European Journal of Educational Research
Volume 8, Issue 1, 313 - 323.
ISSN: 2165-8714
http://www.eu-jer.com/

The Effects of Biology Laboratory Practices Supported with Self-regulated Learning Strategies on Students' Self-directed Learning Readiness and Their Attitudes towards Science Experiments

Kadriye Kayacan *
Necmettin Erbakan University, TURKEY

Isil Sonmez Ektem
Necmettin Erbakan University, TURKEY

Abstract: Self-regulation is an active and constructive process in which students regulate and observe their own behaviour, motivations and cognition by setting their own goals during their learning process. In this study, the aim is to investigate the effects of biology laboratory practices that are supported by self-regulated learning strategies on students' readiness for self-directed learning and their attitudes towards science experiments in laboratory settings. This study, which was undertaken as a quasi-experimental study in accordance with the pretest-posttest design with a control group, was implemented. Second year students who studied science teaching in the faculty of education at a state university in Konya in the academic year of 2018-2019 made up the sample of this study. There were two groups in the study which were "The Control Group" and "The Experimental Group". In order to measure the students' self-directed learning readiness levels, "Scale of Self-Directed Learning Readiness in Laboratory" was used and to measure attitudes towards science experiments "Scale of Attitudes towards Science Experiments" was utilized. Both scales were implemented as pre-tests before the study and as post-tests after the completion of the implementation process. The analysis of the data was conducted via SPSS 18. Independent samples t test was conducted to understand whether biology laboratory practices supported with self-regulated learning strategies have any effect on students' readiness for self-directed learning and their attitudes towards science experiments in laboratories. According to the findings of the study, biology laboratory practices supported with self-regulated learning strategies were observed to make a significant difference in favour of the experimental group considering their self-directed learning readiness and their attitudes towards science experiments.

Keywords: *Biology laboratory, self-regulated learning strategies, self-directed learning readiness, attitude.*

To cite this article: Kayacan, K., & Sonmez Ektem, I. (2019). The effects of biology laboratory practices supported with self-regulated learning strategies on students' self-directed learning readiness and their attitudes towards science experiments. *European Journal of Educational Research*, *8*(1), 313-299. doi: 10.12973/eu-jer.8.1.313

Introduction

One of the fundamental principles of social cognitive theory suggests that human beings have the ability to control their own behaviour. Human beings control much of their behaviour such as how much to work, how long to sleep, what to eat, what to drink, how much to talk and how to behave in the society. The behaviour people display usually depends on their inner standards and their own motivation (Senemoglu, 2013). Self-regulation which was mentioned by Bandura, the founder of social cognitive theory, for the first time is defined as an individual's affecting, directing and controlling his/her own behaviour by observing the behaviour, judging it via comparing it to his/her own criteria and making changes on it if needed (Bandura, 1977; cited by Senemoglu, 2013). The process of self-regulation is an active and constructive process in which students regulate and observe their behaviour, motivation and cognition in accordance with the goals they have identified in the process of learning (Pintrich, 2000). It means that an individual controls and directs his/her own behaviour (Williams, 2010; cited by Eryilmaz, 2016). Self-regulated learning is "the degrees at which students actively participate in their own learning in terms of metacognitive, motivational and behavioural aspects" (Zimmerman, 1990; Zimmerman & Schunk, 2001). Self-regulated learning includes the process in which the behaviour, motivation and cognition directed towards a goal related to an academic issue are controlled by students. The self-regulation of a behaviour requires the active control of resources such as students' time, working environment and peer cooperation. The self-regulation of motivation includes the control and regulation of students' motivational believes such as self-efficacy and targeting a goal. In addition to this, it allows the control of emotions such as anxiety and it enables making some changes to affect learning in a positive way. Thirdly, the self-regulation of cognition also

* **Corresponding author:**
Kadriye Kayacan, Necmettin Erbakan University, Ahmet Kelesoglu Education Faculty, Konya – Turkey
✉ kadriyekayacan@gmail.com

includes the control of various cognitive strategies that are needed for learning (Pintrich, 1995; cited by Vardal & Arsal, 2014).

Different definitions of self-regulation by different researchers lead to the emergence of different models regarding the regulation of learning (Sari & Akinoglu, 2009). In various definitions and models that were proposed by different theoretical perspectives, the common point is the fact that students play an active role in the learning processes behaviourally, cognitively and motivationally (Uredi & Uredi, 2005). All the self-regulation models consider students as active and constructive individuals. They argue that students do not obtain knowledge passively. In contrast, they learn by constructing knowledge in their minds. Students control and regulate their behaviour, motivation, cognition and environment. They identify their learning goal, observe the performance in accordance with the goal and regulate their cognition, motivation and behaviour in order to attain their goal (Pintrich, 2000).

According to social cognitive perspective, self-regulation consists of a cyclical process in which individual, behavioural and peripheral factors interact. The development of the self-regulatory system is dependent upon the triple interaction among environment, personal factors and behaviour. Individuals receive knowledge from others' behaviour and personal factors affect the development of general standards from this behaviour. The behaviour of an individual affects both his/her environment and also his/her reactions. In this way the effects in the surroundings affect both personal perceptions and also the next behaviour to be displayed (Gredler, 2005).

Metacognitive strategies are also significant structures in self-regulated learning processes. In the literature although the significance of metacognition is acknowledged, there are different views which suggest that self-regulation is a component of metacognition or metacognition is a subcomponent of self-regulation (Veenman, Hout-Wolters & Afflerbach, 2006; Cited by Erdogan & Sengul, 2014). Self-regulation is similar to metacognitive awareness which includes task and personal knowledge. Self-directed learning requires individuals to understand the requirements of tasks, personal characteristics and the necessary strategies that are needed to accomplish a task. Metacognitive awareness includes the know-how which facilitates regulating the subject to be learned, observing the learning level, deciding when to use a task approach and doing readings for exams. The main (higher order) component of self-regulation is problem solving production systems in which attaining the goal itself is the problem and the individual investigates whether he/she has made any progress by observing himself/herself. This system contrasts the current situation according to a standard and it tries to decrease the differences (Schunk, 2004).

The individuals who learn through self-regulated learning set goals in their learning and they try to achieve these goals. When necessary, they try different ways to realize their goals. In order to achieve their goals, the individuals who regulate their learning in this way usually use internal motivation rather than external motivation. As they are aware of the capacity that they have, they have high self-confidence and they control their own learning without an external force (Dadli, 2015). According to these explanations, the following points are observed in learning that is based on self-regulation: (a) there is a goal oriented process, namely, students have a goal, (b) students take the initiative and work independently to achieve the goal, which means they take responsibility, (c) students have metacognitive awareness to identify the necessary issues in the task, compensate for their own levels to satisfy the requirements of the task and choose the strategies that they can use to accomplish the task, (c) they try to accomplish the task by using various strategies throughout the process, namely, they act strategically and (d) they have a high level of motivation (Uyar, 2015).

It is thought that the ability of self-regulation is one of the most significant factors in success and academic performance (Zimmerman, 1990; Uredi&Uredi, 2005; Boekaerts, 1996). Some researchers underlined high level of self-regulation strategies as a decisive factor in students' academic success (Eker & Arsal, 2014). Zimmermann (1990) stated that there is a direct link between self-regulation strategies and academic success. Successful students play a more active role in learning and they regulate their own learning (Bland, 2005; cited by Turan & Demirel, 2010). It is also stated that there is a difference in the level of motivation between the students who have a high and low level of success (Ruban & Reis, 2006; cited by Turan & Demirel, 2010).

Towards the end of the 20st century, all developed, developing and underdeveloped countries were in search of finding different and effective ways to prepare their citizens for the life in the 21st century by training their citizens and obtain success in education at both international and local levels (Tutkun & Aksoyalp, 2010). Because in this century the industry, areas such as technology and medicine are developing faster than ever and individuals can keep up with these developments to be educated with 21st century skills (Cinar, Pirasa, and Sadoglu, 2016). Some of the 21st century skills that Binkley et al. (2012) describes are as follows.

Ways of thinking: Creativity and innovation; critical thinking, problem solving, decision making; learning to learn; metacognition (Kostur, 2017). Self-regulation, which is the subject of our study, is a form of learning that supports the ways of thinking such as learning to learn, metacognition and creativity. For these reasons, it is also possible to provide pre-service teachers with self-regulation skills and also have 21st century skills. Teachers must have these skills before they can develop the new generation according to their 21st century skills. In this study, the effects of these skills on the attitudes towards the experiments and their self-learning readiness have been tried to be observed. It is thought that the practice of using self-regulation skills will help to gain 21st century skills therefore our study is important.

In the recent years, educators have focused on the studies which research the effects of self-regulated activities on academic success. When the literature is reviewed, it is common to come by studies that suggest that the learning environments that have self-regulation affect academic success positively (e.g. Schloemer & Brenan, 2006; Camahalan, 2006; Nota, Soresi & Zimmerman, 2004; Paterson, 1996; Israel, 2007; Uredi & Uredi; 2005). Although many studies were found in the literature both nationally and internationally, no study which analysed the effects of self-regulated learning on students' self-directed learning readiness in laboratories and their attitudes towards science experiments in laboratories was found. For this reason, this study aims to investigate the effects of biology laboratory practices that are supported by self-regulated learning strategies on students' readiness for self-directed learning and their attitudes towards science experiments. Accordingly, the responses for the following questions were studied.

Do biology laboratory practices supported by self-regulated learning strategies have an effect on students' self-directed learning readiness?

Do biology laboratory practices supported by self-regulated learning strategies have an effect on students' attitudes towards science experiments?

Methodology

This study was conducted as a quasi-experimental study in accordance with a pretest-posttest research design in order to investigate the effects of the use of self-regulated learning strategies in General Biology Laboratory I course on students' self-directed learning readiness and their attitudes towards science experiments. According to Karasar (2009), quasi-experimental design is used in cases where it is difficult to form groups by which the research will be carried out and pre-existing natural groups are used provided that the research groups are appointed as neutral. In the research, two groups that took General Biology Laboratory course were randomly assigned to the applied method.

Self-regulated learning strategies and the laboratory method used in the research design are the independent variables. As for the dependent variables, they are students' self-directed learning readiness and their level of attitudes towards science experiments.

In the study "Scale of Self-Directed Learning Readiness in Laboratory" was used to measure students' self-directed learning readiness levels and "Scale of Attitudes towards Science Experiments" was used as a pre-test to find out the participants' attitude levels towards science experiments. When the study was completed, the same tests were implemented as post-tests. The study was conducted- on the data collected through these scales. The design of the study was presented below.

Table 1. The Design of the Study

GROUPS	PRE-TEST	IMPLEMENTATION	POST-TEST
EXPERIMENTAL	Scale of Self-Directed Learning Readiness in Laboratory Scale of Attitudes towards Science Experiments	Biology Laboratory Implementations supported with self-regulated learning strategies	Scale of Self-Directed Learning Readiness in Laboratory Scale of Attitudes towards Science Experiments
CONTROL	Scale of Self-Directed Learning Readiness in Laboratory Scale of Attitudes towards Science Experiments	Biology Laboratory Implementations	Scale of Self-Directed Learning Readiness in Laboratory Scale of Attitudes towards Science Experiments

The Participants

Second year students who study science teaching in the faculty of education at a state university in Konya in the academic year of 2018-2019 made up the participants of this study. There were two groups in the study which are "The Control Group" and "The Experimental Group". The number of students that participated in the pre-test was 74. 38 of the students were in the experimental group while 36 of them were in the control group.

While the study group students were selected, convenience sampling technique was used from the sampling methods which could not be selected. The convenience sampling technique is the technique of selecting the sample from the people who are easily accessible and suitable for implementation due to the limitations that can be experienced in terms of time, money and performance (Buyukozturk, 2012). Because of all these reasons, a department in which one of the researchers worked and a course that the researcher carried out was determined as the students and the environment.

The homogeneity of the groups was first examined in the formation of the experimental and control groups. The selected groups consist of groups with similar characteristics in terms of being a second year student studying in the same department (Science Teacher Education Program) and university placement scores. First of all, in this respect, homogeneity of the groups was ensured (Buyukozturk, 2012). Necessary measures were taken in order to ensure the equivalence in the experimental and control groups and it was examined whether the experimental and control group

students differed in terms of attitude and self-learning readiness. Accordingly, there was no significant difference in the scores of the experimental and control group students in terms of both dimensions.

Data Collection Tools

Scale of Self-Directed Learning Readiness in Laboratory (SSLRL)

In the study in order to designate the university students' self-directed learning readiness, the Scale of Self-Directed Learning Readiness in Laboratory that was developed by Alkan (2012) was used. The scale consists of 32 items and 5 sub-factors. In the scale, which was formed as a 5-point likert scale, marking was done from 5 to 1 as "I definitely agree=5", "I agree=4", "I am undecided=3", "I do not agree=2" and "I do not agree at all=1" for the positive items while it was done from 1 to 5 as "I definitely agree=1" and "I do not agree at all=5" for the negative items. The Cronbach's Alpha reliability coefficient was calculated as 0.93 by Alkan (2012). As a result of the analysis conducted in this study, it was calculated as 0.91. The scale was developed with university students. Sample items are given below.

I like to discuss ideas in laboratory studies.

The idea of self-learning in the lab scares me.

The Scale of Attitudes towards Science Experiments (SASE)

This study aims to designate the attitudes of the students who study in Science Teaching Department and "The Scale of Attitudes towards Science Experiments" developed by Yildiz et al. (2007) was used to collect data. The Scale of Attitudes towards Science Experiments was formed as a 5-point likert scale and marking was done as "I definitely agree=5", "I agree=4", "I am undecided=3", "I do not agree=2" and "I do not agree at all=1". The scale consists of 19 items. The lowest possible point in the scale is 19 while the highest point is 95. The positive items in the scale were marked as "5" for I completely agree, "4" for I agree, "3" for I am undecided, "2" for I do not agree and "1" for I do not agree at all and the negative items were marked vice versa. For the final status of The Scale of Attitudes towards Science Experiments, an item analysis was conducted on 110 teachers and the results suggested that total item correlation coefficients were found to vary between .33 and .88. Internal coefficient of consistence varied between .91 and .94. The reliability coefficient for the whole scale was found as .92 via Cronbach's Alpha Reliability Coefficience. Sample items are given below.

Processing a course by doing an experiment leads to a waste of time.

Experimentation in the laboratory causes students to get bored.

Experimenting allows students to interact more.

3. The Implementation of the Study

Before the implementation of the study commenced, a literature review was done on self-regulated learning strategies and then, a sample template was formed to ensure that students used these strategies in laboratory implementations. The formed template was restructured in accordance with the views of 3 academicians who are experts in their fields (science education, curriculum design and biology education) and it was finalized accordingly. While the template was being constructed, Zimmerman's (2000) self-regulation phases were used.

Zimmerman's self-regulation phases were presented in the table below.

THE STAGES OF SELF-REGULATION		
FORETHOUGHT	**PERFORMANCE CONTROL**	**SELF-REFLECTION**
Task Analysis Goal Setting Strategic Planning	**Self-Control** Self-instruction Imagery Attention Focusing Task Strategies	**Self-judgement** Self-evaluation Causal Attribution
Self-Motivation Beliefs Self-efficacy Outcome Expectations Task Interest/value Goal Orientation	**Self-observation** Metacognitive monitoring Self-recording	**Self-Reaction** Self-satisfaction/effect Adaptive/defensive

Figure 1. Zimmerman's (2000) Phases and Sub processes for Self-Regulation

Before the implementation of the prepared template, it was introduced to the students and they were told that the implementations would be conducted according to the template during the study. In addition, self-regulation was explained to the students for a classroom hour. In the week before the implementation started, the students in both groups were given the pre-test using both scales. The implementation process lasted for 5 weeks. In this period both groups did the same experiments. The experiments included going through a membrane through diffusion, examining

plasmolysis-deplasmolysis, mitotic division, meiosis and examining the organisms that live in protozoa cultures via a microscope. When the study was completed, the same data collection tools were applied to both groups as post-tests.

The prepared figure is as follows;

<table>
<tr><td rowspan="7">PREPARATION (FORETHOUGHT)</td><td colspan="2">What is our subject this week and what is my goal?</td></tr>
<tr><td colspan="2">What are the things that I know about this subject?</td></tr>
<tr><td>What are the things that I do not know about this subject?</td><td>How do I access to the information such as concepts, principles, generalizations and formulas and so on?</td></tr>
<tr><td>1.</td><td>1.</td></tr>
<tr><td>2.</td><td>2.</td></tr>
<tr><td colspan="2">The results of my research:</td></tr>
<tr><td colspan="2">Why may learning this subject be significant for me?</td></tr>
<tr><td rowspan="6">IMPLEMENTATION (PERFORMANCE)</td><td colspan="2">What are the things that I need to do to realize my goals?</td></tr>
<tr><td colspan="2">What do I expect as a result of the activity I have done?</td></tr>
<tr><td colspan="2">The activity's steps of implementation</td></tr>
<tr><td colspan="2">The observations and data I need to record during implementation</td></tr>
<tr><td colspan="2">The figures and charts of the implementation</td></tr>
<tr><td colspan="2">The conclusion sentence of the implementation</td></tr>
<tr><td rowspan="5">EVALUATION (SELF - REFLECTION)</td><td colspan="2">Did the implementation end up as needed?</td></tr>
<tr><td colspan="2">If there are errors in the results, what may be the reasons?</td></tr>
<tr><td colspan="2">What are the problems that, I think, are caused by me?</td></tr>
<tr><td colspan="2">The problems that I think stem from tools, environment, friends and so on</td></tr>
<tr><td colspan="2">The benefits that this study provided to me</td></tr>
</table>

Figure 2: The Laboratory Template Used in the Study that is Appropriate for Self-regulated Learning Strategies

The template consists of three main parts which are Preparation (forethought), Implementation (performance) and Evaluation (self-reflection). In the preparation stage, the following instructions in accordance with self-regulation strategies were identified: What is our subject this week and what is my goal? (task analysis), what are the things that I know about this subject? (self-efficacy), what are the things that I do not know about this subject? (self-efficacy), how do I access to the information such as concepts, principles, generalizations and formulas and so on? (strategic planning), what are the results of my research? (goal orientation) and why may learning this subject be significant for me? (task interest). As for the Implementation stage, the following instructions were identified: What are the things that I need to do to realize my goals? (self-control), what do I expect as a result of the activity I have done? (self-control), the activity's steps of implementation (self-control), the observations and data I need to record during implementation (self-recording), the figures and charts of the implementation (metacognitive monitoring) and the conclusion sentence of the implementation (metacognitive monitoring). Finally, the following instructions were identified for the Evaluation part to make students use self-regulation strategies: Did the implementation end up as needed? (self-judgement), if there are errors in the results, what may be the reasons? (self-evaluation), what are the problems that, I think, are caused by me? (self-reaction), the problems that I think stem from tools, environment, friends and so on (self-reaction), what are the benefits that this study has provided to me (self-reaction). Some samples of students' work which are appropriate for the template were provided in the appendices (Please see the Appendices).

Biology Laboratory Implementations

Biology laboratory practice I is an application course that is taught in the second year of science teaching department. Within the scope of this course, students are able to reinforce the theoretical biology course with applied experiments. Course content was determined by Council of Higher Education (YOK) as follows.

Basic laboratory usage techniques. laboratory safety measures, introduction and use of microscope, examination of cell structure, osmosis, observation of diffusion events, the comparison of plant and animal cell examination, cell division and its stages, examination of animal and plants tissues, the development stages of the plant, examining the parts of flowering plants.

In this lesson students prepare the examination before the lesson. In the lesson first teacher and students **talk** about that week's topic and the concepts about topic. After the implementations of the experiment the lesson ends. Students must write a report about experiment and must show this report the next lesson to teacher. In the content of the report; the name of experiment, tools of experiment, theoretical information, implementation of experiment, and the results of the experiment must be written by students.

Analyzing of Data

The analysis of the data was conducted via SPSS 18 software. Firstly to test whether the data shows normal distribution normality test applied. The significant value of Shapiro-Wilk W Test was higher than .05 so variable is normally distributed. Therefore, we use the parametric test for analysis of the data. Independent samples t test was utilized to understand whether biology laboratory practices supported with self-regulated learning strategies have any effect on students' readiness for self-directed learning and their attitudes towards science experiments in laboratories.

Findings / Results

The purpose of this research is to explore of the effect of laboratory practices supported by self-regulated learning strategies on students' self-directed learning readiness and attitudes towards science experiments. Therefore, independent sample t-test was used for data analysis.

1. Is there a difference between the levels of experimental and control groups in terms of readiness for self-directed learning?

Table 1. The results of the T test for experimental and control groups regarding the SSLRL Scale

Groups	N	M	SD	t	p
Experimental	38	133.87	11.67	-1.09	0.281
Control	36	137.0	13.13		

p<0.05

According to Table 1, there is not a significant difference between the experimental group (M= 133.87; SD=11,67) and control groups (M= 137.0; SD=13,13) according to the pre-test results in terms of the level of readiness for self-directed learning in laboratory settings ($t(72)=1.09$, $p >.05$, $r = 0.12$). The size of the effect is low level.

2. Is there a difference between the levels of experimental and control groups in terms of attitudes towards science experiments?

Table 2. The results of the T test for experimental and control groups regarding the SASE Scale

Groups	N	M	SD	t	p
Experimental	38	77.95	9.45	0.735	0.46
Control	36	76.28	10.07		

p<0.05

According to Table 2, there is not a significant difference between the experimental group (M= 77.95; SD=9.45) and control groups (M= 76.28; SD=10.07) according to the pre-test results in terms of the level of attitudes towards science experiments ($t(72)=0.735$, $p >.05$, $r = 0.086$). The size of the effect is low level.

3. Do biology laboratory practices supported by self-regulated learning strategies have an effect on students' self-directed learning readiness?

Table 3. The results of the T test for experimental and control groups regarding the SSLRL Scale as a post-test

Groups	n	M	SD	t	p
Experimental	38	140.24	9.75	4.19	0.025
Control	36	124.86	20.26		

p<0.05

According to Table 3, there is a significant difference between the experimental group (M= 140.24; SD=9.75) and control groups (M= 124.86; SD=20.26) according to the post-test results in terms of the level of self-directed learning readiness ($t(72)=4.19$, $p<.05$, $r = 0.44$).

Consequently, the level of the students in the experimental group is significantly higher for self-directed learning readiness compared to the control group. The size of the effect is medium level.

4. Do biology laboratory practices supported by self-regulated learning strategies have an effect on students' attitudes towards science experiments?

Table 4. The T test results of the SASE for the experimental and control groups

Groups	n	M	SD	t	p
Experimental	38	83.10	8.17	5.37	0.039
Control	36	68.30	14.77		

p<0.05

According to Table 4, the test which was conducted after the implementation suggested that there was a significant difference regarding the levels of attitudes towards science experiments ($t(72)=5.37$, $p<.05$, $r = 0.52$). The average for students in the experimental group (M= 83.10; SD=8.17) were found to have a significantly higher level than control group (M= 68.30; SD=14.77). The size of the effect is medium level.

Discussion and Conclusion

This study has investigated the effects of biology laboratory practices that are supported by self-regulated learning strategies on students' readiness for self-directed learning and their attitudes towards science experiments in laboratory settings.

In our study, firstly, the self-directed learning readiness levels of the experimental and control groups were studied and the results demonstrated that there was not a significant difference between the two groups with regard to their levels. Similarly, the levels of attitudes of the experimental and the control groups towards scientific experiments were analyzed and a significant difference was not observed in the levels of attitudes towards science experiments.

The first sub problem of the study aimed to identify the effects of biology laboratory practices supported with self-regulated learning strategies on self-directed learning readiness. The results of the experimental study demonstrated that biology laboratory practices supported with self-regulated learning strategies had a significant effect on students' self-directed learning readiness. According to the findings, the experimental group's level of self-directed learning readiness in the post-test was significantly higher compared to the control group. Knowles (1975) defined self-regulated learning as the process in which individuals specified their learning needs with or without getting help from the others, defined the resources needed for learning and took the initiative to choose appropriate strategies for learning and evaluate learning products. The concept of self-directed learning is related to the concepts self-regulation, self-efficacy and self-control. Therefore, the students who have acquired the skill of self-directed learning need success in controlling, regulating, and internal and external motivation while realizing their learning activities and experiences (O'Shea, 2003; Cited by Aydede & Kesercioglu, 2009). On the other hand, self-directed learning readiness can be defined as an individual's having the necessary attitudes, abilities and personal characteristics which are essential for self-directed learning (Wiley, 1983; Fisher, King & Tague, 2001; cited by Alkan, 2012). Laboratories are considered as one of the special contexts which help learners take the responsibility of their own learning and contribute to the structuring of knowledge by the learners (Alkan, 2012). In this sense, supporting biology laboratory practices with self-regulated learning strategies will be useful for forming laboratory environments in which students have more duties and this means that they will undertake the responsibility of their own learning.

The second sub problem of the study aimed to identify the effects of biology laboratory practices supported with self-regulated learning strategies on students' attitudes towards science experiments. The results of the experimental study demonstrated that biology laboratory practices supported with self-regulated learning strategies had a significant effect on students' attitudes towards science experiments. According to the findings, the level of experimental group's attitudes towards science experiments in the post-test was significantly higher compared to the control group. Saribas (2009) concluded that chemistry laboratory practices supported with self-regulated learning strategies did not have any significant effect on the attitudes of the experimental and control groups. Hence, findings of this study are not in line with Saribas's (2009) study.

Attitudes are the tendencies which are not themselves observable but they are assumed to lead to some behaviours which can be observed (Kagitcibasi, 1999). In science classes, the goal is to equip students as much as possible with the attitudes and mental process abilities which are essential to solve the science problems that they will encounter throughout their lives. Students will form the base of learning by approaching events like scientists do (Regis, Albertazzi & Roletto, 1996; cited by Demirbas & Yagbasan, 2006).

In the extent of the research, it is limited to examining the effects of self-regulated learning strategies supported biology laboratory practices on students' self-learning readiness and attitudes towards science experiments. In terms of the research method, the pre-test with the control group is limited to the experimental model. The research was conducted in the same groups in both groups (experiment and control) and the studies were conducted by the same researcher in both groups. In this research, in order to eliminate researcher bias, the researcher and control groups have worked together with the researcher and another associate has been involved in the lessons. In terms of data collection techniques, research is limited to Self-Learning Readiness Scale and Attitudes towards Science Experiments. In the study, cognitive processes were not studied by taking into consideration the students' readiness and attitudes. In the next studies, studies examining the effect of biology laboratory applications with self-regulated learning strategies on students' academic achievement can be done. Furthermore, the effect of self-regulated learning strategies supported practices is limited to biology laboratory applications. Studies can be made in order to determine student achievement, attitude, learning readiness, etc. by preparing self-organized learning model supported activities in different courses.

To sum up, this study has concluded that students should receive knowledge in an active way by planning, observing and regulating the process rather than being passively exposed to knowledge. This is considered as significant both for attitudes towards science experiments and also for their own readiness for self-directed learning. The results of this study and also the results of the studies in the literature have demonstrated the positive outcomes of self-regulated learning. It is recommended that teachers and pre-service teachers are informed in this subject as this is expected to yield beneficial results for meaningful learning, self-directed learning and developing positive attitudes.

References

Alkan, F. (2012). *Effect of self-directed learning on the students' success, learning readiness, attitudes towards laboratory skills and anxiety in chemistry laboratory* (Unpublished doctorate thesis). Hacettepe University, Ankara, Turkey.

Aydede, M. N., & Kesercioglu, T. (2009). Fen ve teknoloji dersine yonelik kendi kendine ogrenme becerileri olceginin gelistirilmesi [Developing self-Learning skills scale for science and technology course]. *Cukurova University Faculty of Education Journal*,36, 53-61.

Boekaerts, M. (1996). Self-regulated learning at the junction of cognition and motivation. *European Pyschologist, 1(2),* 100-112.

Buyukozturk, S. (2012). *Handbook of data analysis for social sciences.* Ankara: PegemA.

Camahalan F, M, G. (2006). Effects of self-regulated learning on mathematics achievement of selected southeast Asian children. *Journal of Instructional Psychology, 33*(3), 194-205.

Cinar, S., Pirasa, N., & Sadoglu, G. P. (2016). Views of science and mathematics pre service teachers regarding STEM. *Universal Journal of Educational Research, 4*(6), 1479-1487.

Dadli, G. (2015). *The researching the relation between the 8th grade secondary school students' self regulation skills and self efficiency in science - technology course and their academic success* (Unpublished master's thesis). Kahramanmaras Sutcu Imam University, Kahramanmaras, Turkey.

Demirbas, M. & Yagbasan, R. (2006). The functional importance of scientific attitudes in science teaching and adoptation of scientific attitude scale into Turkish. *Journal of Uludag University Faculty of Education*, *12*(2), 271-299.

Eker, C., & Arsal, Z. (2014). Impact of teaching diaries on the use of students' self-regulation strategies. *Z.Karaelmas Journal of Educational Sciences, 2,* 80-93.

Erdogan, F., & Sengul, S. (2014). A study on the elementary students' self-regulated learning strategies towards mathematics. *Journal of Research in Education and Teaching*, *3*(3), 108-118.

Eryilmaz, A. (2016). *Sosyal bilissel ogrenme kurami [Social cognitive learning theory] .* In Sahin, C. (Ed), Egitim psikolojisi, Ankara: Nobel Yayinlari.

Gredler, M. E. (2005). *Learning and instruction: theory into practice* (5th Ed.). Upper Saddle River, NJ: Pearson Education.

Israel, E. (2007). *Self regulation instruction, science achievement and self efficacy* (Unpublished doctorate thesis). Dokuz Eylul University, Izmir, Turkey.

Kagitcibasi, C. (1999). *Yeni insan ve insanlar. [New people and people]* (10. Baski). Istanbul: Evrim Basin Yayin Dagitim.

Karasar, N. (2009). *Scientific research method*. Ankara: Nobel Yayin Dagitim.

Knowles, M. S. (1975). *Self-directed learning: a guide for learners and teachers*. Englewood Cliffs: Prentice Hall/Cambridge.

Kostur, H.I. (2017). FeTeMM egitiminde bilim tarihi uygulamalari: El Cezeri ornegi [The history of science practices in STEM education: Al Jazari example]. *Baskent University Journal of Education, 4(1),* 61-73.

Kuyumcu Vardar, A., & Arsal Z. (2014). The effect of self-regulated learning strategies instruction on students' English achievement and attitude. *Journal of Mother Tongue Education, 2*(3), 32-52.

Nota, L., Soresi, S., & Zimmerman, B. J. (2004). Self-regulation and academic achievement and resilience: a longitudinal study. *International Journal of Educational Research*, *H 41(3H),* 198-215.

Paterson, C. C. (1996). Self-regulated learning and academic achievement of senior biology students. *Australian Science Teachers Journal, 42(6),* 4-8.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P.R. Pintrich, & M. Zeidner (Ed.), Handbook of self-regulation (pp. 451-502), San Diego, CA: AcademicPress.

Sari, A., & Akinoglu, O. (2009). Self-regulated learning: models ans applications. *M.U. Ataturk Egitim Fakultesi Egitim* Bilimleri Dergisi, 29, 139-154.

Saribas, D. (2009). *Investigating the effect of laboratory environment aimed to improve self-regulates learning strategies on conceptual understanding, science process skills and attitude towards chemistry* (Unpublished PhD thesis). Marmara University, Istanbul, Turkey.

Schloemer, P., & Brenan, K. (2006). From students to learners: developing self-regulated learning. *Journal of Education for Business, 82(2),* 81-87.

Schunk, D. H. (2004). *Learning theories: an educational perspective* (4th ed.). Upper Saddle River, NJ: Merrill&Prentice Hall.

Senemoglu, N. (2013). *Gelisim ogrenme ve ogretim*[Development learning and teaching]. Ankara: Yargi Yayinevi.

Turan, S., & Demirel, O. (2010). The relationship between self-regulated learning skills and achievement: a case from Hacettepe University Medical School, *H. U. Journal of Education*, *38,* 279-291.

Tutkun, O. F., & Aksoyalp, Y. (2010). 21. yuzyilda ogretmen yetistirme egitim programinin boyutlari [Dimensions of teacher training curricula in the 21st century]. *Selcuk Universitesi Sosyal Bilimler Entitusu Dergisi, 24,* 361-370.

Uyar, Y. (2015). *Development of self regulated reading skills and its impact on comprehension* (Unpublished doctorate thesis). Gazi University, Ankara, Turkey.

Uredi, I., & Uredi, L. (2005). The predictive power of self-regulation strategies and motivational beliefs on mathematics achievement of primary school 8th grade students. *Mersin University Journal of the Faculty of Education,1 (2),* 250-260.

Yildiz, E., Aydogdu, B., Akpinar, E., & Ergin, E. (2007). Fen bilgisi ogretmenlerinin fen deneylerine yonelik tutumlari [Science teachers' attitudes towards science experiments]. *Bogazici Universitesi Egitim Dergisi*, *24*(2), 71-86.

Zimmerman B. J., & Schunk, D. H. (2001). *Self-regulated learning and academic achievement: theoretical perspectives.* Retrieved from https://www.google.com.tr/books?id=I2GQFz3v2T8C&printsec=frontcover&hl=tr&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false (17.10.2018).

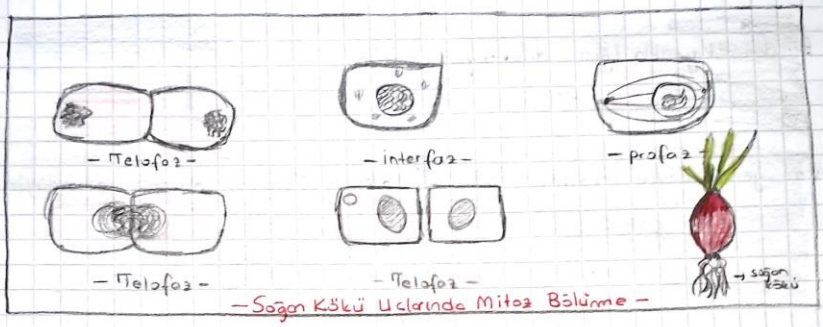
Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: an overview. *Educational Psychologist, 25*(1), 3-17.

Zimmerman, B. J. (2000). Attaining self-regulation: a social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), Handbook of self-regulation (pp. 13-39). San Diego, CA, US: Academic Press.

Appendix

Soğan kökünde gerçekleşen mitoz bölünmeler köklerin büyümesini sağlamıştır. Bölünme sonucunda iki yavru hücre meydana gelmiştir.

*Uygulamanın şema ve şekilleri,



– Soğan Kökü Uçlarında Mitoz Bölünme –

* Uygulamanın Sonuç Cümlesi;

– Soğan kökü uçlarında mitoz bölünmeyi gözlemleyebiliyoruz.

Profaz evresinde kromozomların oluşmuş olduğunu, sentrozomların kutuplara ayrıldığını gözlemleyebildik. Ve bu evrede çekirdekçik kaybolur, çekirdek zarı parçalanır.

Ayrıca interfaz evresinde bulunan hücreleri de gözlemledik. Bu hücrede DNA'nın kendini eşlemiş olduğu ve kromatin ipliklerinin bulunduğunu gözlemlerimizle pekiştirdik.

Arkadaşlarımızın gözlemleyebildiği metafaz evresinde kromozomların ekvatorsal düzlem üzerinde çok daha net göründüğünü pekiştirdik. Anafaz evresi ile telofaz evresini gözlemlerken birbirine benzetsekte anafaz evresinde kardeş kromatitlerin birbirinden ayrılarak zıt kutuplara ayrıldığını ve artık kromozom olarak adlandırıldığını hatırlattık. Sonra bu kromozomların birbirinden ayrılmaya başlaması (boğumlanma) ile telofaz evresi üzerinde konuştuk. Sonuç olarak telofaz evresinde ise kromozomlar kromatin haline dönüşür. İğ iplikleri kaybolur. Ve sonucta ana hücreyle tıpa tıp aynı iki yeni hücre oluşur.

*Uygulama olduğu gibi sonuçlandı mı? (olması gerektiği gibi?)

Evet. Soğan kökü uçlarında mitoz bölünmenin bazı evrelerini gözlemleyebildik.

- 5.DENEY RAPORU -

* Bu haftaki konumuz nedir, hedefim ne?

Bu haftaki konumuz hücre zarından madde geçişleri. Yani hücre zarının üz
bir zardan difüzyonla geçme, molekül büyüklüğünün difüzyon hızına etkis
difüzyon ortamı yoğunluğunun difüzyon hızına etkisi.
Hedefim ise hücre zarının özelliklerini ve difüzyonun ne olduğunu kavram

* Bu konu ile ilgili bilmediklerim nelerdir?

1) Difüzyon hızına etki eden faktörlerin içeriği
2) Difüzyon kurallarının geçerli olduğu başka ortamlar

* Bilmediğim kavramı, ilke, genelleme, formül vb bilgiye nereden nasıl ulaş

1) Öncelikle konu ile ilgili kitaplardan yardım alırım
2) Gerekirse internet kaynaklarına başvururum
3) Okulda dersin kendisinden, soru sorarak öğrenebilirim

* Araştırma Sonuçlarım:

- Hücre zarının görevleri; hücreye şekil verir, korur, sitoplazmanın dağılmasını önler. Ve hücre içi ve dışı arasındaki madde alışverişlerini sağlar
- Hücre zarından madde geçişi; a) zardan geçebilenlerin taşınması b) zardan geçemeyenlerin taşınması olarak ikiye ayrılır.