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Development of Learning Skills in Medical Students through PBL-STEM

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Abstract

The dynamics in the requirements of professional practices is changing rapidly the goals of higher education. Apart from the theoretical knowledge there is already a number of requirements, such as: team work, communicational, time management skills etc. that are essential for a successful career. This paper outlines some findings about the relationship between the way the teachers plan their courses, and the quality of the results that the students achieve. In particular, the article looks into the role of the Project-Based Learning (PBL) in STEM as an educational method that successfully supports the concept of contemporary teaching strategies and stimulates the students to strive toward self-actualization and lifelong learning.

Keywords: *Project-Based Learning, Self-regulated Learning (SRL), learning skills;*

1. Introduction

The way in which the students perceive and understand learning context and therefore their own studying, is a major interventional factor which influences the relationship between the teaching and learning outcomes. An occurring tendency since the end of the last century in the field of educational studies has been the growing interest among researchers toward SRL. This new orientation is at least partially due to the rejection of outdated perceptions of putting emphasis on certain aspects of learning – especially in regard to university education – which according to many authors [1], [2], [3] have become impractical if not pointless. These researchers share the view that educational theories from the past have lost their popularity and usefulness. New, much more practical and purposeful concepts are needed. SRL might prove to be the starting point for the development of up-to-date concepts and ideas for the improvement of the academic environment which would enable the students to acquire the needed competence to become adequate and effective learners.

Even though Natural Science, Medicine and Engineering education is for the most part based on relatively conventional teaching methods and applying new methodology is key to achieving the contemporary goals of education. PBL provides fertile ground for the successful combination of learning content and practice, which would, in turn, broaden the students' academic perspectives and help them acquire useful professional and academic skills.It could be applied in practical exercises to stimulate SRL encourage the students to look into various possibilities, test out new ideas, work as a team, revise their thinking, and present their best solutions.

This paper is part of a research that is focused on the analysis of the possibilities to manage the process of establishing SRL practices among students in their early academic education, by applying the methodological inventory of the PBL using the principles of STEM-PBL. The research was conducted 88 first year students from the Faculty of Medicine at Sofia University "St. Kl. Ohridski". All of the students were working on a group project for Parasitology as part of the Human Biology course.

2. Materials and methods

PBL provides the students with the opportunity to study actively by getting fully immersed in the content of the various tasks, and thus not only does it help them improve and further develop their learning and communicational skills. This makes PBL suitable for university education, but it should be carried out with caution as it is possible for certain problems to arise in the process of project activities. Such problems are usually caused by lack of experience, too much pressure, disagreement between the participants, or by failing to register each member's individual contribution to the project.

In the experimental design students are tasked with a project that is divided in several stages which allow for a mid-work reporting and assessment. This makes it possible to track the individual contribution of each participant, and to make corrections where necessary, without sacrificing the freedom of personal choice and the successful completion of the project by all of the students.

2.1. Subject

"Study of the parasite agents, the spreading and treatment of some human parasitic diseases"

2.2. Goals

Professional and academic competence development.

2.3. Structure of the Project

The project comprises of three separate stages (Fig. 1) and has an overall duration of 6 weeks. The start of the project coincides with the period of the last four parasitology exercises of the semester.

Stage I consists of mainly individual work done by each student. Their tasks include gathering and analysis of information from various sources on the parasites, vectors and hosts in several human parasitic diseases. During Stage II, the students form small groups of two or three based on the biological relations of the organisms that they had researched in the previous Stage and the students' tasks are related to the studying of the human diseases caused by the said parasites. At Stage III students perceive themselves as part of one big group that incorporates all the small groups formed during the preceding Stage. Here the participants have to prepare and then make a presentation of the final joint product of the project. Each student shows the audience the slides that display information on the particular disease that he or she has researched during the project. After the whole presentation is over a short discussion ensues in which the participants share their thoughts and impressions in regard to the project.

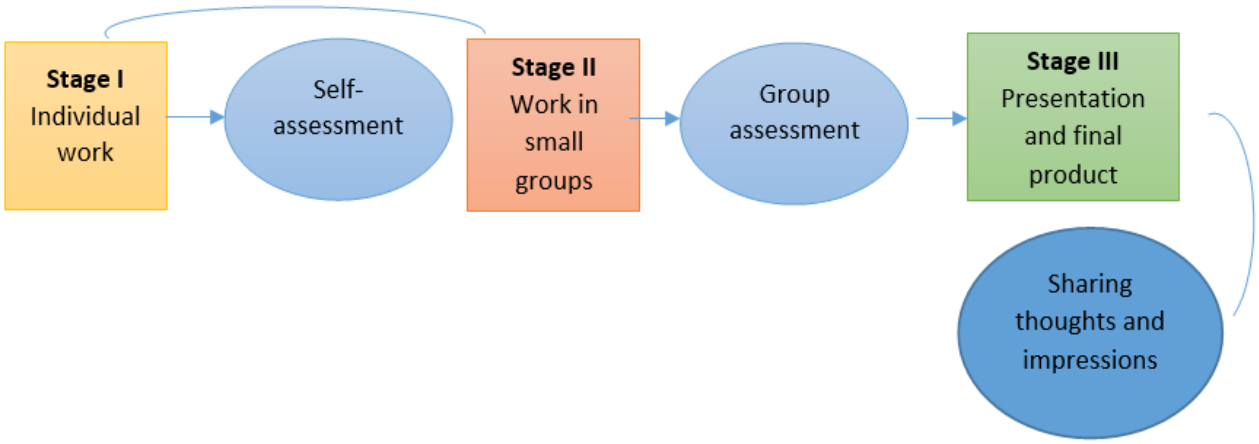

Figure 1. Project structure

For the purposes of the project a shared Google Drive account is opened where each participant creates an individual folder in which to upload their work at all stages. On the one hand, the shared storage space makes it easier for the students to cooperate with one another and to exert better self-control, and on the other hand, it allows the professor – and in this particular case the author of this research paper – to discreetly gather information about the work process and the progress of the project, and to receive important feedback [4] on the level of clarity and the consistency of the instructions given to the students in regard to each task. As a means to gain access to additional information about the work process in the group, when needed, the professor assumes the role of a "friend-critic", which proves to be a good strategy for ensuring the students' effective performance.

2.4. Assessment of the Project Work

The project works assessment carried out in a complex manner where the final grade is determined by three separate components: 70% of the grade is based on the external assessment, 20% from self-assessment and the last 10% - intragroup assessment.

There are three elements that are taken into account for the formation of the professor's grade: 1) the extent to which the final presentation meets the preset requirements, 2) the level of active participation and the integrity of the student while working on his or her tasks, and 3) the quality of the results and the final presentation.

Additionally, a survey on the level of satisfaction with the project is conducted among the students which provides a valuable feedback on the effects the PBL has on the development of learning skills. The questionnaire is divided into three parts containing a total of 37 five-point questions. Part C, titled "Group Assessment", focuses on the students' diligence and the degree of group cooperation.

3. Results and Discussions

3.1. Data Analysis

All students are grouped on the basis of the answer of following question: "How do you assess your work/performance in this project?" Depending on how the students responded to the question, four groups (G_1, G_2, G_3, and G_4)are formed as follows: G_1 – 39 people who answered "Excellent", or 44.32% of all the respondents; G_2 – 44 people who answered "Very Good", or exactly 50% of the students; G_3 – 3 people who answered "Good", or 3.41%; and G_4 – 2 people who answered "Not Good", or 2.27%.

The quantitative part of the analysis looks into the frequency of usage of the responses from Part A of the questionnaire, where the most frequently given answer is a relevant descriptive statistic [5] displaying the general tendencies among the students in regard to the impact the PBL has on the development of learning skills. The qualitative part of the analysis is based on comparing and contrasting [6] the responses from Part A between all four groups. The comparing and contrasting of answers shows that the students react in a similar way to certain aspects of the development of skills in project-centered teamwork conditions.

3.2. Results

This article deals with the responses of Part A of the self-assessment questionnaire, and more specifically – the responses to the questions related to the importance of PBL for the development ofboth learning skills, and teamwork and management skills by the students.

Table1. Results from the responses to questions no.15, 16 & 21 given by the students in G_1 and G_2

15	Does the execution of project tasks help you learn the subject terminology more easily and more quickly?	Yes, absolutely	Rather yes	I'm not sure	Yes, but not completely	Absolutely no	
		68.18	29.55	2.27	0	0	"Very good"
		71.79	28.21	0	0	0	"Excellent"
16	Do you think you can apply what you learned during the project in other academic disciplines too?	Yes, absolutely	Rather yes	I'm not sure	Yes, but not completely	Absolutely no	
		70.45	25	2.27	2.27	0	"Very good"
		69.23	30.77	0	0	0	"Excellent"
21	The project work stimulates the students to take responsibility of their own personal and academic growth.	Yes, absolutely	Rather yes	I'm not sure	Yes, but not completely	Absolutely no	
		77.27	15.92	2.27	2.27	2.27	"Very good"
		64.1	30.77	5.13	0	0	"Excellent"

The results of the analyzed questionnaire answers as shown in Table 1 make it clear that working on a project in academic environment is readily embraced by the students who perceive PBL as a more open educational approach for achieving the desired educational goals.

Table 2. Responses to the statement: "Project work helps you…"

Project work helps you to develop …	Yes, absolutely	Rather yes	I'm not sure	Rather no	Absolutely no
skills for working with professional and academic literature	73	23	2	1	1
communication skills	58	36	2	2	2
critical thinking skills	45	32	14	7	2
creativity	64	25	11	0	0
perform assignments in different subjects	57	32	9	1	1
responsibility for your own personal and academic growth	63	31	6	0	0
ability to take the initiative when working in group	57	38	5	0	0

Table 2 shows the results of the improvement of the skills targeted with this project. In regard to the development of learning skills through PBL, the most frequently used answers for all of the components researched in this paper are once more "Yes, completely" and "Rather yes", given by more than 70% of the respondents. The answer "I'm not sure" is also present for all of the listed skills, varying in range between 2 and 14 percent. More specifically, a little over five percent of the respondents picked "I'm not sure" when answering questions related to the application of education in developing such skills as critical thinking, creativity, taking the initiative, etc.These results could be pertinent to either personality traits or the level of recognition and application of components of the cognitive activities which were not well represented in the students' previous experience.

In terms of qualitative results from this research, it must be noted that the overwhelming majority – 87 of 88 students – perceive PBL as a constructive educational approach that contributes to the development of personal skills as well as leaning skills that would help them achieve better efficiency in their academic education.

4. Conclusions

4.1. Findings

The research aspect of this paper on the effects of project work on the development of learning skills and some personal skills by the students could be presented by the following findings:

1.The projects activities provide ample opportunity to improve personal and learning skills, i.e. the students learn not "what to think", but rather: "how to think" when faced with a variety of tasks.

2.Team work requires that the professor pay special attention to his or her teaching approach.

3.PBL-STEM is student-centered approach that encourages the students to recognize the relationship between the development of personal skills and their efficiency as professionals.

4.2. Concluding Remarks

The design of education based on solving real problems is applicable from the very first stages of academic education. PBL could be utilized in courses on fundamental science subjects, and thus change the orientation of the teaching towards learning skills development. The results show that PBL encourages the students to have independent thinking when faced with academic problematique, and stimulates them to develop a higher level of cognitive skills.

PBL provide student-centered and independent learning. Students that have achieved a certain level of independency in learning would in turn acquire the skills needed to become much better professionals in future.

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