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Improve the quality of students' knowledge in the section "Coordination and regulation" using the Singapore PBL (problem based learning) method in biology lessons

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Abstract

This study examined the impact of PBL (problem based learning) on students' academic performance in the subject of biology. At the beginning of the school year, for entrance monitoring, students took a test in the section "Coordination and regulation", the results of which were low. Teachers have developed a special author's program for this section with PBL elements. The study was conducted in the South Kazakhstan region at school X, 8th grade students. All 8 classes were divided into experimental and control groups (number 97). The control group was trained with the traditional method, while the experimental group was trained with PBL. For the analysis, a t-test for independent samples was used to compare the difference between the groups. The results showed a significant difference between the groups, PBL-proved to be an effective method to improve students' critical thinking and problem-solving skills.

Keywords: problem-based learning, PBL, achievement , analysis, traditional method, program, coordination, regulation.

Introduction:

Updating the content of secondary education in the Republic of Kazakhstan today is very much in demand and relevant for the education of the future generation. The whole world today strives to get a high-quality education. Because the competitiveness of the economy of any country depends, first of all, on the level of development of its human resources, which is directly related to the education system. It is education that creates "human capital", which crucially determines the economic potential of a country and is the source of its economic growth. Therefore, according to the requirements of the time, we must educate and educate the younger generation according to new methods. In the updated biology course program, sections are repeated every year, and accordingly are considered in depth. Students find it difficult to assimilate some sections. Teachers need to use new teaching methods to achieve the learning goals of the updated program.

Problem based learning was initiated by Barrow and Tamblyn in the 1960s at McMaster University Medical School in Hamilton. Traditional medical education disappointed students who considered the large amount of

materials offered in the first three years of medical education irrelevant to medicine and clinical practice. The PBL curriculum is designed to stimulate learning by allowing students to see the relevance and application of future roles (Barrows, H.S. (2000). She maintains a high level of motivation to learn and demonstrates the importance of a responsible, professional approach to the values of teamwork. Motivation to study is interesting because it allows you to choose questions that are applicable in real life. Diversity and complexity are very important when formulating PBL problems (Donner and Bickley 1993). Two features of learning are the level of diversity and complexity that students perceive. (Mauffette, Kandlibinder and Soucisse 2004: 11) Problems may vary in size depending on the duration of the study. Some tasks are solved in two textbooks. Others are designed for weeks or months. Sometimes problems can be presented in a gradual detection mode. Students try to solve these problems in textbooks or from Internet resources. At the beginning, the class is divided into small groups of students (usually 5-8) working together on a problem. Often there is a tutor in each group. If this is not possible, then there are teachers. The teacher's job is not to give information or a mini-lecture on this issue, but to facilitate the PBL process and help students solve the problem. In PBL, classroom activities are problem-based. The teacher does not teach for a long time. Instead, when a teacher introduces PBL to a course, students are given the right to play a responsible role in their learning. The teacher is not an authoritative source of information and knowledge. Students should take the initiative to be interested and learn; and the instructor should guide, research and support student initiatives. Students' knowledge gained as a result of self-study should be applied to the problem by repeated analysis and solution. In general, PBL aims to motivate students to participate in the learning process and help them develop problem-solving skills. "The main principle of PBL is problem solving" through self-knowledge training, since training is based on a real problem (Flack, 2013: 274). Students of the PBL group are more experienced in finding and solving problems (Mergendaler, Maxwell and Bellissimo (2006: 52). They consider the problem in a broader spectrum, taking into account a multidisciplinary approach.

Table 1. Comparison of Problem-based learning and traditional learning ("Problem-based learning“, Samford University) The main tasks of the work:

1. Creation of an experimental group
2. Problem definition
3. Finding solutions
4. Generating ideas
5. Introduction to the learning process
6. Synthesis and application in experimental classes

The main PBL tool is the FILA table (Facts, Idea, Learning issues, Action plan), which is designed to develop students' thinking

Таблица1 FILA (Facts, Ideas, Learning issues, Action plan)

F	facts	These are the facts that will be extracted from this problem
I	ideas	Writing possible reasons, ideas, solutions to exactly those facts that were indicated and recorded in the "Facts" column. Should also be described without any judgment.
L	Learning issues	- must be voiced in the form of a question -should contribute to the construction of knowledge to solve the problem when answering -must relate to the curriculum of the subject
A	Action plan	Arises from gaps in the "Facts" column or fuzzy information in a problem that needs clarification. It also includes research resources.

Table 2 Comparative characteristics of problem-based and traditional learning

PBL (problem based learning)	Traditional training
The teacher is in the center of attention The teacher as a transmitter Students as passive receivers Structured environment Individual and competitive training Assessment is a teacher's responsibility	The student is in the center of attention Instructor as a facilitator or co-author Students as designers, active participants Flexible environment Co-education Assessment is the shared responsibility of the student, the group and the teacher

Research objectives: 1. To study how the method of problem-based learning affects the quality of students' knowledge in the section "Coordination regulation"

2. To investigate the influence of the method of problem-based learning on the gender difference of students.

Hypothesis of the study:

H 1: There will be no significant difference between the experimental and control groups in the section "Coordination and regulation"

H 2: There are no gender differences in problem-solving skills between the groups

Methods:

The analysis was carried out using a static test, a t-test using the SPSS program for Windows 7. The population of 8th grade students (N 97) was divided into experimental and control groups. The students answered 20 questions of the pre and post test. For 3 weeks, students were trained according to a specially developed PBL program.

Discussion:

The analysis showed that problem-based learning positively affects the abilities of students, as well as the achievements of student-teachers. The present study shows that Problem-oriented learning has higher scores compared to traditional approaches to the development of thinking and learning skills. PBL requires students to organize, plan, and manage a huge amount of information related to the problem. Thus, students acquire procedural knowledge, which is reflected in the study. This means that through PBL, student-teachers have understood how to implement learning in various situations. They also learned to gain knowledge through discovery, collaborative learning, and problem solving. As Raman A. (2002) noted, "PBL is based on the excitement that arises from a sense of discovery." Problem-oriented learning (PBL) has been widely used in many areas of education, focusing on critical thinking and problem solving (Yew & Goh, 2016). PBL can be applied in many fields, the topics under consideration have been successfully implemented in various fields of education (Loyens, Jones, Mikkers), PBL has proven itself as a suitable way of teaching and is welcomed by teachers and students to improve learning.

Before the experiment began, a test similar to the last test was conducted in all sections of the 8th grade of the school. As a result, it was found that students made many mistakes in the section "Coordination and regulation", at the meeting of the department it was decided collectively, all 8 classes in elective courses conduct lessons using the PBL (problem based learning) method, Four (groups) had approximately the same average value. Then our team randomly selected two groups. Using a similar method, one group was assigned to the experimental group, and the other to the control group.

Table 2 Gender differences of students

Groups	Groups	Male	General
Experimental	19	20	39
Comparative	21	19	40

Preliminary and post-test analysis of the experimental and control groups

The result of the study shows that the average score of the experimental group on the problem-solving skill during pre-testing is (9.35) and in the comparison group (9.35) was almost the same. This was a good starting point for the output of the effect after use (PBL) in the program. Therefore, if the experimental groups score higher than the control groups on the post-test, we hope that this will be related to the method, provided that other intervening variables are controlled.

We controlled for all possible confounding variables, such as time difference, teacher influence, and topics that needed to be covered. Thus, the effect of the method is obvious. The result of the post-test shows that the two groups have increased dramatically, and the growth of the experimental group is much better; the average score is 14.205 for the experimental group and the average score is 10.775 for the control group. The average value of the trait before the experiment is 9.359±2.058 (m = ±0.330) The average value of the trait after the experiment is 14.205±2.285 (m = ±0.366) The number of degrees of freedom (f) is 38 The Student's paired t-criterion is 9.339 The critical value of the Student's t-criterion for a given number of degrees of freedom is 2.024. If the significance level is less than 0.05, we conclude that there are differences between the groups. So there is a definite difference between the two groups.

Table 3 Test results of control and experimental group students

Names of scales	**Average value in the "Experimental" group** Mean ± SD N	**The average value in the "Control " group**	**Empirical value of the criterion/t**	**Significance level/p**
pre test	9.3±2.312	9.359±2.058	-0,12	0,905
post test	14.205±2.285	10.775±1.968	-7,143	0***

p<0,05 - p<0,01 - p<0,001

When using the value of the t-value for significance, the negative value is considered as their positive counterpart (the absolute value of the result is taken). If the absolute t-value is greater than the critical t-value, the null hypothesis is rejected (Elliott & Woodward, 2007). However, ignoring this notion, in this study P-values were used to decide whether to accept or reject the null hypothesis. Note that both methods lead to the same conclusion. The paired sample t-test shows (using the SPSS program) that the difference for both the experimental group (t (39) = -0.12, p <0.05,) and the control group (t (40) =7,143 , p <0.05,) was statistically significant. This shows that both groups have increased to a statistically significant extent. However, it is obvious that the increase in the experimental group is better than in the comparison groups. As shown in Table 3, the experimental groups scored above the minimum.

Analysis of gender differences on the post-test

Table 4 Table of the pre-test results of the gender difference of students

Names of scales	the average value in the "male" group	The average value in the "female" group»	Empirical value of the criterion	Significance level
Experimental	9.789±2.347	9±1.732	1,18	0,247
Control	9.053±2.223	9.737±2.156	-0,963	0,342

Table 5. Post test of gender differences of students

Names of scales	the average value in the "male" group	The average value in the "female" group»	Empirical value of the criterion	Significance level
Experimental	14.895±2.183	13.368±2.14	2,176	0.036*
Control	9.947±1.957	11.526±1.775	-2,605	0.013*

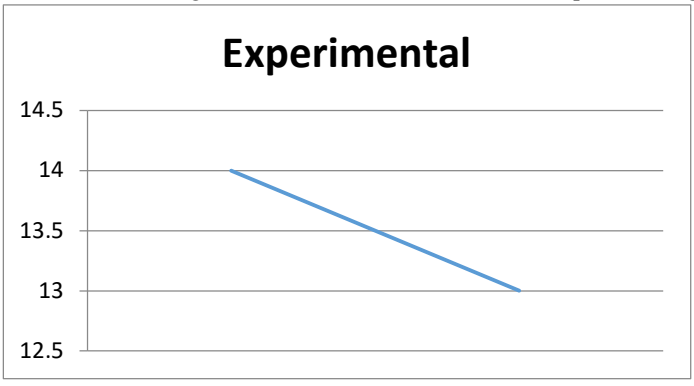
Table 4.5 above shows a significant difference between the gender differences (df = 19, t = 01.18, p> 0.05) to the study section (df = 20, t = 0.0963 p> 0.05); this shows that male students scored more points than female. Consequently, it was obvious that there was gender dominance in the results obtained for both the experimental group and the control group.

Conclusion:

From the point of view of students, "Coordination and regulation" is considered one of the most difficult sections of biology, and they believe that only particularly gifted students understand this section. However, this study shows that student academic performance can be improved with PBL. Diggs (1997) also explained that the PBL method allows students to better understand science. Previous studies conducted using the PBL method in various conditions by different researchers, as well as this study prove that PBL is a more effective method of teaching selected topics compared to the traditional method of teaching. Thus, PBL is a good alternative teaching method to improve student academic performance. At the same time, students need to develop social skills in order to be active in group discussion and to carry out independent learning. Students should also have a sense of trust. Based on the above discussion and the results of the study, the following conclusions were made:

The problem-solving skills of both the experimental group and the comparison group have significantly increased. There are gender differences among students, male students scored a large number of points, this proves that boys are good at solving problems and their problem-solving skills are well developed.

Figure 1 increase in the gender difference of students in the experimental group



The statistical results rejected the null hypothesis outlined in this study, which stated that there is no significant difference between the problem-solving skills of students trained using problem-oriented learning instructions and those trained using the traditional method, after the influence of average pre-test scores has been controlled. The PBL method is a more effective method of teaching biology in the section "Coordination and regulation" compared to the traditional method of teaching. This is because the students of the experimental group achieved higher results than the students from the control group.

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