Flipped homework: A new approach for effective knowledge acquisition and competency development

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Abstract
Nowadays, learners' digital skills open more opportunities for effective learning, using more digital knowledge resources and more learning paths, thus developing their competencies. Teachers also have many opportunities to change the learning process toward efficiently achieving learning goals and acquiring knowledge. This study proposes a new model for teaching "flipped homework". The research begins with a discussion about homework as a means to achieve educational goals and the learning process – time frame. Some world practices and scientific research on the learning process and vacations are presented, as well as the duration of the school day. The paper includes an overview of the very popular flipped classroom approach. Then, the proposal for the flipped homework method is presented. The paper presents steps for designing an innovative flipped homework lesson. A case study about the flipped homework/project implementation in the Technological School of Electronic Systems – Sofia during the 2022/2023 school year proves the method benefits the learning process, knowledge understanding, and competencies development. The conclusion summarises the research contribution and outlines the developed competencies of the students as a result of flipped homework implementation in a real learning environment.

Keywords: lesson, flipped, competency, teaching.

1. Introduction

Learning does not mean being informed that particular educational practices are effective. Learning means the application in the real classroom of certain educational practices, which leads to a more effective learning process and higher educational outcomes. That is why the effective use of time in classes plays a key role in better learning and understanding of the learning material and knowledge acquisition. Because much of the learning occurs in a home/non-formal environment (individual work or teamwork) [1], homework plays a key role in knowledge advancement and competencies development. Many researchers have analyzed homework, school daytime, and the time for vacation. Different educational systems structure the time of the school year differently, but all educational systems and learning models have some homework. This study seeks to answer the following research questions: Can the homework time be effective? How do the learners start doing their homework/projects? What happens if students have homework/project questions? Can the students understand the new knowledge better during the lesson to perform better in the homework? The research methods used are literature review, desk research, case study analyses, and experiments within a real learning environment. The study analysis covers the homework related to secondary school students.

2. Homework

Homework research dates back to the early 1900s. However, no consensus exists on the general effectiveness of homework [2]. Many factors, such as age, grade, learning material, and learners' identity [3] and others impact the homework. There are many pros and cons about what and how much (time, difficulties, amount, etc.) the homework has to be. Homework is a type of work. Work as a means of human activity involves mental or

physical effort done to achieve a purpose or result. Work as a means in physics is the transfer of energy by a force acting on an object as it is displaced. So, homework requires efforts by the students to perform well in their learning. Research states that homework has [4], [5]:

- significant benefits at the high school level;
- reduced benefits for middle school students;
- little benefits for elementary school students.

The National Parents Association (USA) [6] and the National Education Association [7] support the "10-minute homework rule," which recommends 10 minutes of homework per grade level per night (10 minutes for first grade, 20 minutes for second grade, etc., up to two hours for 12th grade). This research is based on the interview of 1,173 respondents to the questionnaire, of which 566 responded in the spring and 607 responded in the fall [8]. Another research [9] on how do student prior achievement and homework behaviors relate to perceived parental involvement in homework, analyze the relationship between different student behaviors when doing homework with students' academic achievement. The research analyses:

- time spent on homework;
- time management;
- amount of homework completed;
- procrastination;
- emotions;
- goals and motivation for writing homework attitudes.

There is a body of literature on how parental involvement in homework affects students' academic achievement. However, few studies have examined how students' prior achievement levels influence their homework behavior and how children's academic functioning influences parental control or support over homework [9]. A comparative analysis of children's time use and educational achievement: An assessment of evidence from China, Japan, and the United States, shows that homework time positively and significantly affects math test scores in all three countries. One hour of homework increases math test scores by 0.203 [10]. There is a body of literature on homework. Some authors discuss the minutes spent on it, some argue the parents' support, some are focused on the student's motivation and others on the number of given tasks and projects. But, no research has analysed when (at what time) homework is given to students. A common approach, as practice shows, is that the homework is given at the end of the lesson.

3. Learning duration

3.1. Duration of summer holidays

Does less break/holiays time lead to less knowledge loss?

The best education systems in the world require students to be in school between 175 and 220 days, or 35 to 45 weeks. This variation suggests that total number of school days per year is not a determining factor in student performance [11]. On average, primary school students in Organisation for Economic Co-operation and Development (OECD) countries

receive 805 hours of instruction per year, and lower secondary students 916 hours, spread over 38 school weeks. However, these averages mask wide variations across countries [12].

The total length of school vacations averages around 14 weeks per year, ranging from less than 11 weeks in Costa Rica and Denmark to 17 weeks in Greece, Latvia and Lithuania [13]. A tool “School calendars in Europe” gives an overview on the start of the school year, the timing and length of school holidays, as well as on the decision-making level. Its two main objectives are to provide a better understanding of students' school rhythms in Europe and to facilitate the organisation of transnational activities and exchanges at school level in Europe. It covers the 37 European countries, members of the Eurydice network. For example, the indicator duration of summer holidays (Figure 1) shows the minimum and maximum durations of the summer holidays in weeks. It does not take into account specific starting dates for specific grades (usually for the last grade of a cycle).

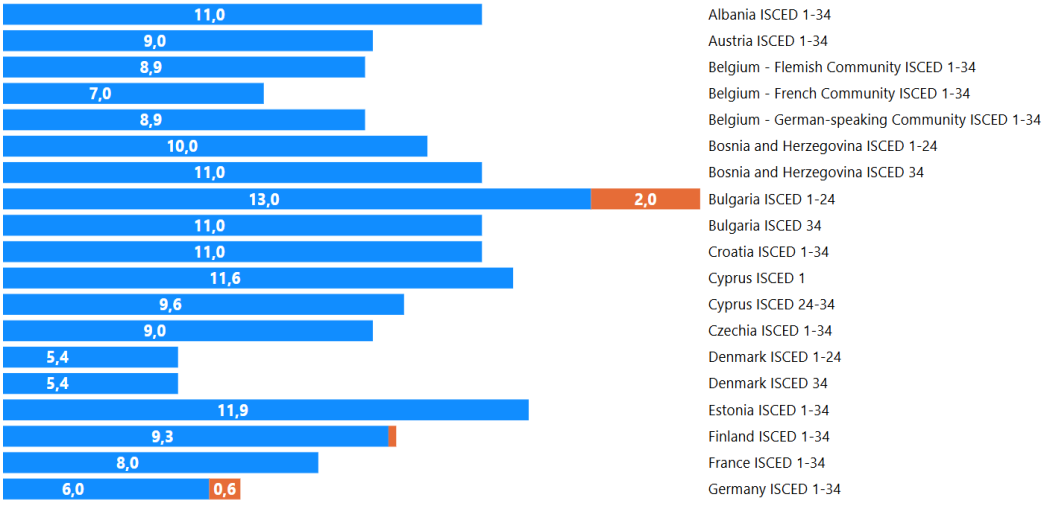

Fig. 1 Duration of summer holidays (in weeks), 2024/2025 Europe [14]

The school year duration of the Bulgarian education system is set with order no. 4 of 30 November 2015 on the curriculum Issued by the Minister of Education and Science stating that the duration of the school year depends on the Grade, as follows [15]: 32 weeks – Grades 1-3; 34 weeks – Grades 4-6; 36 weeks – Grades 6-11; 31 weeks – Grade 12.

3.2. Classes duration

Classes duration, the same as the school year length, differ from country to country. But typically, classes extend from fifty to ninety minutes, depending on the school’s structure and teaching style [16]. Other factors are the education level and degree (high school, bachelor's degree, master's degree), the grade and agre range (1st grade, 12th grade), or the complexity of the knowledge domain, class size. Research on what the average schooling is like in different global destinations shows that there are a lot of differences, not only at the beginning of the school day but also during the lunch breaks (Figure 2) [17].

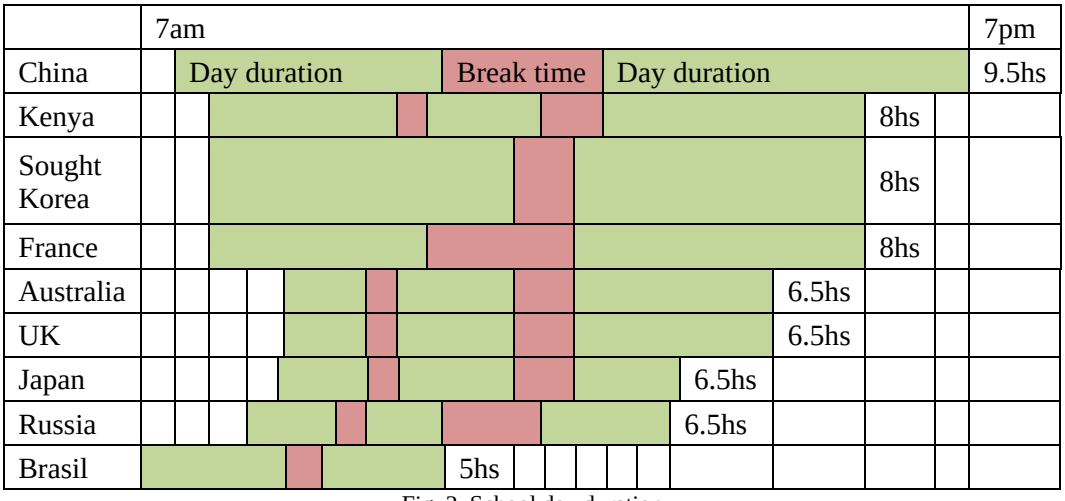

Fig. 2. School day duration

The duration of a lesson in the Bulgarian education system vary according to the agre. It is determined by regulation no. 10 of september 1, 2016 on the organization of activities in school education Issued by the Minister of Education and Science. The duration of the lesson for all types of preparation is [18]:

- 35 minutes - in grades I and II;
- 40 minutes - in grades III - VII;
- 45 minutes - in grades VIII - XII;
- 45 minutes - for teaching practice in art schools;
- 45 minutes - for teaching practice, as well as for specialized preparation in the field of sports and for active recreation and recovery as a result of training loads in sports schools;
- 60 minutes - for production practice;
- 90 minutes - for production practice in sports schools.

There is a great variety in the educational systems regarding the length of the school year. Accordingly, the duration of the vacation is different, when students are usually not engaged in learning activities (homework for the vacation) and part of the acquired knowledge is forgotten. That is why during the classes at the beginning of each school year in individual subjects, time is provided for checking knowledge and recalling knowledge. It turns out that forgetting acquired knowledge is one of the main problems in learning and achieving educational goals.

4. Flipped classroom

The flipped classroom intentionally shifts instruction to a learning-centered model, where students are often exposed to new topics outside of school (during the homwrok time), freeing up classroom time for deeper exploration of topics, creating opportunities for learning. Militsa Nechkina, a member of the USSR Academy of Pedagogical Sciences, first proposed the flipped classroom model in 1984. Salman Khan contributed to the development of the flipped classroom (Wikipedia). In 2004, Khan began recording videos, because she believed that the recorded lessons would allow her to skip segments she had

mastered and replay parts that bothered her. Based on this model, Salman Khan founded Khan Academy [19], which some associate with the flipped classroom. However, these videos are just one form of the flipped classroom strategy. In the flipped teaching method, the instructor provides learning tools such as guided readings, lecture videos, lecture slides, and practice problems to ensure that students learn the concepts on their own [20], [21], [22]. During the last several years, the publication numbers related to the flipped classroom have grown exponentially [22]. In the flipped classroom method, classroom time is used for engaging in activities, such as discussions, problem-solving, and collaborative projects, reinforcing and applying the knowledge gained beforehand. This method emphasizes active learning, student engagement, and personalized instruction [23]. The flipped classrooms benefits are many. The method supports student-centered learning, the learning is active and engaged, there is enhanced teacher-student interaction, and the learning is flexible and adaptable.

5. Homework and flipped classroom discussion

To discuss the questions about the homework and flipped classroom approach, an online interview was held during the summer vacation in 2023 on the 27th of August. The participants in the discussion were 75 teachers from high schools in Bulgaria. The interview aimed to discuss the time when the homework is given to students - at the beginning, in the middle, or at the end of the class, as well as if the teachers apply the flipped classroom method in their teaching. The interview was held during a 4-hour training course [24]. The questions that were given to the teachers were:

- *"When during the lesson do you give your students the homework?"*. 95% of the teachers/tutors reply that they give homework to students at the end of the lesson. There are also replies about examples that homework is given a week after the lesson. Homework is given in written format during the lesson or through digital platforms (Google Classroom) and digital communication channels (e-mail).
- *"Do you know the flipped homework method? Have you ever applied the flipped homework method in your lessons?"*. 100% of the teachers reply negatively.
- *"Have you ever applied the flipped classroom method in your lessons?"* 84 % of the teachers reply that they are acquainted with the approach, and sometimes they apply it in their work.

6. Flipped homework method

Forgetting can be infuriating, particularly when trying to learn a new skill or absorb vital information. When the student is not able to recall the knowledge needed, the emotions become negative and stress occurs. German psychologist Hermann Ebbinghaus in the 1880s found that within an hour of learning new information people tend to forget up to 50% of it. Within 24 hours, this can increase to 70%. By the end of the week, people tend to retain only about 25% of what they've learned (Figure 3) [25].

Research show that there are different ways to help boost memory and beat the typical forgetting curve, such as spaced learning, practice active recall, use mnemonic devices, get enough sleep, exercise and lessen stress [26].

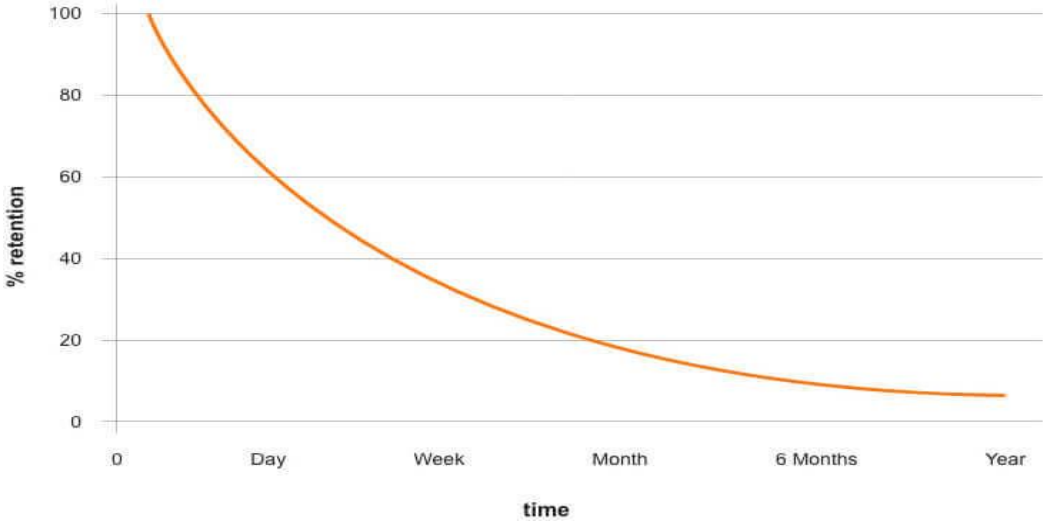

Fig. 3 Ebbinghaus's forgetting curve

Educators can combat the effects of the forgetting curve by employing spaced repetition and active recall in the teaching methods, ensuring that information is reviewed at increasing intervals to enhance long-term memory retention. Ebbinghaus investigated the rate of forgetting, but not the effect of spaced repetition on the increase in retrievability of memories. Practical applications of spaced repetition were first suggested by Mace in 1932 (Figure 4) [27], [28].

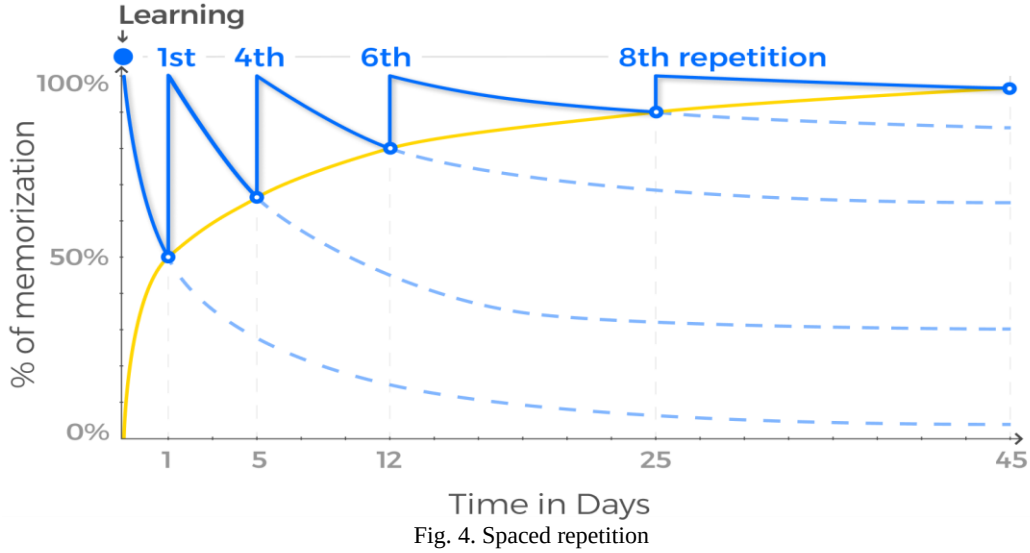

Fig. 4. Spaced repetition

In the common case, the traditional learning process starts with the topic of the knowledge and then follows some learning activities, such as explanations, discussions, solving problems, and others depending on the teacher's approach and pedagogy (Figure 5).

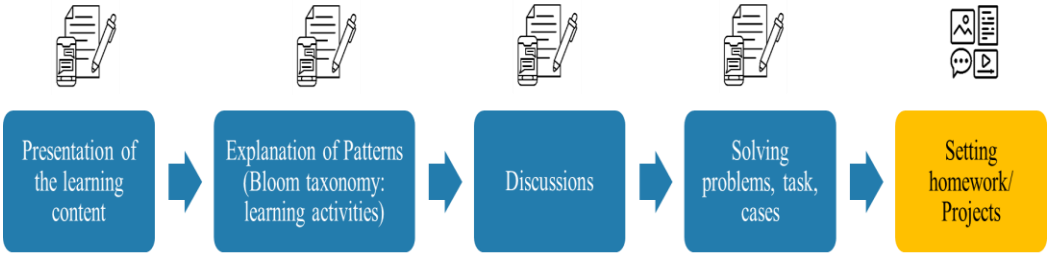

Fig. 5. Traditional learning process

In comparison to the traditional learning process, when the homework is given at the end of the learning, in the flipped-homework method the homework is given at the beginning of the lesson (Figure 6). The flipped homework method is based on the perception that the student will not only acquire knowledge but much more to understand the new knowledge easily when the teacher repeats the learning content from time to time during the lesson, as well as addresses the knowledge in support of solving the problems/tasks from the homework.

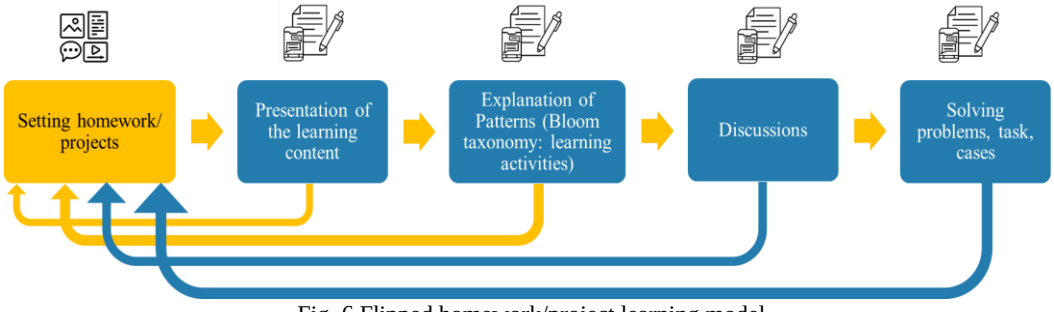

Fig. 6 Flipped homework/project learning model

The flipped homework method is much more beneficial for learning than the traditional approach. The understanding of knowledge is improved, the efficiency of time use is improved, and the attention span of learners is higher. The interest of learners increases and motivation is higher. The flipped homework approach is assessment-related, it improves the effectiveness of the discussions during the process of understanding new knowledge.

***A deffinition**: Flipped Homework is a method that intentionally and actively redirects learners' attention to the practical benefits of the knowledge and competencies acquired during class for solving assigned homework cases and tasks assigned at the beginning of the class.*

The stages for designing an innovative flipped homework lesson are shown in Figure 7.

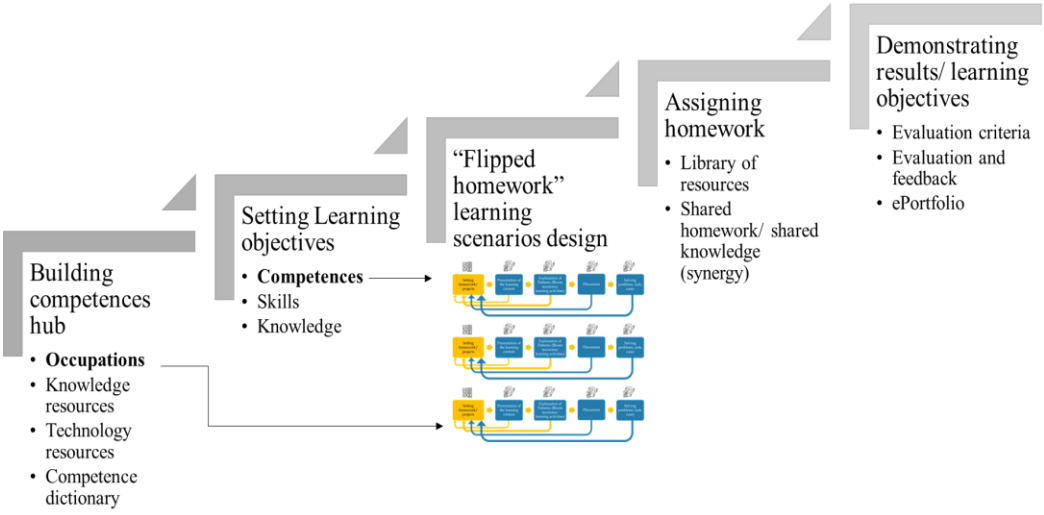

Fig. 7 Stages of design of an innovative flipped homework lesson

The method of the flipped homework/project can be applied on a semester and yearly basis during the school year (Figure 8).

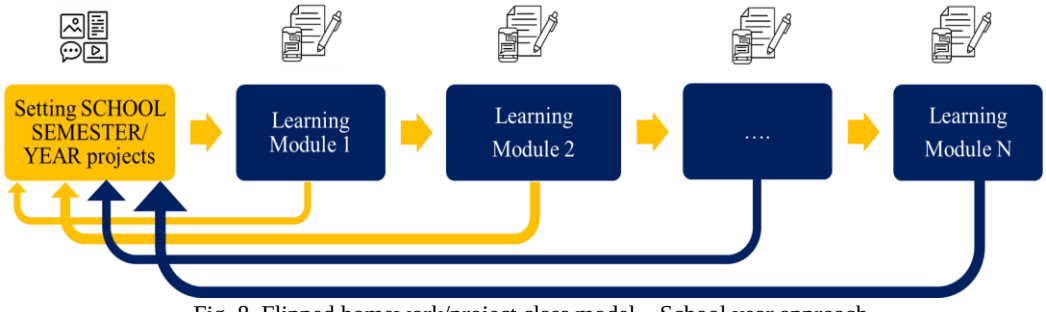

Fig. 8. Flipped homework/project class model – School year approach

7. Flipped homework method application

The flipped homework method was implemented in practice at the Technological School of Electronic Systems - Sofia during the 2022/2023 school year. The students who participated were 10-grade students (15 years old) - 104 students during the learning of the course "Economics". The course has 36 classes per year, 18 per semester. The method was implemented during the 1st semester for project work/homework. At the beginning of the semester, the homework project requirements were given to the students and explained in detail. The time spent on project instructions was half of the lesson time (20 minutes). The students wrote down the instructions in their notebooks. The semester started with Module 1 – Basics of a Company Registration, the next topics were studied Module 2 – Capital Structure, Module 3 – Balance sheet data and Analyses, and Module 4 – Company Investments and Net Present Value Method.

During each lesson and Module, a reference to the homework project work was done. The students were encouraged to have questions and to fulfill part by part of their home

semester project. At the end of the semester, they had to prepare a written report and record it within their e-portfolio. They also had to create a visual representation (Infographic) [29], [30] of the analyses using infographic tools. Each student had to present the project at the end of the semester for exactly 3 minutes. The project presentation was in front of all students during the final lesson. In Figure 9, an example work of one of the students (Alexander Shestakov) is presented.

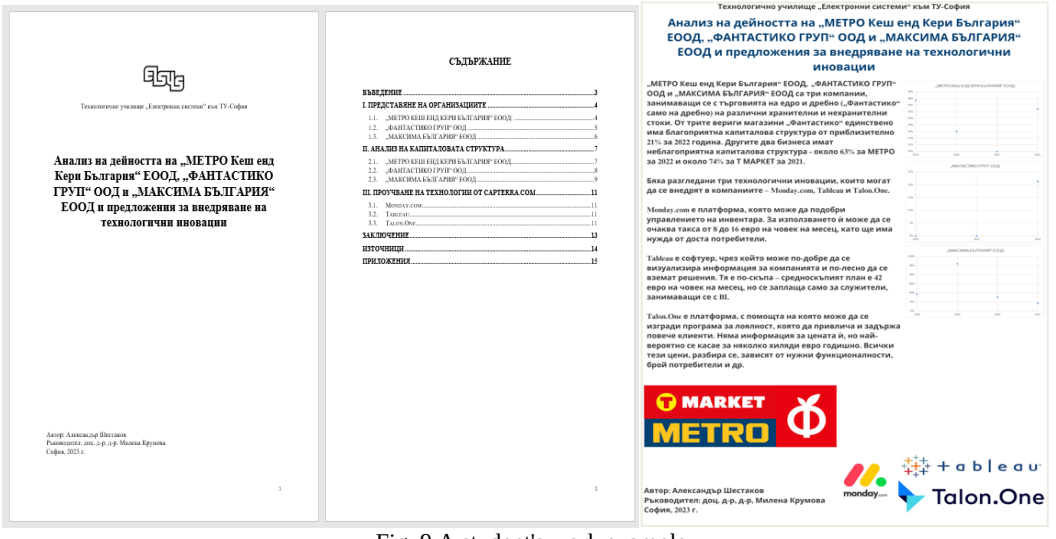

Fig. 9 A student's work example

The flipped homework approach's results were encouraging and added value to the learning process during the semester. The students improved their understanding of economy sectors, company types, capital structure and analyses, company balance sheet, long-term and short-term assets, company investments assessment, etc. The class discussions were more efficient, and more questions were raised.

8. Conclusion

This study outlines important questions regarding the time efficiency of the learning process in the context of homework, the length of school days, and the role of vacation length. The literature has shown that there are many studies about analysis of homework, which have been done from a diverse perspective. The analyses of the school day and vacation show that the length differs in different countries. But, none of the research was done regarding the time, when the homework is given to the students – at the beginning, in the middle, or at the end of the class, and if this impacts knowledge acquisition and understanding. The homework activities/projects are part of every school and university curriculum, and they have predetermined hours (self-work) for it. The teachers and educators at every school, and university have an opportunity to use the flipped homework method during the school year to improve teaching efficiency, knowledge understanding, and competencies development. Flipped Homework is a method that intentionally and actively redirects learners' attention to the practical benefits of the knowledge and competencies acquired during class for solving assigned homework cases and tasks

assigned at the beginning of the class. The flipped homework method reflects in the higher efficiency in understanding new knowledge, discussions, and all the other learning activities held in class. The Flipped homework method is a competency-based approach, in which the goal of learning is the development of competencies that are structured through an analysis of competencies in real-world occupations. Competences are demonstrated and evaluated through e-portfolios (individual and teamwork). The conducted case study at the Technological School of Electronic Systems – Sofia proved the flipped homework method efficiency. The students developed many competencies, which were demonstrated at the end of the semester. They demonstrated their analytical and research competencies, digital competence, literature review, and citing skills, comparative analyses competence, data interpretation, information structuring and summary (infographics), presentation competence, speaking in front of an audience, and time management, as well as knowledge sharing competencies. All competencies were proved by artifacts, which were recorded within each student's e-portfolio.

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