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PREPARING AND USING VIDEO MATERIALS IN HIGH SCHOOL DURING MATH CLASSES

In recent years, the formation of new educational platforms has significantly influenced the systems and organization of the educational process. The project reported here used resources from Khan Academy. The posted video materials were an inspiration to make innovative attempts to develop materials of this type by both pupils and students.

Although Khan Academy has been operating since 2008, there is still little empirical research to report on the platform's impact on student learning, cognitive benefits and soft skills development.

The article describes a one-semester didactic experiment carried out in the school year 2021/2022 with students of the third grade of secondary school who followed the core curriculum after the 8-year primary school and also first-year students of mathematics at the Pedagogical University of the National Education Commission in Krakow.

Keywords: *Khan Academy; flipped classroom method; flipgrid; video materials; Fibonacci sequence; analytical geometry; trigonometry.*

Introduction

In recent years, many educational platforms have been created. This concept is used to describe integrated systems of educational services offered online. The educational platforms enable the collection and storage of teaching materials that can be divided according to the adopted criteria so as to facilitate familiarization with files, e.g. mathematical analysis, linear algebra, differential equations, etc. The Wolfram Alpha platform is well known in mathematics. Polish high school graduates know the Matemaks platform well. In this work, we are focusing on Khan Academy, which is an innovative educational platform basically covering all subjects [1; 2]. Its characteristic feature is free access for everyone to all the collected content. Millions of users can acquire new knowledge and skills simultaneously, because the educational content on the platform is translated into about 40 languages.

The platform can be used during classes at school (teacher-student), as a tool of the increasingly popular flipped lesson method and during individual learning. Khan Academy has been operating since 2008, but there is still little empirical research to show results on the platform's impact on student learning, cognitive benefits and soft skills development.

The present work is of practical nature; it is created as a guide for a mathematics

teacher. It presents experiences from two months of work with students involving new technologies, and new teaching approaches. The development of technology is far ahead of changes in the education system, especially from the point of view of its organization and assimilation of technology developments. The innovative nature of the actions taken here presumes the idea that school and university students not only watched video materials from the Khan Academy platform, but were also asked to undertake the effort of preparing educational materials on their own.

Results

Khan Academy is a non-profit organization. In 2006, a graduate of Massachusetts Institute of Technology and Harvard Business School, Salman Khan founded an association whose main goal is to "provide quality education to everyone, everywhere". In 2004, Salman Khan tutored mathematics using Yahoo!'s Doodle notebook. As more and more people wanted S. Khan's lessons, he decided that short recordings of the lessons on YouTube would be more practical. Due to the popularity of the recordings, in 2009 Salman Khan quit his job in finance and became involved in creating educational videos and sharing the recordings as part of Khan Academy (free access). The organization is maintained by donations offered by donors (including Ann and John Doerr and the Bill and Melinda Gates Foundation) and companies (including Google).

Currently, the platform offers over 9,000 online instructional videos in such subjects as: mathematics, biology, physics, computer science, world history, economics and finance, arts, world history and SAT practice (preparation of students for university exams and entrance exams to universities). In 2018, there were 60 million registered users on the Khan Academy platform. In 2019, 2.7 million students enrolled in Khan Academy's official SAT practice, a 17% increase compared to the previous year, and 240,000 teachers in over 50 countries benefited from Khan Academy resources [3].

The flipped classroom method. The development of technology has played a huge role in the evolution of the flipped classroom method. Initially, when this approach was created invented, students received paper materials in order to get acquainted with the new information before the next class [4]. This solution helped teachers and lecturers to start classes with a conversation with students or move on to more demanding topics. Currently, teachers can remotely share developed materials as well as recorded lessons using e.g. educational platforms [5]. Studies on the modern flipped classroom method indicate as its main advantages that:

– students can learn to play the same video or its fragments many times, stop it at any time when they consider it necessary or beneficial,

– students can learn at their own pace and at any time and place,

– it improves students' understanding of the presented content and increases the effectiveness of teaching during the lesson.

The materials prepared beforehand enable students to focus on the essence of the discussed content – they are not required to search for materials on their own. Students can learn at their own individual pace. They assimilate new material or fill gaps in understanding of what they have already learned. In this way, they effectively consolidate knowledge. Students take responsibility for their learning process, by actively managing it – they set the pace of work, time spent and where they learn [6]. It was noted that teaching mathematics in a novel way using project-based and problem-based learning showed significant improvements in problem solving skills in high school. The use of the flipped classroom model in mathematics lessons in Taiwan has shown a significant difference in learning outcomes and motivation compared to traditional methods in middle and low level students [7].

Changing roles – teacher and student. The experiment was carried out in Spring of the 2021/2022 school year. Its participants were third-grade high school students subject to implementing the core curriculum after an 8-year primary school. The experiment was implemented so that it replaced regular mathematics lessons. During the experiment the students, in particular, were asked to change roles and pass from being receivers of prepared material to becoming creators of their own video materials. During the first experiment unit, students were given the task of developing and recording a film on the golden ratio and the Fibonacci sequence. The project was planned for several weeks. Members of three-person teams were randomly selected [8] for discussion on how to assign students in groups in the most effective way. The first stage of the project comprised watching materials available on the internet, collecting information from various sources including materials provided by the teacher and then analyzing collected data. The students lacked knowledge of the notion of a sequence, which created a major obstacle in their progress (students at the stage of carrying out the project did not know, among others, arithmetic and geometric sequences). The second stage of the project involved con-

sultations with the teacher. More precisely, in this phase the teacher assisted students in each group individually, engaging them in discussion and answering their questions. The conversations revolved around the progress of each project: ways to obtain information and methods of presenting the acquired information, as well as technical problems related to recording and editing the video material. The third stage focused on the recording of the video material and making it available on the Flipgrid platform at the set date [9] for a Flipgrid usage in education analysis. The students were asked to complete a questionnaire beforehand in the project.

At exactly the same time, freshmen mathematics major students during the course on Linear Algebra were given exactly the same task to perform. The difference between university students and high school students was that students were familiar with the concept of a sequence and they were more mature. However, none of the groups have ever discussed the golden ratio and the Fibonacci series before. This is a subject that does not appear in the core curriculum at school, nor in the Linear Algebra syllabus. The possibility of discovering and working with such a sequence had a motivating effect on students who show an above-average interest in the subject. The innovation of this project was the reversal of the student-teacher role. When analyzing the surveys, one can notice a definitely positive reception of the new activity during mathematics classes. The involvement of pupils and students in the project was not limited to the search for appropriate materials and the recording of a video material. After the completion of the project, both groups of students watched films prepared by their peers from the other group. Then they were requested to evaluate the prepared materials and to answer questions organized in a survey.

Survey results. The survey contained five questions, three of them are presented below. This choice is dictated by the fact that they were open. A total of 570 responses were collected. The most representative answers have been selected below.

Question 1. Did the watched material arouse your interest?

“Way way too short. I think I'd be more interested if instead of music (which I don't think had anything to do with the presentation), the issue was discussed. On the plus side there was the list of the used sources that were used”.

“The material did not interest me, which was largely due to the lack of recordings of the person telling the story, as well as a font that is unreadable, in colors that are hard to read with a lot of content”.

“The material sparked my interest, but to a large extent, this interest was built by a beginning which I didn't expect. Later, my interest was maintained by well and interestingly used graphic materials”.

“Yes, the material is prepared in a very attractive way. The big advantage is that the slides are narrated, not read”.

“Yes, the beginning catches attention, you can see that the person who made the video has tried. During the video, she was drawing on the image, there was a screen recording during using a calculator, and such things are more interesting than simply describing drawings and reading”.

“Yes, the material was prepared in an interesting, mathematically correct and original way. Consistent engaging content. Clear message, key information”.

Question 2. Has the content presented in the material been conveyed in a clear manner and does it form a coherent whole?

“In general, the content was conveyed in a clear and coherent way, a big plus for seeing what is being said”.

“The content was presented as clearly and coherently as possible. It was clearly stated or written in the presentation what is going to be discussed at each moment, which makes the message a lot easier to understand, in my opinion”.

“Nobody really handed over the material. They only scroll dry facts for a minute”.

Question 3. Does the sound and image quality allow you to focus on the substantive message?

“Image quality is good, it makes it easier to concentrate on the substantive message material. However, the sound quality is average, there are moments where it is very hard to understand what a person is saying because the music is too loud, which makes the material difficult to understand”.

“The image focused the viewer's attention. The sound itself was good quality, but the music playing in the background was pleasant at first, but later became too loud and interfered with understanding the content presented”.

“I think the movie would be much better with a person presenting the information rather than a selection of music playing in the background”.

Continuation of the project. Due to the positive reactions of high school students to the project, the project continued. Preparing video materials was very interesting for younger classmates who expressed their willingness to join in the new activity. The second project for the same class concerned issues from the

"Analytical Geometry" section. The only difference from the previous project was that the students divided themselves into four groups of 5 and two groups of 6. The students were supposed to develop a solution to the standard tasks analyzed during the classes (each group was given a different task). A very important stage of the project was the graphic presentation of the solution. The purpose of the requirement was to familiarize students with the tools available to visualize, for example, a straight line intersecting a circle. The table below contains information about the average grade from the test for the class participating in the study. The table highlights the results of the test that took place after the project was developed. A significant improvement can be seen, as students who follow the core curriculum traditionally were scored one mark lower than when they had to record the videos themselves.

Table 1

Average results obtained from knowledge tests in the third grade

Planimetry	2,390625
Logarithmic and exponential function	2,0
Analytical geometry	**3,015625**
Sequences	**3,2413793103**

In the school year 2021/2022, students of the second grade implemented the core curriculum after an 8-year primary school. In parallel with the second project in the third grade, they were tasked with developing the topic "Trigonometry – application in everyday life". Similarly to the first project in the third grade, students were randomly assigned to groups of 3. Each stage of the project was analogous. The only difference compared to the first third-grade project was that the students have already learned the basics of the topic. The table below contains information about the average grade from the test for the second class participating in the study. Table 2 shows results of the test that took place after the project was finished. A significant improvement can be seen, as students following the core curriculum traditionally were scored one mark lower than when they had to record the videos themselves. The numbers in black refer to average notes in the traditional teaching, whereas the numbers in red concern the experimental part of material. It is worth to underline that trigonometry is traditionally perceived as more difficult that e.g. quadratic function. Yet the students present better achievements here, which is due to the innovative method they were confronted with.

Table 2

The average results obtained from tests checking knowledge in the second grade

Planimetry	1,3980645161
Quadratic function	2,7142857143
Polynomials	1,(162)
Quantifiable function	1,89(39)
Trigonometry	**3,1(6)**

Discussion

Using the observations of Surya and Syahputra (2017), who drew attention to teaching mathematics in a different way using the project method, a project was created based on materials prepared by students for students. The employment of the flipped lesson method during a new activity made a significant difference in the results Bhagat, Chang, and Chang (2016). For the most part, students in both classes assimilated the new material discussed in class in an even/constant manner. The above results allowed me as a teacher to observe how students cope better with new content when they search for and develop information that is completely new to them. The initial version of the project involved only making a film about the Fibonacci sequence and the golden ratio. The continuation of the project was created at the request of students. Initially, students from the same class wanted to get involved in making more films. However, the innovativeness of this project attracted the interest of students from other classes – as a result, a project that assumed the development of one topic initiated the next two. In the 2022/2023 school year, the project is being more extensive. The target groups are first year high school students. Students are being divided into 3 groups. Two groups are going to be tasked with preparing a similar project. Each group is going to develop a different topic, which is going to be developed later during the classes based on the videos. Students are going to be able to learn using materials prepared by their peers as well as to evaluate the projects of another group. The third group is going to be tasked with reading through all the materials and expressing their opinion as a group that has not previously recorded the materials.

Conclusion

The most significant aspect of discussed project is that none of the groups has previously participated in a similar project. Only two of the groups that are supposed to express their opinions during the project are going to prepare materials. The task of the third group is to evaluate the projects, which is important because the students of the last group do not know what the preparation and

development of materials look like. It will be a whole new way of learning for students. Therefore, the feedback obtained will be very important and will later contribute to improving this method of working with students.

References

1. Khan, S. (2012). The one world schoolhouse: Education reimagined. New York, NY: Twelve. 272 p.
2. Mann, B. (2014). The One World Schoolhouse: Education Reimagined by Salman Khan. *American Journal of Education*, 120: 283–286.
3. Khan Academy (2023). Retrieved June 12, 2023, from http://www.khanacademy.org/.
4. Ağirman, N. & Ercoşkun, M. (2022). History of the Flipped Classroom Model and Uses of the Flipped Classroom Concept. *Uluslararası Eğitim Programları ve Öğretim Çalışmaları Dergisi*, 12: 71–87.
5. Ouariach, S. & Maha, K. & Mohamed, E. & Khaldi, M. (2023). The Flipped Classroom From Passive Information Absorption to Active Learning. *IGI Global: Publisher of Timely Knowledge*. Doi: 10.4018/978-1-6684-7275-0.ch015.
6. Surya, E., Syahputra, E. (2017). Improving High-Level Thinking Skills by Development of Learning PBL Approach on the Learning Mathematics for Senior High School Students. *International Education Studies*, 10(8): 12–20.
7. Bhagat, K., Chang, C., Chang, C. (2016). The Impact of the Flipped Classroom on Mathematics Concept Learning in High School. *Educational Technology & Society*, 19(3): 124–132.
8. Huxham, M. & Land, R. (2000). Assigning Students in Group Work Projects. Can We Do Better than Random? *Innovations In Education & Training International*, 37: 17–22.
9. Lowenthal, P.R., & Moore, R. (2020). Exploring student perceptions of Flipgrid in online courses. *Online Learning Journal*, 24(4): 28–41.

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ПІДГОТОВКА ТА ВИКОРИСТАННЯ ВІДЕОМАТЕРІАЛІВ У СТАРШІЙ ШКОЛІ НА ЗАНЯТТЯХ З МАТЕМАТИКИ

Анотація. *Формування нових освітніх платформ за останні роки значно вплинуло на системи та організацію навчального процесу. Проект, про який йдеться у статті, використовував ресурси Khan Academy. Розміщені на цій платформі відеоматеріали стали джерелом натхнення для новаторських спроб розробки матеріалів такого типу учнями та студентами.*

Незважаючи на те, що Khan Academy працює з 2008 року, досі мало емпіричних досліджень щодо впливу платформи на навчання студентів, когнітивні переваги та розвиток навичок спілкування.

У статті описано односеместровий дидактичний експеримент, проведений у 2021/2022 навчальному році з учнями III класу загальноосвітньої школи, які навчалися за профільною програмою після 8-річної початкової школи, а також студентами першого курсу математичного факультету педагогічного Університет комісії народної освіти в Кракові.

Ключові слова*: Академія Хана; метод перевернутого класу; фліпгрід; відеоматеріали; послідовність Фібоначчі; аналітична геометрія; тригонометрія.*

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