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Anna Michniewska

Khan Academy in biological education

Social changes that have occurred in recent years, and in particular the need to acquire knowledge throughout life, show the role of distance education with particular emphasis on lifelong education, independent of age, place of origin or stage of education (Potyrała, Michniewska, 2015). The development of modern technologies enables us to provide education at the highest level without leaving home in the form of e-learning courses, virtual universities or open education (Bednarek, 2008). New media are conducive to learning based on interaction and participation rather than passive learning (Musiał, 2015). One example of distance learning is MOOCs, which are becoming increasingly popular all over the world. According to Grażyna Penkowska, MOOCs are based on the belief that everyone has the right to lifelong learning (Penkowska, 2015). Characteristic for MOOCs is, in addition to traditional training materials such as instructional videos, articles, exercises, providing a place for social learning through interactive forums, group tasks, projects, and mutual evaluation. Remote learning systems offer a wide range of education using information systems that enable them to acquire knowledge that goes beyond school education (Barczak, et al., 2006).

Khan Academy is one of the examples of Massive Open Online Courses. It is a free educational tool that participants can use anywhere and at any time. Salman Khan founded the Khan Academy organization in 2006, and his slogan was: "ensuring high quality education for everyone and everywhere" (Khan, 2013). Initially, the courses mainly covered mathematical issues, and only later more subjects were added (Gurba, 2015). Most of the materials are prepared for students, starting from elementary school (introductory materials in mathematics), secondary education (e.g. mathematics, biology, physics, etc.), students and adults (films and scientific articles that go far beyond material implemented in high school (e.g., materials prepared at the academic level in organic chemistry.) Khan Academy is a non-profit organization whose goal is to provide open education and access to reliable information (Plebańska, 2015). Khan Academy offers a huge amount of educational materials and other forms of support in the teaching and learning process that give allow students to work at their own pace, in and outside the classroom. The Polish and foreign Khan Academy platform is not only a tool for students, but also for teachers and parents who can monitor progress in the work of their children's progress.

Elements of the Khan Academy

- Videos with explanations related to specific issues.

Each film presents a short piece of knowledge enabling an in-depth understanding of the topic. The authors of the Khan Academy citing research conducted in 1996 by professors of the University of Indiana – Joan Middendorf and Alan Kalish – about the optimal concentration time of students assumed that films should last an average of ten minutes (Khan, 2013: 39). Most of the films are shown in the form of a blackboard on which the teacher draws with colored pens. The videos in their form are to remind the teachers explaining new issues and their detailed notes on the board. The films form a coherent whole. When discussing new topics, the lector refers to previously presented content and previous materials. Besides, some materials have been expanded to include colorful Crash Course videos that were created as part of an educational YouTube channel started by the Green brothers, John Green and Hank Green, who are notable for their VlogBrothers channel.

Since joining YouTube in 2006, Khan Academy has a wide audience. Data from August 2019 indicate almost 5 million subscriptions and over 1,677,982,668 views worldwide for the Khan Academy channel (https://www.youtube.com/user/khanacademy) where 7447 educational films are placed. "KhanAcademyPolski" (https://www.youtube.com/user/KhanAcademyPolski) is subscribed by over 56,000 users of the portal and has 16 million views, where users have at their disposal 4004 films prepared in the Polish language.

- Articles

Khan academy has in its resources a huge amount of texts prepared based on scientific articles. Each of the texts has a rich References and references to other articles to expand the content. The content of the articles can provide separate learning content as well as support in the assimilation of information from the films on the platform. The authors of the articles made sure that they were understandable to all users, by using illustrations and pictures, as well as by hyperlinking with other materials discussed on the platform.

- Exercises and tests

Most of the topics were equipped with additional exercises and tests to check and consolidate the acquired knowledge. Students can register on the portal to save the points scored and the results of individual exercises. In addition, IT projects have been prepared for participants, requiring the use of acquired skills in practice to engage students in active participation in the learning process using the Academy, elements of gamification are used through the use of badges, awards and the ability to monitor their progress in learning (Potyrała, Michniewska, 2017). Teachers can also access the results after setting up an account and assigning students to their class. Also, teachers and parents receive reports on the work of their pupils, e.g. the Coach Reports, which describes in detail the messages and skills acquired by students, as well as information about completed tasks and their level of difficulty (https://pl.khanacademy.org/resources).

- Discussion forums

Khan Academy enables interaction between participants by asking questions, commenting on other statements, rating comments, giving tips and thanks. Students from around the world can exchange comments after each batch of material.

Bricken points out that Khan Academy uses technology to create a new dimension in education, but a base of passive video content is not enough to create the future of science. In his report, he points out the great importance of teacher influence and feedback, providing student support and creating a sense of community among users (Bricken et al., 2019).

Analysis of Khan Academy platform resources

Khan Academy is a tool offering educational materials in 5 fields: mathematics, natural sciences, humanities and arts, computer science, economics and finance.

An analysis of the Polish and international Khan Academy platform in terms of issues related to science subjects provided information on what subjects can be taught with the help of the Khan Academy, what topics are included in individual courses, what amount and quality of materials have been prepared so far, and how many exercises and tests can be carried out by the student to check his knowledge. Information on this subject is collected in Table 1 and Table 2.

Table 1. Content analysis of Khan academy from the Science department in Polish Platform pl.khanacademy.org (Potyrała, Michniewska, 2017).

	Subjects	Modules	Topics	Materials (films, articles, exercises)	Exercises
Science	Biology	31	106	592	69
	Physics	20	76	601	11
	Chemistry	17	52	420 *(plus 14 AP® chemistry)	18
	Cosmology and astrology	4	15	90	-
	Health and medicine	22	149	892	16
	Organic chemistry	14	57	310	-

Table 2. Analysis of material content available from biology in Khan Academy.org

Modules	Topics	Movies	Articles	Exercises	Quizzes and tests
Intro to biology	2	2	4	1	0
Chemistry of life	3	11	5	1	0
Water, acids, and bases	4	14	5	4	3
Properties of carbon	2	6	3	1	0
Macromolecules	5	16	5	4	3
Energy and enzymes	6	17	8	5	1
Structure of a cell	4	11	11	5	3
Membranes and transport	5	13	5	4	3
Cellular respiration	6	12	9	5	3
Photosynthesis	4	11	6	4	1
Cell signaling	2	3	5	1	0
Cell division	4	12	9	5	3
Classical and molecular genetics	5	9	14	6	2

DNA as the genetic material	3	10	7	3	1
Central dogma (DNA to RNA to protein)	3	7	10	3	1
Gene regulation	2	3	6	2	0
Biotechnology	4	4	7	2	0
Developmental biology	3	4	4	0	0
Bacteria and archaea	2	2	6	1	0
Viruses	1	1	5	0	0
Evolution and the tree of life	3	20	9	4	1
History of life on Earth	3	12	2	0	0
Ecology	8	22	20	8	4
Biodiversity and conservation	5	16	0	2	0
Behavioral biology	1	2	4	0	0
Principles of physiology	2	0	5	2	0
Human biology	5	25	6	0	0
Plant biology	1	3	1	0	0
Crash Course: Biology and Ecology	2	51	0	0	0
Meet the biology professional	1	0	8	0	0

Also, the quantitative analysis of materials from the subject biology shows a variety of materials that enable learning this subject. The data summarized in Table 2. show that students and teachers can use 391 educational films, 189 articles, 73 exercises and 29 tests available. The analyzed materials showed that from the content of the biology subject they are most often presented in the form of short films, but not from every topic the student has the opportunity to test his knowledge or expand in the form of articles. An interesting offer is materials prepared in a form other than a blackboard (Crash Course: Biology and Ecology), and in the form of colorful and funny videos where students can see the teacher's face. These materials are a separate element of the course, they complement the materials presented on the platform, they do not have any checking.

Particularly noteworthy is the fact that on the platform in the science, biology section, there are several modules in chemistry, e.g. Chemistry of life, Water, acids, and bases, Properties of carbon, Macromolecules. The material described in the following modules repeatedly goes beyond the material students use in biology lessons.

The material from Khan Academy is adapted to American teaching systems and prepares for American end-of-year exams. Mostly the subjects and content of educational materials do not coincide with the Polish Core Curriculum. The knowledge and skills that can be acquired by taking courses on the Khan Academy platform are often not even in the Core curriculum for high school, but they can serve as a tool for lifelong education. Biology materials are a good source of acquiring or expanding their knowledge for students who pass the matriculation examination in biology or science students.

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Abstract

The Khan Academy platform is one example of Massive Open Online Courses that are used in distance learning. The Khan Academy contains a large number of materials that provide education without leaving home or help to prepare the lesson with the flipped learning method. The author of the article analyzed materials on science subjects with particular emphasis on biology issues. A wide range of movies, articles, exercises, and tests available on the Khan Academy website as well as YouTube can be used in teaching and learning for people of all ages.

Keywords: Khan Academy, MOOC, distance learning, flipped education

Anna Michniewska
Szkoła Podstawowa nr 33 w Krakowie, Poland
e-mail: anna.michniewska@gmail.com