepare the microscope | 155 | 96.87 | 5 | 3.13 |
| | 8. Could turn on the light of the microscope | 158 | 98.75 | 2 | 1.25 |
| | 9. Could install the prepare to the microscope accurately | 147 | 91.87 | 13 | 8.13 |

Table 2: The Assessment of Students During the Process of Finding the Image in Using the Microscope

| Assessment Phases and Items | | Student Statuses | | | |
|----------------------------------|---|-------------------|----------|---------------------|----------|
| | | <i>Successful</i> | | <i>Unsuccessful</i> | |
| | | <i>f</i> | <i>%</i> | <i>f</i> | <i>%</i> |
| The Process of Finding the Image | 1. Knows how to look through the eyepiece | 40 | 25.00 | 120 | 75.00 |
| | 2. Can adjust the image using the stage | 127 | 79.37 | 33 | 20.63 |
| | 3. Can use the holding clips | 110 | 68.75 | 50 | 31.25 |
| | 4. Can make the coarse adjustment and sharpen the image | 135 | 84.37 | 25 | 15.63 |
| | 5. Can make the fine adjustment and sharpen the image | 72 | 45.00 | 88 | 55.00 |
| | 6. Can sharpen the image by using the lighting | 50 | 31.25 | 110 | 68.75 |
| | 7. Can change the rate of zoom by using the objectives | 112 | 70.00 | 48 | 30.00 |
| | 8. Can decide the appropriate zooming for the specimen | 102 | 63.75 | 58 | 36.25 |
| | 9. Can find the specimen image | 75 | 46.88 | 85 | 53.12 |
| | 10. Can decide that the specimen image is correct | 64 | 40.00 | 96 | 60.00 |
| | 11. Can feel themselves ready for different prepares | 45 | 28.12 | 115 | 71.88 |

Table 3: Findings regarding the Possible Reasons of the Problems Faced by the Students during the Process of Finding the Image and Preparing Prepare in Using Microscope

| Students' Expressions | <i>f</i> | <i>%</i> |
|---|----------|----------|
| 1. The students who stated that they couldn't use microscope because they have only been exposed to demonstrative experiments | 35 | 77.78 |
| 2. The students who stated that they've never seen microscope before | 22 | 48.89 |
| 3. The students who stated that they are afraid of using microscope because it's an electrical device | 17 | 37.78 |
| 4. The students who stated that they are afraid of using microscopes because they are very expensive devices | 8 | 17.78 |

identified as successful if out of 160 students, 80 (50%) or more were successful in that item. According to these data, when Table 1 is examined, it was determined that 60.63% of the students were unsuccessful in the item "Could use the appropriate method for the sharpness of the image". Based on the observations of the researchers, it was determined here that students faced a problem because they misused the materials as water and methylene blue in order to sharpen the image. Of the students, 56.25% were found unsuccessful in the item stated as "used the slide ve lamellai correctly". According to observations, students have difficulty with putting the slide over the lamella because they confused the slide and

the lamella. Again, when we look at Table 1, it can be seen that 50% of the students were unsuccessful in the item "could distinguish slide and lamella". Of the students, 53.75% were found to be unsuccessful in the item "could use cross-sectioning methods appropriately for the specimen". The observations demonstrated that students had difficulties in taking cross-section from the specimen. In the experiment of investigating the stoma in the leaf, students were found to take cross-sections mostly vertically rather than transversal cross-sections. Besides, when examining starch, students were found to have difficulties in taking specimens from wheat and rice.

The Findings regarding Students' Achievement at the Stage of Finding the Image in the Process of Using the Microscope: The findings regarding the assessment of the students in the process of preparing the prepare and microscope in using microscope.

When Table 2 is examined, it can be seen that the item in which the students were least succesful was "Do you know how to look through the eyepiece?". As a result of the observations made by the researchers, it was determined that most of the students (% 75) did not know how to look through the eyepiece. At this stage, students were found to close one of their eyes while looking through the eyepiece. By the time students were found to complain from pain in the eye. Of the students, 71.88% were determined to be unsuccessful in the item "Feel themselves ready for different prepares". Of the students, 68.75% were found to be unsuccessful in the item "Can sharpen the image using lighting". Of the students, 60% were found to be unsuccessful in the item "Can decide whether the image is correct". It was determined that students confused the images they've seen with a number of unrelated, unclear shapes formed by water drops. Of the students, 55% were found to be unsuccessful in the item "Can sharpen the image by making fine adjustment". According to the observation made by the researchers, students usually have no problems at the phase of making coarse adjustment (84.37%) but they state that the image vanishes during fine adjustment. Besides, 53.12% of the students were found unsuccessful in the item "Can find the specimen image". Therefore, it can be said that the students who could not make fine adjustments lived problems in finding the image.

Findings regarding the Possible Reasons of the Problems Faced by the Students during the Process of Finding the Image and Preparing Prepare in Using Microscope: Among 160 students, 45 selected students who lived problems with using microscope were interviewed. When the possible reasons of the problems faced by the students in preparing prepares and finding specimen image were examined, the results in Table 3 were obtained.

When Table 3 above is examined it can be seen that, 77.78% of 45 students stated that their teachers did demonstrative experiments in their previous educational lives. Therefore, students stated that they did not use microscope directly but rather looked at the image with a completely ready microscope. Of the students, 48.89% stated that they have never seen microscope in their previous educational lives. This can be attributed to the

fact that the participants study in classroom teaching program and they have graduated from social science fields of high schools. Of the students, 37.78% stated that they experienced problems because the microscopes used in the laboratories are electrical devices and they are afraid of electricity. Finally, 17.78% of the students stated that they are afraid of using microscopes because they think that computers are expensive devices and can easily be broken down.

RESULTS

This paper shows that 60.63% of students couldn't use appropriate method for the sharpness of specimen image. The students prepared the prepare by dropping more than one drop when using water and methylene blue or dropped the water or methylen blue on the outer surfaces of slide and lamella and therefore could not obtain a sharp image. It was determined that, 56.25% of the students could not use the slide and lamella correctly. The observations showed that the students lived difficulty in placing the slide under the lamella during preparing the prepare because they confused slide and lamella. When we look at Table - 1, 50% of students were found unsuccessful in the item "Could distinguish slide and lamella". In this item 50% of the students were found successful and the other half were found unsuccessful. As a result, 56.25% of the students could not use slide and lamella correctly. It was concluded that 53.75% of the students could not use cross-sectioning methods for the specimen appropriately. It was found that students used vertical rather than a transversal cross-sectioning method when preparing the prepare in the experiment of investigating the stoma in a leaf. Moreover, when investigating starch, students were found to live problems during taking samples from wheat and rice. Generally, it can be said that students are incompetent in using microscope and this can affect science education negatively. Similarly, teachers' being incompetent and unexperienced in using biology instruction materials [9], might affect biology teaching negatively. Therefore, in order not to let the interest towards science diminish and to be able to apply the microscope experiments more effectively and to promote the microscope using abilities in students and to increase the achievement in these experiments: firstly, the students should be informed about the parts of the microscope and then students should be allowed to do the experiments themselves by touching the microscopes and using the instruments. It is thought that this will increase the microscope using skills of the students.

As a result of the observations made by the researchers, a great majority of students (75%) were determined not to know how to look through the eyepiece. At this stage, students are found to close one of their eyes while looking through the eyepiece. By the time, students started to complain from pain in the eye. It was found that 71.88% of the students felt themselves unready for different preparates. Here, it can be concluded that students lived problems in capturing a full image and thus did not have self-confidence. According to Özmen and Ayas [3], if laboratory tasks are carried out appropriately students may develop their skills in using laboratory equipments and so their self-confidence might increase. In order to promote self-confidence, laboratory tasks should be carried out appropriately and effectively.

It was determined that 68.75% of the students could not sharpen the image using the lighting. Here, students made some complaints because they couldn't make light adjustments correctly. One of mostly made complaints is headache due to excessive light. Of the students, 60% were found to be unsuccessful in deciding whether the image is correct. It was determined that students confused the images they've seen with a number of unrelated, unclear shapes formed by water drops. Moreover, students stated that they saw the shadow of their eyelids because they couldn't adjust looking distance. Of the students, 55% were found to be unsuccessful in sharpening the image by making fine adjustment. According to the observation made by the researchers, students usually have no problems at the phase of making rough adjustment (84.37%) but they stated that the image vanished during fine adjustment. Besides, 53.12% of the students were found unsuccessful in finding the image. As a result, it can be suggested that students lived difficulty in finding image. When all these problems are examined it can be seen that, it's hard to attain learning objectives when student activity is not carried out sufficiently as stated by Şahin *et al.* [10]. Therefore such a failure may be explained with the fact that students were not actively involved in laboratory tasks in their previous educational lives. According to Garnett and Garnett [11], it's aimed with laboratory tasks to help students demonstrate effective learning products and attain technical and inquiry-related skills. Therefore, at all levels of education, activities should be carried out in a way that will develop students' skills of using microscope. These activities should be investigated after planning them in an increasing difficulty before starting the experiments. In this way, students may start with easier experiments and by achieving each experiment their motivations towards the course and the microscope may increase.

After the interviews made with 45 students, it was found that 77.78% of the students stated that their teachers always showed them demonstrative experiments in their previous educational lives. Therefore, students stated that they did not use microscope directly but rather looked at the image with a completely ready microscope. Here, developing students' skills of using microscope is more important than having them see the image. In parallel with these findings, when a study conducted by Yeşilyurt [12] asked students' views about "Using microscope in Laboratory", most of the participant students stated that microscopes were used to see routine images prepared by educators rather than as an instrument to develop students' skills of thinking and inquiring. Similarly, this finding aligns with the results of the study by Dikmenli *et al.* [4]. Of the students, 48.89% stated that they have never seen microscope in their educational lives before. This can be attributed to the fact that the participants study in classroom teaching program and they have studied in social science fields in high school. Of the students, 37.78% stated that they experienced problems because the microscopes used in the laboratories are electrical devices and they are afraid of electricity. Finally, 17.78% of the students stated that they are afraid of using microscopes because computers are expensive devices and they thought they can easily be broken down. A student with developed microscope using skills is thought to see that such kind of fears are baseless. Furthermore, students should be made well aware of the working principles of microscope and be helped to overcome their fears.

REFERENCES

1. Mitchel, J.K., M.A. Warden and B.P. Crum, 1999. Fun Microbiology: Making Plain ve Frozen Yogurt. Here's a microbiology experiment that you can eat. American Biology Teacher. How- To -Do- Its. October, p: 595.
2. Tezcan H. ve Günay S. (2003). Lise kimya öğretiminde laboratuvar kullanımına ilişkin öğretmen görüşleri, Milli Eğitim Dergisi, sayı: 159.
3. Özmen, H. and A. Ve Ayas, 2001. Kimya öğretmenliği öğrencilerinin laboratuvar uygulamalarında karşılaştıkları güçlüklerin tespiti, Çukurova Üniversitesi Eğitim Fakültesi Dergisi., 12(21): 1-7.
4. Dikmenli, M., L. Türkmen and O. Ve Çardak, 2002. Üniversite öğrencilerinin biyoloji laboratuvarlarında mikroskop çalışmaları ile ilgili alternatif kavramları. V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi. [http:// www.fedu.metu.edu.tr/~ufbmek-5/b_kitabi/PDF/Biyoloji/bildiri/tl7d.pdf](http://www.fedu.metu.edu.tr/~ufbmek-5/b_kitabi/PDF/Biyoloji/bildiri/tl7d.pdf) (26.12.2004).

5. Alkaslassy, E., 1998. Motivating first-year biology students to use microscopes and the scientific method. Page 337, in *Tested studies for laboratory teaching*, Volume 19 (S. J. Karcher, Editor). Proceedings of the 19th Workshop/Conference of the Association for Biology Laboratory Education (ABLE).
6. Azar, A., 2003. Okul deneyimi ve öğretmenlik uygulsideası derslerine ilişkin görüşlerinin yansımaları. *Milli Eğitim Dergisi*, 159. [05.04.2009] <http://yayim.meb.gov.tr/dergiler/159/azar.htm>.
7. Yıldırım, A. and H. Ve Şimşek, 2008. *Sosyal Bilimlerde Nitel Araştırma Yöntemleri*. Ankara: Seçkin Yayıncılık.
8. Büyüköztürk, Ş., R.K. Çakmak, Ö.E. Akgün, Ş Karadeniz and F. Ve Demirel, 2008. *Bilimsel Araştırma Yöntemleri*. Ankara: PegemA Yayıncılık.
9. Çakıcı, Y., 2006. İngiltere’de biyoloji bilimlerinin gelişimini etkileyen faktörler. *GÜ, Gazi Eğitim Fakültesi Dergisi*, 26(I): 23-34.
10. Şahin, N.V., B. Şahin and H. Ve Özmen, 2000. Liselerdeki biyoloji öğretmenlerinin derslerini deneylerle işleyebilme ve laboratuar kullanma olanaklarının incelenmesi, Hacettepe Üniversitesi Eğitim Fakültesi IV. Fen Bilimleri Eğitimi Sempozyumu, Beytepe, Ankara.
11. Garnett, P.J. and P.J. Garnett, 1995. Refocussing the chemistry lab: A case for laboratory-based investigations, *Australian Teachers J.*, 41(2): 26-33.
12. Yeşilyurt, S., 2006. Öğretmen adayları ve öğretim elemanları gözüyle genel biyoloji laboratuar uygulamalarının değerlendirilmesi, *Kastamonu Eğitim Dergisi*, 14(2): 481-496.