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FLIPPED CLASSROOM: AN EFFECTIVE APPROACH FOR DEVELOPING AND ASSESSING INFORMATICS COMPETENCIES

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Abstract. This paper describes the design and implementation of the flipped classroom approach, adapted to the education system in the Republic of Moldova, which was applied in the “Spiru Haret” lyceum, Chisinau, the Republic of Moldova. The purpose of implementing this approach is to promote personalized learning and to increase the learning outcomes of face-to-face education. In order to diversify and differentiate the activities, it was identified the learning styles of the students according to the Honey and Mumford learning style questionnaire. Also, in this paper are described four assessment methods appropriate to this approach. The experiment is based on developing skills in the informatics discipline so that the students are motivated to choose this discipline as their baccalaureate exam. The results of the experiment show the number of students who chose Informatics as a baccalaureate exam for the last six academic years, the Informatics exam is optional.

Keywords: *flipped approach, flipped classroom, flipped method, learning style, new approach.*

Rezumat. Articolul reflectă aspecte de proiectare și implementare a abordării de clasă inversată, adaptate la sistemul de învățământ din Republica Moldova și puse în aplicare în liceul teoretic „Spiru Haret” din Chișinău. Scopul implementării acestei abordări este de a promova învățarea personalizată și de a crește rezultatele învățării. Pentru diversificarea și diferențierea activităților au fost identificate și analizate stilurile de învățare ale elevilor conform chestionarului de stil de învățare Honey și Mumford. De asemenea, în acest articol sunt descrise patru metode de evaluare adecvate acestei abordări. Experimentul s-a bazat pe dezvoltarea competențelor la disciplina informatică astfel încât elevii să fie motivați în a alege această disciplină ca examen la bacalaureat. Rezultatele experimentului arată numărul de studenți care au ales Informatica ca examen la bacalaureat în ultimii șase ani academici, examenul de Informatică fiind opțional.

Cuvinte-cheie: *abordare nouă, clasă inversată, metodă inversată, stil de învățare.*

1. Introduction

The pandemic situation has brought several changes in the field of education, and different learning demands have emerged. In order to compensate for the demands that come with this situation, the Ministry of Education and Research and educational institutions have

tried to find new opportunities to get over the pandemic circumstances and to continue the educational process without any interruption. It was organized the video lesson recording sessions, which were later broadcast on a TV channel and can be found on the Online Education platform [1]. During this period, it was strategic to implement the flipped classroom strategy using the recorded video lessons. Therefore, this approach was launched in the “Spiru Haret” lyceum, Chisinau, Republic of Moldova, at the Informatics lessons.

The flipped classroom has nowadays become a very popular implemented strategy. This approach aims to promote personalized education opportunities in which students learn at their own pace and, consequently, to improve the teaching-learning process by changing students’ abilities to become self-directed learners [2, p. 240]. The teacher guides the students, motivates them, and gives feedback on their performance.

The Flipped Classroom approach began in Woodland Park high school in Colorado, USA, in 2007, and it has been popularized by Jonathan Bergmann and Aaron Sams. They recorded the live lessons and broadcasted them online for the students that missed the classes [3, p. 3]. The main aim of this approach is to provide preparation of the students for the subject before the classes [4, p. 43] and during the lesson to apply activities that increase the learning outcomes of face-to-face education [5, p. 1].

Whereas this approach is widely implemented in different fields, there are many definitions regarding the concept of the flipped classroom in the research of different authors. According to Bishop and Verleger [6, p.5], the flipped classroom is a student-centered learning method based on “an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom”. They restricted the definition excluding the designs that do not involve instructional videos as an outside of the classroom activities. Zamzami Zainuddin and Siti Hajar Halili [7, p. 315] define the concept of the flipped classroom as a student-centered approach where the students are more active than the teacher in the classroom activities. November and Mull [8, p. 1] consider this concept as a model that provides students prepare themselves for the lesson by watching pre-recorded videos, listening to podcasts, and reading the information regarding the topic from the books or other profile resources. Gallagher [9, p.40] argues that by implementing the flipped classroom model, the students have had a more active role and an ultimate responsibility for their learning, whereas Pierce and Fox [10, p.4] claim that the quality of student-teacher interaction is a compelling force in improving student performance. According to Milman [11, p. 85], the flipped classroom is an approach that aims at improving the efficiency of lessons and the students’ performance by transferring knowledge to students via videos and other electronic materials outside the class as well as through discussions, group work, and applications during the classes. Toto and Nguyen [12] define the concept as an approach that increases active learning activities and allows the student to use his knowledge in class with the guidance of the teacher.

The governing board and key leaders of the Flipped Learning Network declared the four pillars of the flipped classroom: F-L-I-P, which have to be taken into consideration while achieving this approach. The pillars incorporate a checklist of eleven indicators that teachers have to incorporate into their practices [13]. It mentioned the following pillars [Ibidem]:

F – flexible environment, to establish spaces and time frames that permit students to interact and to reflect on their learning.

L – learning culture, the flipped classroom is a student-centered approach, where class time is dedicated to exploring topics in greater depth and creating rich learning opportunities.

I – intentional content, to create differentiated and relevant content accessible to all students.

P – professional educator, the role of a professional teacher is even more important, and often more demanding, in a flipped classroom. Professional teachers are reflective in their practice, connect with each other to improve their instruction and accept constructive criticism [Ibidem].

Therefore, in the flipped classroom approach, the students watch the theoretical part of the lesson via online videos, presentations, learning management systems, electronic and non-electronic materials before the classes and take notes, prepare questions in case of ambiguity. During the classes, the students accomplish activities such as finding answers to the questions they prepared before classes, working in pairs or groups to solve the problem or task given by the teacher, finding the solution, discussing, collaborating, and cooperating. The approach involves the students' own investigations, deep involvement, and intense efforts from the students, which leads to the transfer of the learning responsibility from the teacher to the student.

2. Materials and Methods

The pandemic situation has led to an increase in the use of technology, which, in turn, has made revolutionary changes in the educational system. Therefore, in our opinion, the flipped classroom would be the appropriate method to implement in the teaching and learning process since this approach, along with technology, helps students to achieve an efficient teaching atmosphere aimed at improving the self-learning skills of the students and conducting in-depth investigations on various topics. In addition, the method increases the power of the teacher-student relationship by using classroom time to deepen students' knowledge through several teacher-facilitated activities, such as laboratory activities, group projects, debates, and discussions between classmates and the teacher.

In implementing the flipped classroom method, the students are required to become acquainted with the new topic before classes using different types of resources such as videos, podcasts, software, websites, books, and other documents, presentations, and other electronic or non-electronic sources, concentrating on the lowest levels of the cognitive domain, such as remembering and understanding. In the early stages of the experiment, as homework, the tasks related to these two cognitive domains were given because the students are more accustomed to the traditional methods and they are closer to the explanations given on the board. This means that the transition to the flipped classroom has to be overcome naturally, otherwise we risk having students who will not be satisfied with the newly implemented method. While in the classroom, the students are focused on higher levels of cognitive domain according to Bloom's revised taxonomy, including applying, analyzing, evaluating, and creating. Therefore, the students become more engaged in the classroom activities, thinking critically and allowing the teacher to know better the students and create a real differentiation in the teaching and learning activities, increase team-building skills.

The student culture is not oriented towards a steady learning process. Thus, for the beginning, it may be difficult to comprehend the importance given to more complex cognitive skills. In order to overcome these inconveniences, the students have to penetrate into the inner working forces and realize the importance of activities involving interaction, creativity,

and problem-solving. Even more, to enhance learning, students need to identify individual learning styles, and it would be useful to help them identify their own learning styles by applying the instrument to measure them. In this experiment, it was applied the Honey and Mumford learning style questionnaire [14]. Peter Honey and Alan Mumford developed this learning styles questionnaire in 1986 and it was designed to measure learning preferences in individuals aged 16 and over [Ibidem]. Furthermore, the teacher needs to engage in learning styles at the planning stage. It is very important when and how the students obtain the information.

The implementation of this method is beneficial if well-established steps are followed. Firstly, the teacher has to design the learning activities by choosing appropriate content from different sources, using open-source materials, and in different formats. It would be better to create your own educational materials. Secondly, make students responsible for their own learning by applying different forms of formative assessment at the beginning of the lesson. In this experiment, to assess whether or not the most important points have been understood, it was used Kahoot Premium+ version and Google Forms, as these platforms offer an instant report and it is very easy to detect the gaps in the students' learning. Based on the number of correct answers, the teacher can clarify any areas that have not been completely understood, this being a landmark where to start with teaching the current lesson. Thirdly, easy-to-understand content and easy-to-do tasks, give them out of class. Fourthly, and lastly, what they had to learn at home, it has not been taught in the class, except for the unclear or ambiguous concepts.

Initially, it is sometimes difficult to know what to do with the time freed up by the preliminary work given to students in advance. To involve students in the classes activity, the teacher should create more motivating activities that give students the responsibility to make choices, to be at a complex cognitive level, to be interdisciplinary, to allow interaction between students, to be allocated sufficient time for the task, and to have clear guidelines in carrying out the task. It is important in the design of a flipped lesson that the teacher takes into account the intelligence level of the class. However, the plan of the flipped lesson cannot be completely designed because the teacher cannot know in advance the ambiguities of the students or if it will be some gaps between the teacher's expectations and the students' learning.

In order to engage all the students in the given activity and to make them more motivated, it is recommended to split the students into groups for accomplishing the given task, to let them present the done work to the whole class and finally, to allow them to evaluate their classmates' done work by voting using an electronic voting system. In this case, it was used the Mentimeter platform, as it collects and proceeds the students' votes instantly, and the responses are displayed immediately on the teacher's computer. Even more, the voting result can be instantly shown to the whole class, using a projector or a smartboard. The voting poll can be expanded to include, for instance, open-ended questions and comments as a way to engage discussion on a topic while maintaining anonymity.

The classroom formative assessment makes it possible to determine the students' performance and what they have learned, to help students recognize their weaknesses and strengths, and to work on areas that need improvement [15]. When it is necessary, the teacher has to re-design the lesson or the teaching-learning strategies accordingly. As formative assessment is significant in the flipped classroom, to ensure it, four assessment methods have been implemented in this experiment, such as self-assessment, peer assessment, co-

assessment, and building a portfolio. The self-assessment method gives students significant autonomy to review their performance and to identify elements that can be improved to achieve certain predefined goals. The peer assessment method involves students in this process by allowing them to assess the work of a classmate against a set of criteria given by the teacher, and to provide feedback to each other on their work. The co-assessment method provides a collaborative assessment and a reflection concerning the assessment results. It can be both a formative and summative assessment. In this case, it was used the Google Forms platform, Kahoot Premium+, the compile OnlineGDB or a paper-test. The portfolio assessment method requires a major student's responsibility for their own learning. In this experiment's case, a portfolio is a collection of homework that demonstrates the student's efforts, progress, and achievement in Informatics, and it was done on the GitHub platform.

3. Results and Discussion

The flipped classroom approach was applied in the "Spiru Haret" lyceum, Chisinau, the Republic of Moldova. The experiment was applied during the three years of studies (2018-2019, 2019-2020, and 2020-2021), in high school (grade 10 – 12). The purpose of the experiment was to increase the number of students who choose Informatics as a baccalaureate exam. Therefore, the fourth baccalaureate exam is an exam in which students choose by themselves a discipline from four offered, in which they want to complete it. For the humanistic profile, they have to choose from the following disciplines: biology, chemistry, physics, geography, informatics, mathematics, and for science profile, from: biology, chemistry, physics, geography, informatics, and history.

Following the application of the methodology described above, it will be represented below the results of the students' choice of the Informatics discipline on the baccalaureate exam for the last six years of studies. In the academic years 2015-2016, 2016-2017, and 2017-2018, the flipped classroom method was not implemented in the educational activities. While in the following three years of studies: 2018-2019, 2019-2020, and 2020-2021, this strategy has been implemented in the teaching-learning process.

After collecting the data, the results show that there is a slight increase in the number of students who have chosen informatics at the baccalaureate exam for the humanities profile (See Figure 1) and a more significant increase for the science profile (See Figure 2). Figure 1 and Figure 2 interpret the data on the total number of students in the class by years of study and students' number who chooses informatics as a baccalaureate exam, the same for each year of study.

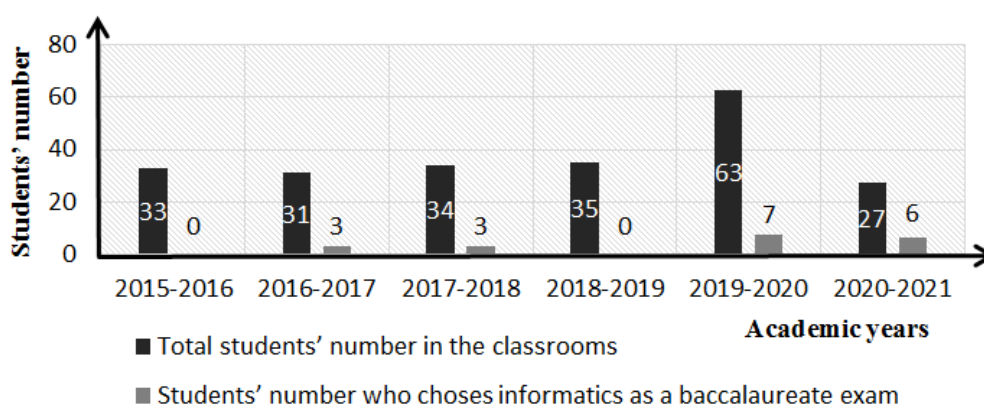


Figure 1. The results of the students' choice of the Informatics discipline at the baccalaureate, humanistic profile.

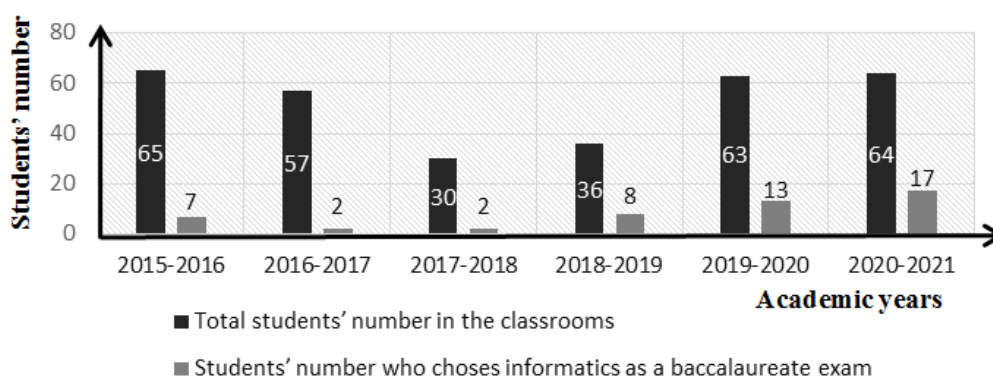


Figure 2. The results of the students' choice of the Informatics discipline at the baccalaureate, science profile.

This is not a robust scientific study, but it shows that through the flipped classroom model, the teacher has been able to help students with lower informatics skills perform and overcome fear by choosing informatics as a baccalaureate exam. The main weakness of this approach, as detected in this study, is that students who attend classes without preparation may fail to understand the content delivery and give up active involvement during classes.

Thus, a strategy must be implemented for preparedness to the students before attending the flipped classroom and this strategy must be supported and promoted by teachers together with students so as to improve the teaching-learning process.

In order to successfully implement the flipped classroom method, the teacher's professional competences have to be strengthened to avoid students' confusion during discussions, it requires multi-level teaching for competent students who can extend their learning scope and promote their own abilities. In conclusion, the key challenge of the flipped classroom is certainly managing to strike a balance between the system's aims, techniques, tools, and assessment methods and, of course, the diversity that is favorable to learning.

4. Conclusions

One of the most important concepts in the teaching and learning process is creating opportunities for students to be engaged in meaningful activities. The teachers are reflective in their practice. Thus, when the teachers observe and understand their students, they can provide these students with the support and encouragement they need to be successful. The flipped classroom approach, in which students learn at their own pace, promotes personalized education opportunities, is easy to apply in any classroom, and helps students with self-directed learning. The key challenge of the flipped classroom method is certainly to find a balance between the planned objectives, the selection of appropriate techniques, tools, and assessment methods, and, of course, the diversity that is conducive to learning. The Flipped Classroom approach, described at the beginning of this paper, is adapted to the education system in the Republic of Moldova and can be implemented in any field. The results of the experiment show an increase in the number of students who choose Informatics as a baccalaureate exam, which demonstrates the effectiveness of the flipped classroom approach.

Conflicts of Interest. The author declares no conflict of interest.

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