DIGITAL APPLICATIONS IN DISTANCE SCIENCE EDUCATION

SERKAN UNLU
SEYIT AHMET KIRAY

ISRES Publishing

Digital Applications in Distance Science Education

Serkan UNLU

Teacher, Halil Fahri Orman Middle School
İstanbul, Türkiye

Seyit Ahmet KIRAY

Necmettin Erbakan University
Ahmet Kelesoglu Education Faculty
Department of Science Education, Konya, Türkiye

ISRES Publishing

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Authors

Serkan UNLU
Seyit Ahmet KIRAY

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PREFACE

This book has been prepared to introduce common technological tools that can be used in science education in the distance education process. Although most of the applications introduced in the book are used in face-to-face education, this book focuses on their use in the distance science education process. In the Introduction part of the book, the increasing importance of distance education and the use of distance education in science education are mentioned. Subsequent chapters are classified by letters. In section A, Video Recording and Conferencing Tools are introduced. Many distance education tools have emerged in the world, especially after the Covid-19 pandemic. In this section, the most widely known of these, ZOOM, Google Meet, Loom, Teamlink and Webex are briefly introduced. In section B, video tools with educational content are introduced. Although there are many video platforms in different languages in this area, video sites that are known worldwide and that can be used for educational purposes are introduced in this section. It is mentioned how these sites can be used in distance science education. Under this title, only MOOCs, TED, E-Twinning Online, Khan Academy and Udemy video platforms have been introduced and how they can be used in distance science education has been emphasized. Modeling and Design Tools are introduced in section C. Among these tools, 3D Virtual Science Labs, which is gradually becoming widespread today, Tinkercad and Fusion 360 modeling and design tools, which are known worldwide, were introduced and comments were made on how to use these tools in distance science education lessons. In section D, the introduction of Virtual/Augmented Reality Based Mobile Training Applications is given. Among these tools, it was preferred to introduce the ones that are widely known and can be used in science education. Virtual and augmented reality tools whose focus is outside of science education are not included in this section. In this section, mobile applications that can be used in science education are included under the titles of 4D+ Flashcard apps, Mobile Apps for Astronomy, Mobile Apps for Biology, Mobile Apps for Chemistry, Mobile Apps for Physics. There are simulation tools in section E. In this section, two-dimensional simulation tools are introduced. The simulation tools in this section are limited to PHeT simulations and Algoodo simulation tool, which are widely used in science education. Coding tools are included in the F section of the book. In this section, the introduction and application examples of Code.org, Scratch, Mblock, ArduinoBlocks coding tools, which are widely used in coding, are presented. Especially 4-8. The importance of block coding was emphasized in the classrooms and coding tools were limited to introduction to coding and block coding tools. Text encoding tools are not included in this section. In section G, Web 2.0Based Measurement and Evaluation Tools are introduced. In this section, the introduction of Kahoot, Quziz, Baamboozle, That Quiz, Socrative, Mentimeter and Google Forms tools, which can be used in both distance and face-to-face science ed-

ucation, and their use in science education are highlighted. In section H, under the title of Digital Story and Presentation Preparation Tools, StoryboardThat, Storyjumper, Powtoon, Pixton, Glogster, Infogram, Time.graphics, Microsoft Sway, Promo, Canva, Creately tools are included. It has been mentioned how these digital story tools will be used in distance science education, and sample screenshots of these tools are included. In section I, Classroom Management and Data Gathering Tools are introduced. Under this title, information is given about the widely known Edpuzzle, Google Classroom, Padlet, Seesaw programs and examples of applications made with them are given. As a result, we hope that this book will contribute to science educators who want to use educational technologies in the field of distance education, to see the big picture in this field.

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Serkan UNLU
Halil Fahri Orman Middle School
İstanbul, Türkiye
E-mail: unluserkan897@gmail.com

Seyit Ahmet KIRAY
Necmettin Erbakan University Ahmet Kelesoglu
Education Faculty, Science Education Department
Konya, Türkiye
E-mail: ahmetkiray@gmail.com

MANAGING WRITERS

Serkan UNLU, completed his undergraduate and graduate studies at Necmettin Erbakan University. His main areas of interest are coding, augmented reality and educational technologies. He is currently working as a Science Teacher at Halil Fahri Orman Secondary School.

E-mail: unluserkan897@gmail.com **ORCID:** 0000-0002-4993-1784

Seyit Ahmet KIRAY, is an associate professor at Necmettin Erbakan University. He completed his undergraduate education in Selcuk University Physics Teaching, his master's degree in Science Education at Selcuk University, and his doctorate in science education at Hacettepe University Primary Education doctorate program. He received his associate professorship in the field of science education. His academic fields are conceptual science, technology use in science education and STEM education.

E-mail: ahmetkiray@gmail.com, **ORCID:** 0000-0002-5736-2331

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Serkan UNLU
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Seyit Ahmet KIRAY
Necmettin Erbakan University

Introduction

The history of distance education can be taken back to ancient times, but it can be said that distance education in today's sense started with radio, television, and the internet. While education was completely identified with the concept of school a century ago, today the share of schools is decreasing, and the share of internet-based education environments is increasing. Now it has become almost impossible to raise a single type of person in a school with a fixed education program. The meeting of people with the media and social media has led to quite different social and cultural changes. In the past, while the society in which people live was the most effective factor in education and personal development, today different communities are formed in virtual environments and people adopt different development and interests. As the impact of technology on society increases, vastly different communities are formed, and different digital languages and cultures emerge. Today's children no longer accept the classical teaching tools, they want to use the technological tools, and met when they were babies, in teaching environments.

With the Covid 19 pandemic, distance education platforms have been used almost all over the world necessarily. Although there were distance education applications before the pandemic, distance education could not become as important as it is today, as it did not confront humanity as a necessity. The fact that education is carried out entirely on distance education platforms for more than one year has led to the question of how distance education can be used effectively. For many educators who have not actively taken distance education in the past, the first goal has been to provide only distance connection and to convey theoretical information with the straight lecture method. This situation has brought about the question of the quality of distance education. How should distance education be used in which types of courses? Despite the transition to face-to-face education in the post-pandemic period, it has been discussed how an effective education can be given in distance education.

Developments in technology and digitalization increase the importance of distance education day by day. Studies on the effective use of distance education continue after the pandemic. In particular, the following four factors seem to be effective in increasing the importance of distance education in the future.

1- Epidemics, natural disasters, and wars

2- Rapid developments in educational technologies

3- Losing the effectiveness of school education stuck between walls

4- Social change and the search for individual education programs

With the pandemic, distance education was widely used as a formal education tool, perhaps for the first time. From this point of view, distance education applications in the Covid-19 period can be accepted as the first experience of humanity as an official education system. In this sudden situation, most educational institutions focused on providing education online rather than the quality of education. When the studies on the effectiveness of distance education during the pandemic period are reviewed, it is seen that most of the studies are shaped within the framework of this focus. The research findings show that it is questioned whether there is the infrastructure necessary to fulfill a compulsory task such as the problem of accessing the internet and whether the students have a computer, tablet, or phone. Although the Covid-19 pandemic period was initially viewed as a temporary situation, it has been understood that such situations are likely to occur in the future. This situation showed that serious preparation should be made for the effective use of distance education applications carried out during the Covid-19 period with a sudden reflex.

After the Second World War, as the system established in the world began to shake, the expectation that the number of wars would increase, and even major wars would emerge. The necessity of investing in distance education has increased so that education is not interrupted during wars. Especially with the widespread use of applications such as Starlink providing internet access via satellite, it has been shown that individuals can access the internet under all conditions. The fact that energy production with renewable energy sources has started to be made by individuals, and people's investments in renewable energy production in their homes and gardens show that local- based electricity production can be realized in the near future, independent of the main grid. These two developments show that it will be possible to access the internet and electricity under all kindsof conditions in the near future. If this happens, distance education systems can be used more effectively in order to continue education without interruption in natural disasters and wars. In the past, schools were vacationed in extreme rain, fog, and similar situations, but after the pandemic, online education started to be used in such cases. The above developments in the current period show that the importance of distance education in formal education will increase in the future.

In the current era, developments in the field of technology have accelerated excessively. This has led to the development of educational technologies. A subject that was tried to be explained by drawing on the chalkboard for hours in the past can be shown as a simulation, augmented reality, or video in a noticeably brief time today. While calling a field expert to classes used to be very costly, today an expert on a subject can connect to the lesson environment from his/her environment and talk about that subject live and answer questions. With virtual tours, environments such as museums, facilities, parks, cities, and the like can be visited. With the hologram, the image of a living thing or object can be reflected in the educational environment in three dimensions. Any technology from ten years ago is obsolete and is being replaced by recent technologies. This rapid change in the field of technology now leads to the questioning of the sustainability of classical education.

The rapid change in technology and information shows that it will no longer be possible to give a common education to society. Children who are intertwined with technology become literate without going to school and can learn a different language without the

need for school and have information about different subjects. The classical understanding of collective education is now seen as just a waste of time. This shows that a radical change in the understanding of education is remarkably close. It is clear that distance education cannot be ignored in a new education system. The importance of distance education will increase, especially when it becomes compulsory to provide education according to the interests and needs of the individual.

Social media, digital games, augmented reality, and artificial intelligence applications lead individuals to create a virtual world of their own today. In the past, children who spent most of their days on the streets have been replaced by children who spent time in front of computers, tablets, and phones. This situation causes the structure of education to be questioned in the current period and in the future. Educational institutions today lag behind this individual and social change caused by technology. When an education system is designed according to the interests and needs of the individual, it is almost impossible to realize this within four walls with the classical education approach. However, the current time period necessitates the transformation of education systems according to the interests and needs of individuals. In addition to artificial intelligence, distance education will have an important share in this transformation that will occur in education. One of the biggest benefits of distance education is undoubtedly that it provides effective individual learning environments (Cerezo, et al., 2010). Individuals with similar interests and needs can now be brought together in a virtual classroom, even if the distance between them is large, and special education programs can be designed for them.

Due to the above reasons, it is inevitable that the number of applications and research for the realization of effective distance education-centered education practices will increase. It is expected that the studies carried out today, mostly for due diligence, will be replaced by effective distance education practices in the future. Distance education applications will inevitably differ according to the quality of the courses. Today, while there is a consensus that knowledge-based subjects can be delivered by distance education, it is seen that distance education is considered cold in applied subjects. Pre-service science teachers stated that distance education is more suitable for verbal lessons (Uzoğlu, 2017). In their study, Pınar and Dönel-Akgül (2020) examined the opinions of secondary school students about the science course they took with distance education. The students stated that the use of distance education in the science lesson was disadvantageous because the activity and experiment dimensions of the research science lesson could not be done. In particular, the lack of the application dimension of science lessons in current distance education applications is a disadvantage in terms of science education. Ünal and Finduz (2020) revealed that science teachers are against the continuous teaching of science lessons with distance education, and that science teachers think that distance education can be effective if it is used as complementary education.

Considering the historical development of science, experiment and observation have a key place. Due to this feature coming from historical development, science lessons have become a course that requires to be included in learning in laboratory and out-of-school learning environments as well as theoretical subjects. With the influence of the positivist understanding of science that was dominant at the beginning of the last century, laboratories were created in schools for science lessons, and observations were made within the scope of the lessons. This aspect of science courses is missing in online distance education applications. Students who are active during experiments and observation become passive during online education. In order to eliminate this de-

ficiency, it can be considered tocarry out experiments with two- or three-dimensional simulations. It may be possible for simpleactivities to be done by the learners during the online course. Although it is possible for students inyounger age groups to do simple activities at home, it is not possible to do many experimentsindividually at home, especially at the high school level. This situation strengthens the idea of including all experiments at high school and above level in the online learning environment bymaking simulations. Fabric and Kan (2022) stated that the effectiveness of the physics course indistance education can be increased with simulations. However, it is not correct to limit digitalapplications that can be used in distance education to simulations only. Educational technologies areconstantly evolving and changing. Some applications disappear in a fleeting time, while otherscontinue to be used by updating or revising over time. The number of new applications is increasingday by day. In this book chapter, it is aimed to compile digital applications that are actively usedtoday and can be used in science lessons in distance education.

Digital Applications That Can Be Used in Distance Science Education

There are many web and software-based applications that can be used in science lessons in the distance education process. These applications and programs can be grouped under certain headings according to their functions. These headings and common practices under these headings are introduced below.

A. Video Recording and Conferencing Tools

Today, the main tool of distance education has been video recording and conference tools. Especially during the Covid-19 pandemic, the use of these tools for educational purposes has gained immense importance. Below, some educational video recording and conferencing platforms that are widely used in distance education all over the world are introduced.

Zoom

It is a video-conferencing application that is realized with an end-to-end encryption method and is accepted among the most used applications worldwide. This application, which is especially effective in the distance education process, comes to the forefront in terms of education because it can easily create meetings, lectures, seminars, and similar activities with its opportunities and strong infrastructure. It comes to the forefront in terms of education due to the fact that activities can be easily created. In the update, the whiteboard mode, and many ready-made templates such as mind map, chronological order, and tables were added to the features of ZOOM. With ZOOM, instant meetings can be held, meetings can be scheduled in advance on certain dates, and meetings can be recorded and stored. Long-term use of ZOOM is paid, but meetings under 40 minutes are free. Meetings of up to a hundred people can be held easily with ZOOM. Depending on the license, the number of participants can go up to a thousand people in large meetings. It is estimated that this number will increase even more in the future. Thanks to the file-sharing feature it offers in meetings, it makes it easier to use for educational purposes. Figure 1 shows the screenshot of ZOOM's features.

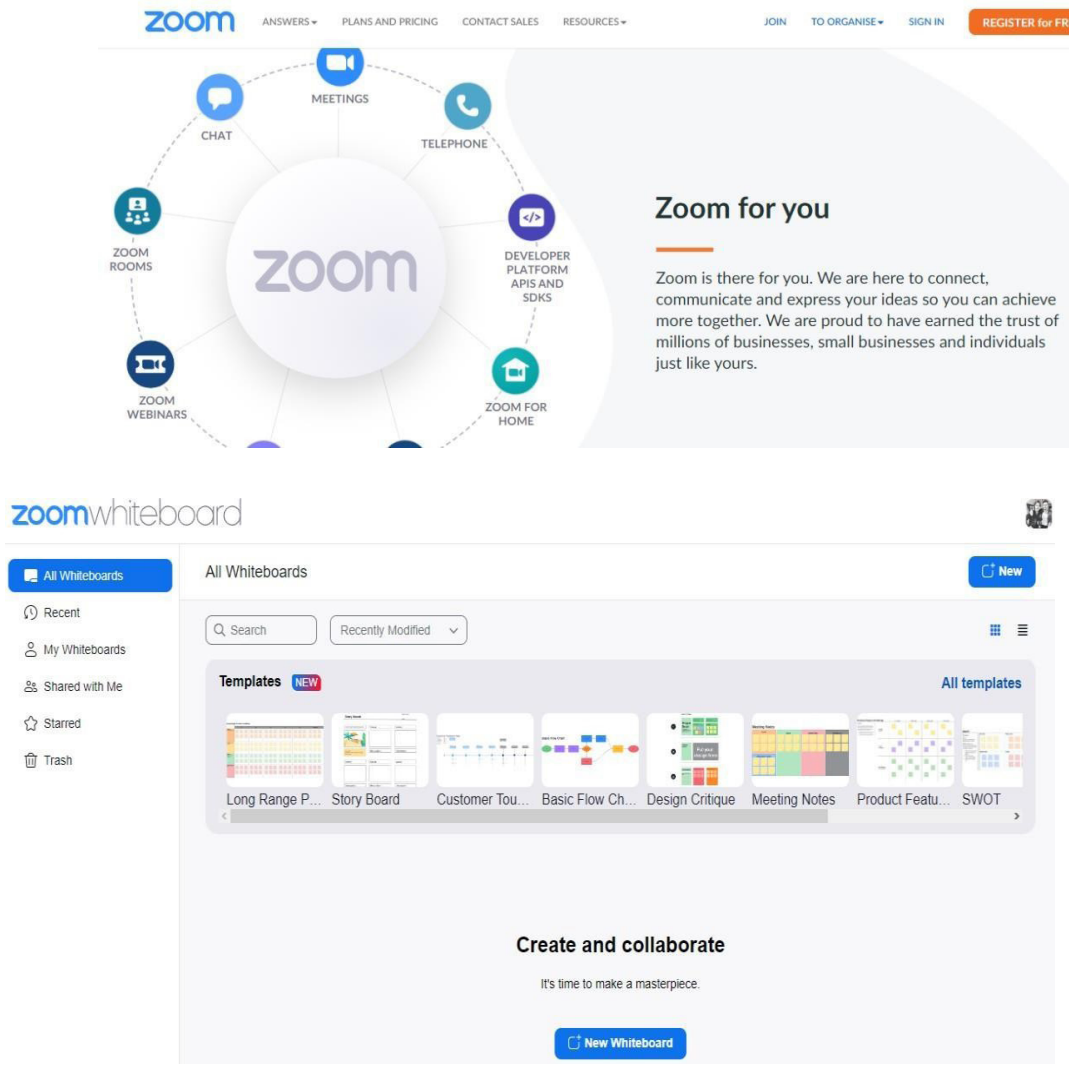


Figure 1. ZOOM screenshot

Google Meet

It is a video-conferencing application that is connected to the Google calendar application and easily logged in with an e-mail account. Google Meet is a completely free and easily accessible application integrated into Google products. You can create future meetings via Google calendar and receive notifications from the app a few days in advance. It is possible to join the meetings easily with the code created by the administrator or the link sent. Meetings created with the Google Meet application can be entered with an email address. With the Google meet application, the background can be edited before the meeting. With Google Meet, it is possible to hold meetings with up to five hundred people today. It is estimated that this number will be much higher in the future. Google Meet can automatically adjust the image resolution, detect the spoken sounds, and give them as English subtitles. With Google Meet, the entire screen or a specific window can be shared during the meeting. During this sharing, information such as documents, presentations, and spreadsheets can be shown. This feature of Google Meet is one of the most crucial factors in its use for educational purposes. Google Meet screenshot is shown in Figure 2.

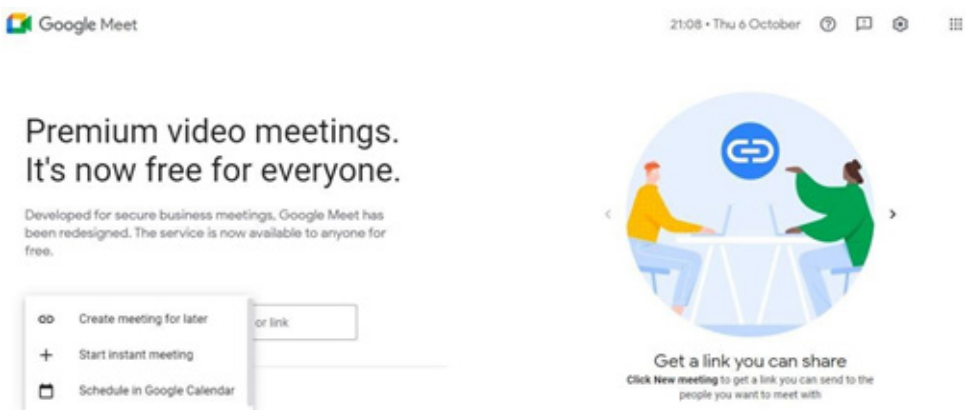


Figure 2. Google Meet screenshot

Loom

Loom is a video recording and sharing application that can be used as a desktop shortcut application or a browser add-on. With Loom, video narrations can be made, and these videos can be shared from social media accounts with a link. With Loom, some places in the presentation or video can be drawn for an abbreviated time to make instant focus during the video preparation process. Images and sounds can be captured with the artificial intelligence feature of Loom. A password can be added to the product to be watched with Loom. With a Google account, you can register for free and benefit from many free features. Loom's instant file and video sharing feature allow it to be used for educational purposes. In Figure 3, there is a screenshot from the Loom main page.

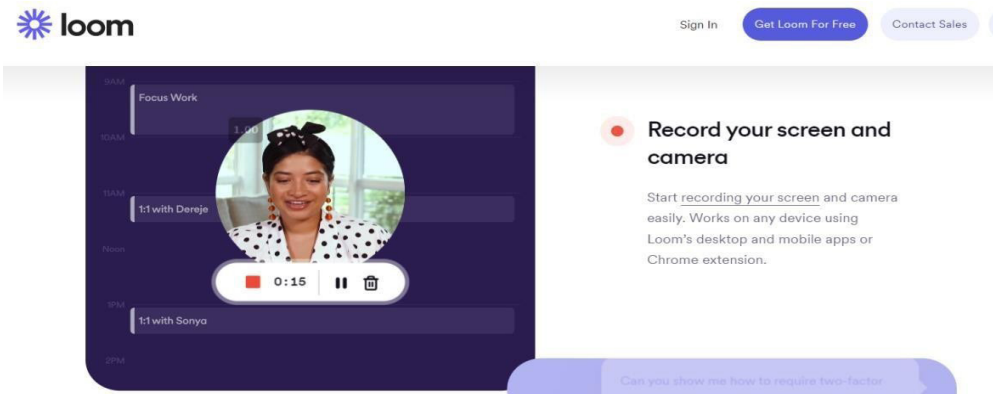


Figure 3. Loom screenshot

Teamlink

Teamlink stands out with its solid infrastructure and free and unlimited usage features. It is not yet known whether it will turn into a paid application in the future. In addition, Teamlink has increased its awareness with its free and unlimited use feature during the Covid-19 pandemic period. Teamlink can be downloaded free of charge to computers as a web application and can be installed on the phone from mobile applications. This application, which has a simple interface, serves up to three hundred participants free of charge without a time limit. Thanks to the file-sharing feature it offers in meetings, it makes it easier to use for educational purposes. In Figure 4, there is a screenshot from the Teamlink main page.

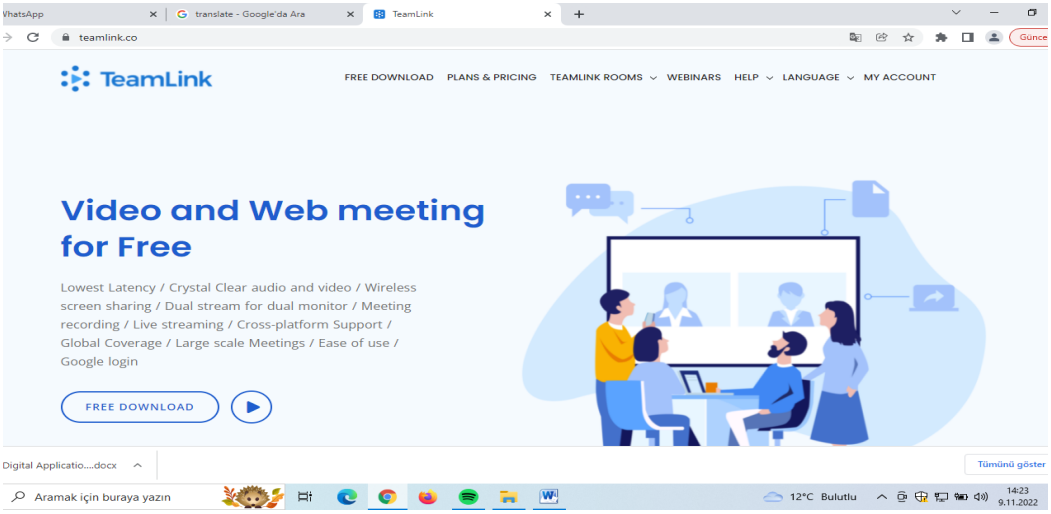


Figure 4. Teamlink screenshot

Adobe Connect

Adobe Connect is a platform developed for the virtual meetings and distance learning. It is among the most used virtual classroom applications in the world, as it offers access from mobile devices. Adobe Connect includes all the essential components required for virtual meeting and distance learning. Adobe Connect meetings and virtual classrooms can be easily accessed and monitored from different mobile devices. One of the key features of this application allows the user to customize the dynamics on the screen by creating functional screen panes. It can record meetings and pieces of training held in Adobe Connect. Other people can be invited to the meeting or distance learning with the link created for meetings in Adobe Connect. He/she can communicate with the participants in audio, writing, and video. Adobe Connect has become one of the platforms that can be used effectively in distance education thanks to its file and screen-sharing feature (Figure 5).

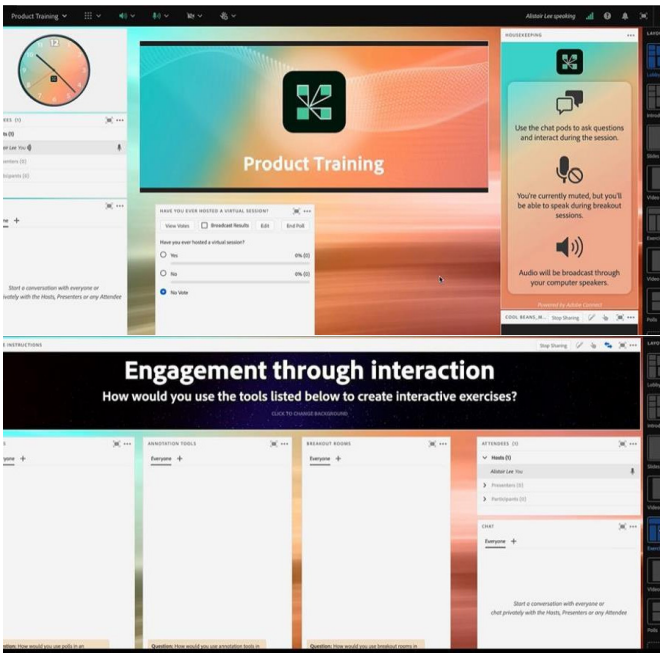


Figure 5. Adobe Connect screenshot

Webex

Webex is a video conferencing platform that can be accessed from both the desktop application and the web, with features such as calling, messaging, and team building from the contact list. Webex's free application can hold meetings with up to one hundred people. In its paid application, this number is currently two hundred people. This number is expected to increase in the future. Webex allows you to easily share desktop screenshots, presentations, applications, or files within the meeting. In this way, you can have a productive conversation and can be used as a distance education tool.In Figure 6, there is a screenshot from the Webex.

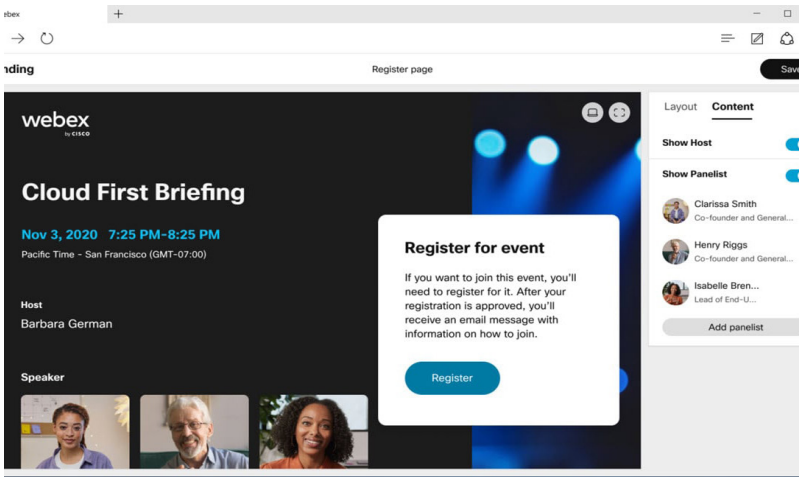


Figure 6. Webex screenshot

B. Video Tools with Educational Content

The importance of online educational content tools is increasing day by day. Although the number of these tools is exceptionally large, content tools that are only used for educational purposes, that can be used in distance science education, and that are globally known, are introduced.

Massive Open Online Courses (MOOCs)

MOOCs is a digital educational platform with global and free online courses that support learning in different fields. It was created by the British Council so that people from all over the world can shoot and share course videos and watch the shared videos for free. There are MOOCs courses for almost every field on the platform. Students can attend classes at any time and listen to the course they want. Information about the course content is on the course page. If students want to get a course certificate at the end of the courses they have watched, they can also get a certificate by paying a certain fee. To become certified, they must attend more than half of the courses and take exams. Those who do not require a certificate can watch the course they want for free, whenever they want. The lessons on the MOOCs platform can also be used effectively by teachers. MOOCs videos can be used as an extracurricular learning environment in flipped classrooms and distance education applications. It can be used during the lessons by taking sections from the videos here. MOOCs' huge pool of videos includes a large amount of content that will meet the needs of teachers working in the fields of science, especially physics and chemistry. In Figure 7, there is a screenshot showing some MOOCs topics.

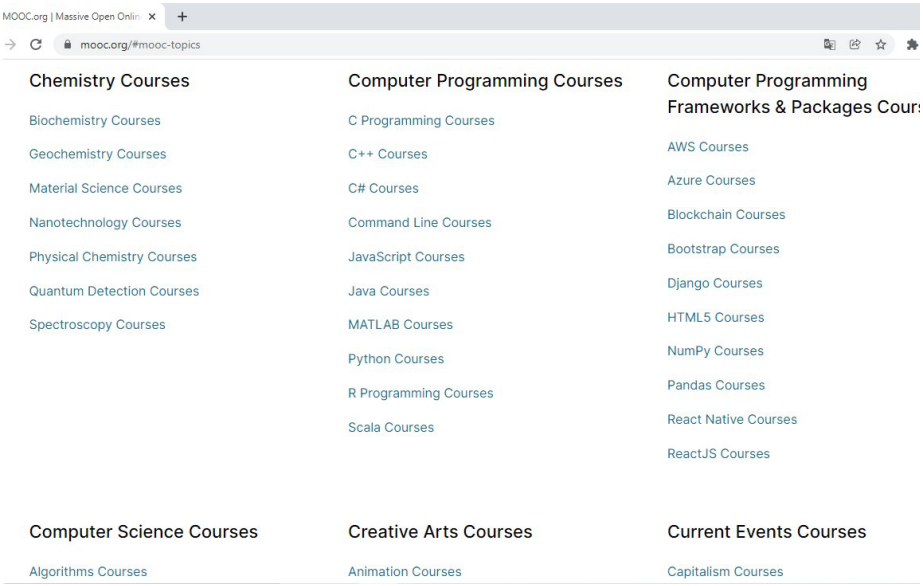


Figure 7. Screenshot showing some MOOCs topics

TED (Technology, Entertainment, Design)

TED was created to organize a conference by inviting people with advanced knowledge in different fields. It was started with people in the field of technology and design at the initial stage, and in the course of time, its scope has expanded with the invitation of many scientists, writers and people who have knowledge in certain fields. TED is a non-profit organization that allows the best of the field, experts in their field to speak. The speeches at the conference are shared with the entire world as open access. Today, conversations are shared with subtitles in different languages. With this application, which allows non-English speakers to follow their speech in their own language, the popularity of TED videos is increasing day by day. By choosing appropriate content from TED videos, it can be used by science teachers in both distance education and face-to-face education processes. Figure 8 includes a screenshot from the TEDx Istanbul conference.

Figure 8. A screenshot from the TEDx Istanbul conference

E-Twinning Online

E-twinning online is an online course application that stands out with the course content prepared by experts in the field and aims for personal and professional development. Teachers, students, and individuals of all ages can register via the web with an e-mail account. This program, which is especially appealing to teachers, includes courses in numerous fields from virtual reality to web technologies, from innovative approaches to coding applications. In the area where the course lists are located, there is preliminary information about the definition and content of the courses. The stages of the course and the text, links, or videos in its content are also among the information given. Courses are currently available free of charge only by signing up. Especially the content in the field of STEM education is quite suitable for use in online science education. The courses here can be used in distance science education courses, or the courses here can be recommended for additional extracurricular learning. Figure 9 shows the screenshot of the E-Twinning website.

Figure 9. A screenshot from e-Twinning website

Khan Academy

Khan Academy is an online education platform established to provide free education to anyone who wants to learn. This completely free application is a web application that supports the educational process with more than ten thousand course content videos and offers the opportunity to those who want to learn new things. It can be accessed by searching the name of the application on Google, and the appropriate content can be accessed from the "courses" section. Lecture videos in many fields such as Physics, Chemistry, Biology, Astronomy, Earth sciences and many other fields in its content provide students with very useful additional resources in the field of science education. Online courses at Khan Academy can be used in distance science education courses, or as an additional resource after the course, related videos can be selected from the rich video content of Khan Academy and recommended. Below is a screenshot from the Khan Academy homepage in Figure 10.

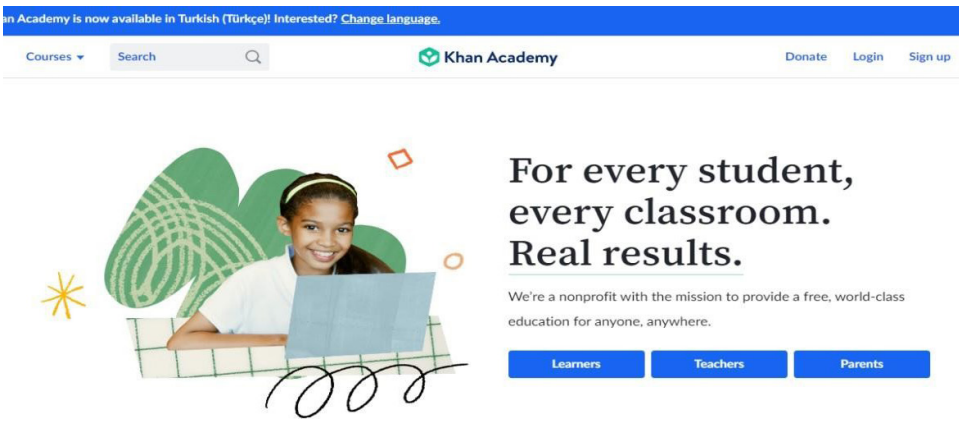


Figure 10. A screenshot from Khan Academy homepage

Udemy

It is an international video content platform that has content that can appeal to people of all ages, and where experts in the field make videos and train. One of the most functional features of this application is that people who successfully complete the training are given certificates that are valid for most institutions and organizations. Although there are free courses on Udemy, most of the courses are offered for a fee. However, due to the fact that the cost of many pieces of training is quite cheap, it can be easily purchased and used by teachers. It is possible to access educational content in many areas on this platform, which offers most of its training free of charge during the Covid-19 pandemic process. Especially the pieces of training in the "science" category contain content that can be used during and after distance science education lessons. In Figure 11 below, there is a screenshot about science from Udemy homepage.

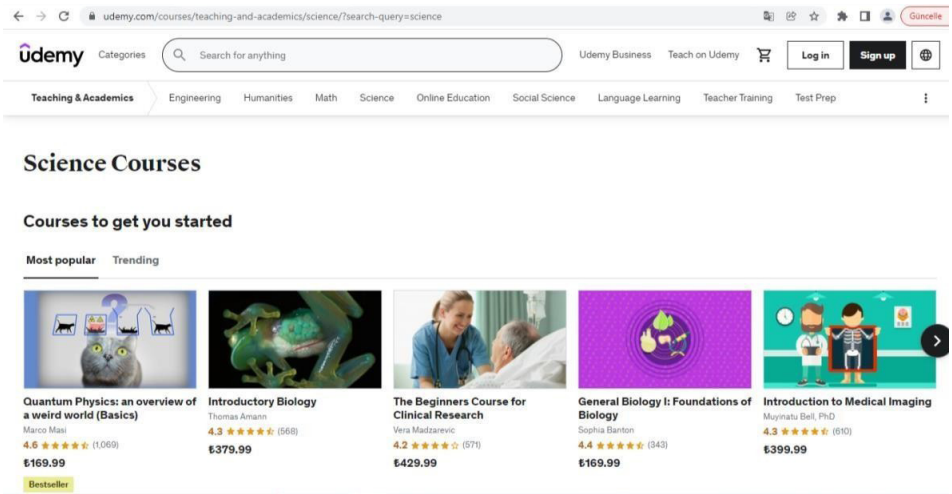


Figure 11. A screenshot about science from Udemy homepage

C. Modeling and Design Tools

Under this section, some of the tools that are used for design and modeling, which are globally known, and which can be used in distance science education applications are introduced.

3D Virtual Science Labs

It is a three-dimensional application that helps to design some laboratory experiments in the desired size, depth, and shape. The number and content of websites designed in this area are increasing day by day. With these applications, experiments can be designed one-to-one in a virtual environment. These applications can be seen as an application that can help to close the lack of activity and experimentation in science lessons, especially when distance education is compulsory. At the same time, risky or costly experiments to be carried out in the laboratory can be designed in three dimensions in a virtual environment with this application. 3D Virtual Science Labs can be considered as a successful VR-based virtual classroom application where students and teachers can experiment without risk (Dere & Sahasrabudhe, 2010; Bridge, Gun, Kastanis, Pack, Rowntree, Starkey, & Wilson-Stewart, 2014). Figure 12 below shows a screenshot from a 3D virtual laboratory.

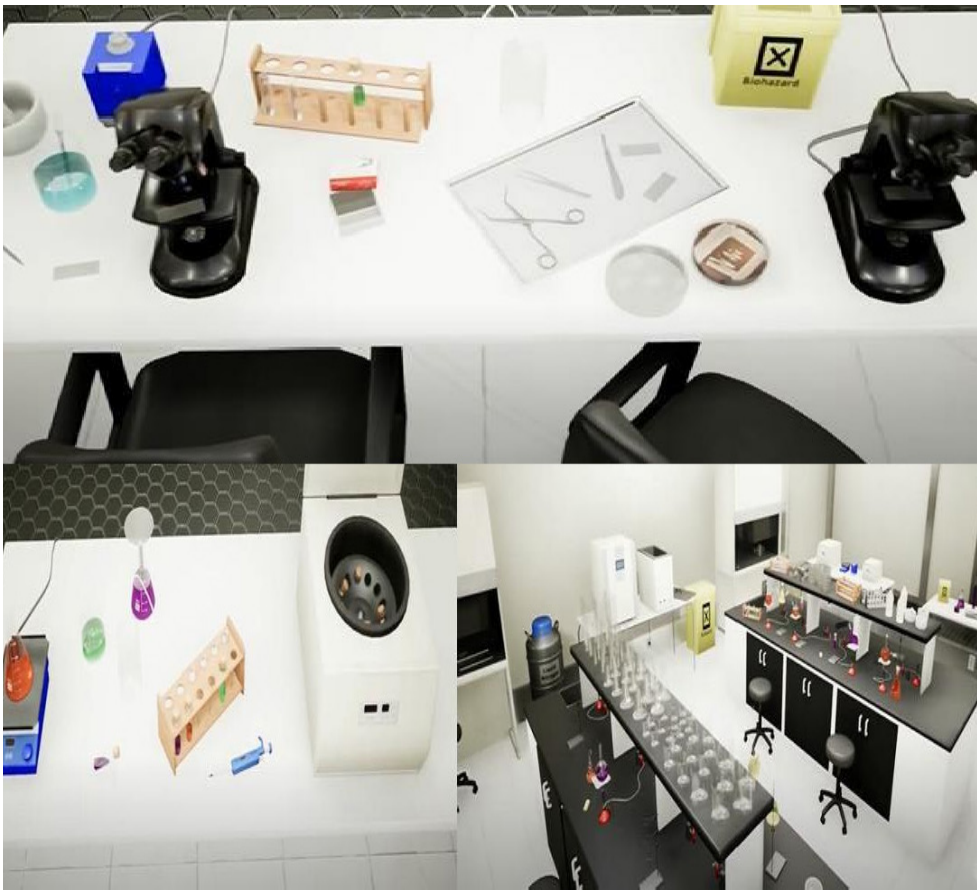


Figure 12. A screenshot from a 3D virtual laboratory

3D virtual lab applications allow not only teachers but also students to perform experiments in a virtual environment. These applications provide their users with a virtual laboratory environment close to reality. In the application, there are many experiments separated according to sub-fields of science such as physics, chemistry, and biology. Thanks to the assistant robot offered to the service of the users, the users can get support in the parts they have difficulty in the experiment process. Screenshots of sites belonging to some of these applications are given below (Figure 13).

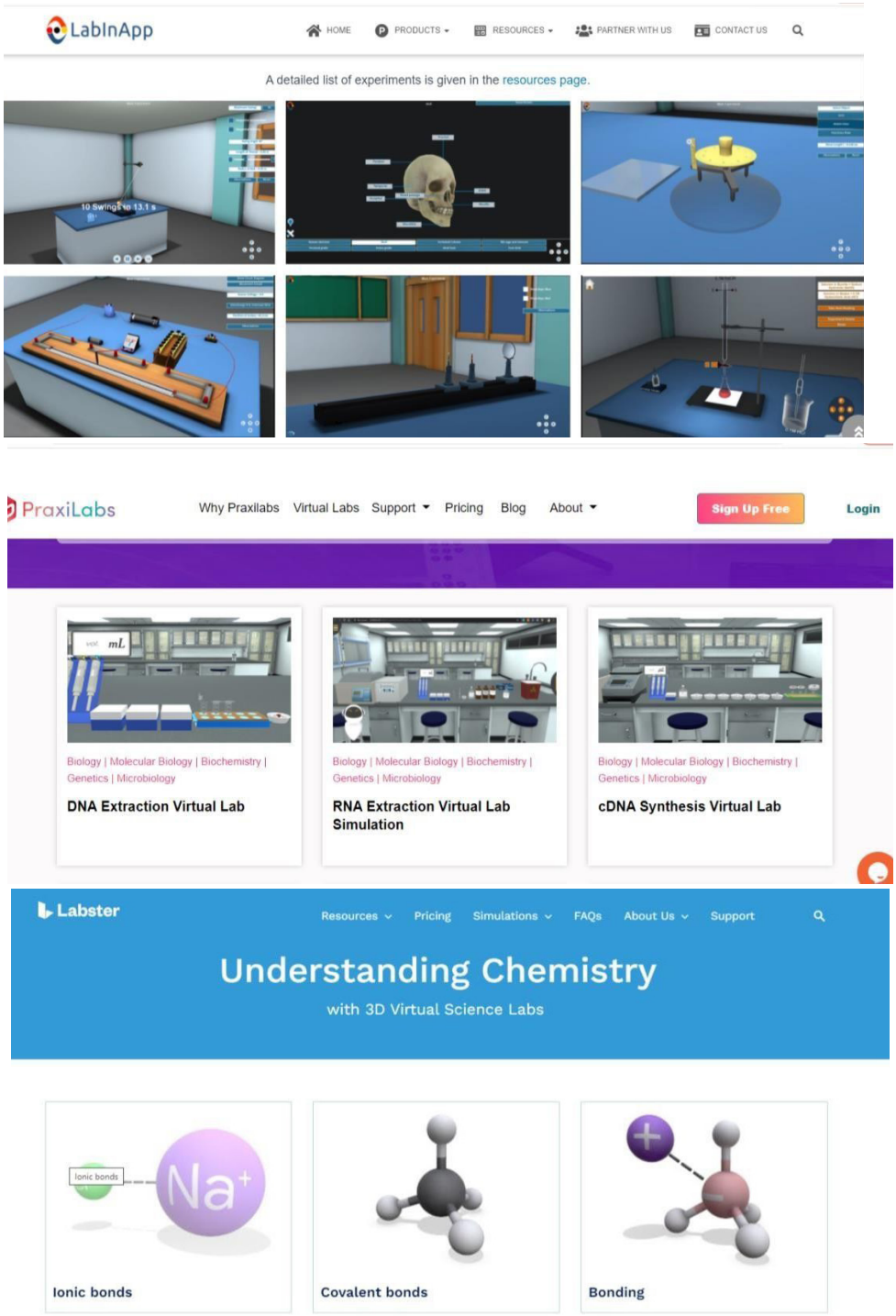
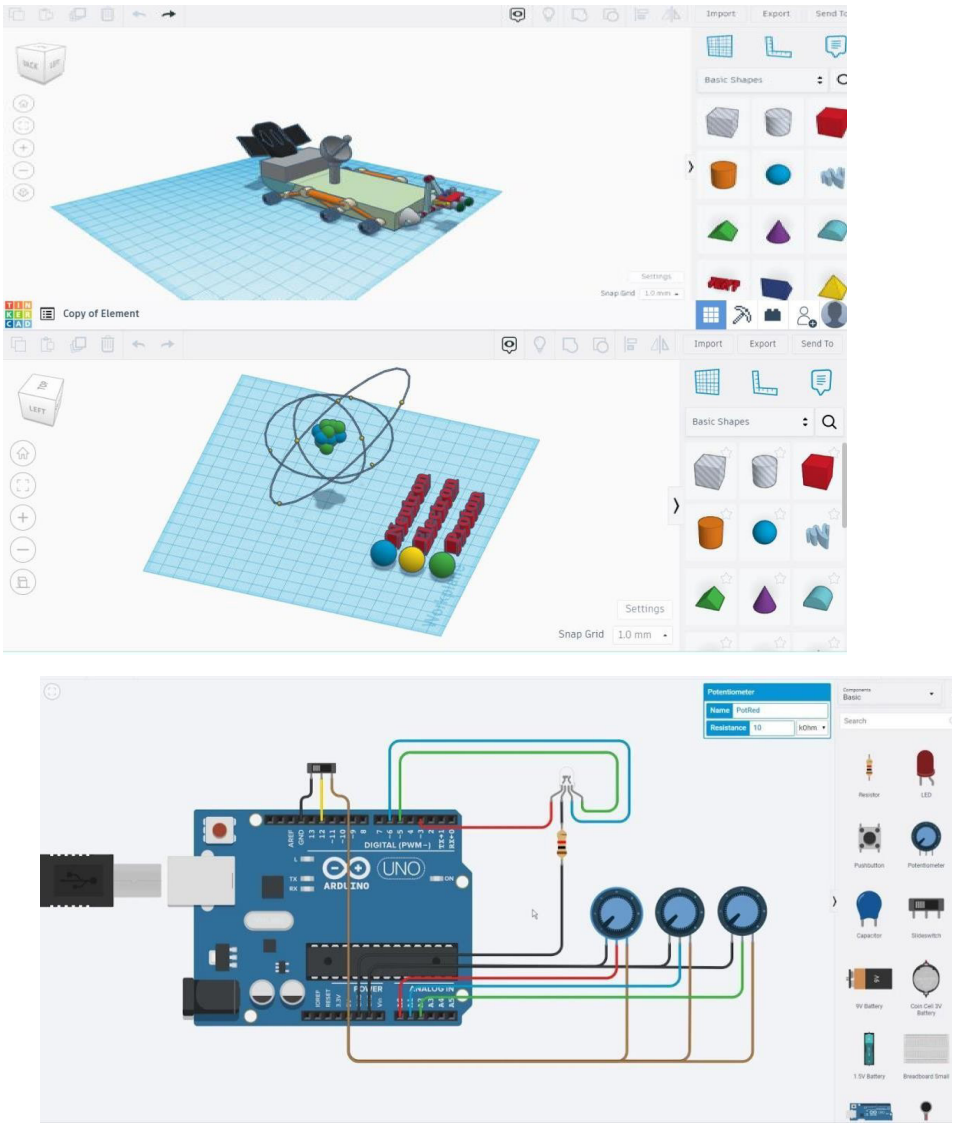


Figure 13. Screenshots of three separate 3D virtual laboratory applications.

Autodesk Tinkercad

Autodesk Tinkercad is a digital design application that can be used by teachers and students to design three-dimensional materials, especially for science lessons (Doğan and Uluay, 2020). This application makes the designed models and products three-dimensional and enables them to be presented online. At the same time, it is possible to use it very effectively in the distance education process, since it offers teachers and students the opportunity to make designs in a virtual environment (Amalia et al., 2020; Derlina et al., 2020). Access to this application is completely free. To use the applica-

tion, it is sufficient to register in the system with a Google account. Autodesk Tinkercad content includes free tutorials showing how to use the application. In the application, circuit designs that work together with coding tools using microcontroller cards can also be made. Considering that the importance of coding in education is increasing day by day, it can be said that the importance of Autodesk Tinkercad is increasing day by day. Below are screenshots of some of the learning products and designs prepared with Tinkercad (Figure 14).



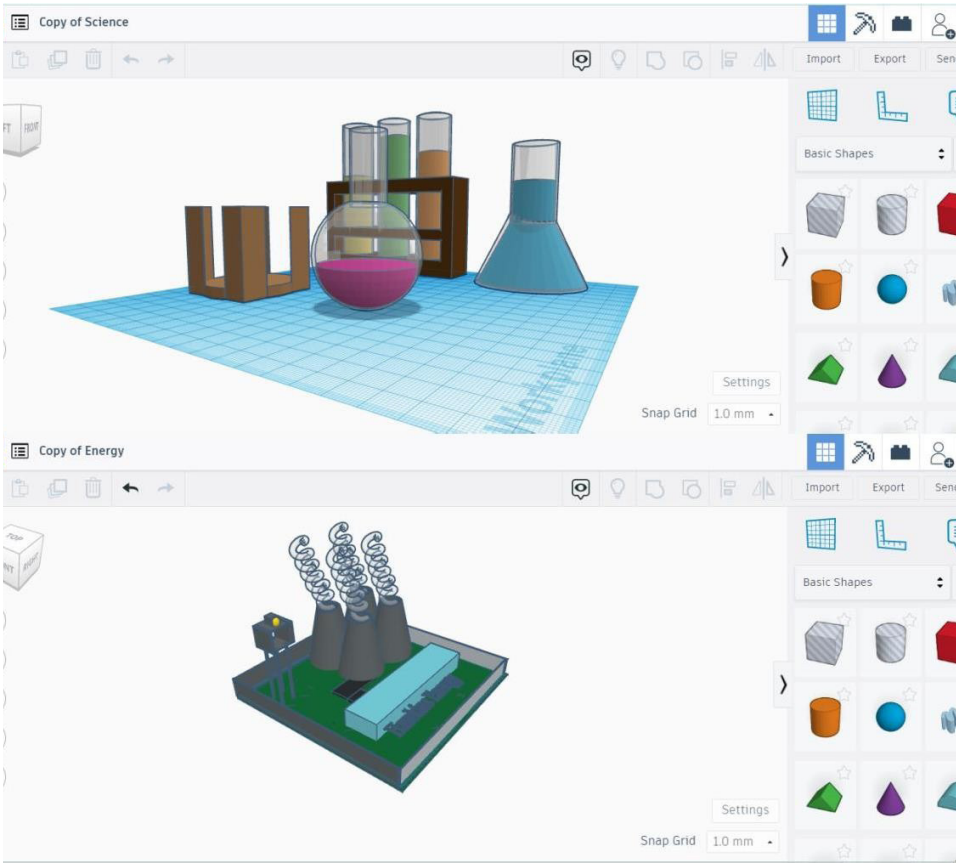


Figure 14. Screenshots of some products and designs prepared with Tinkercad

Fusion 360

Fusion 360 is a modeling and design application with a simple interface that allows creating of a three-dimensional model and making adjustments to the model (Dağlı, 2022). Just like Tinkercad, the Fusion 360 application can also be used to design materials and models for science lessons. Especially in distance science education applications, students can be given performance assignments and projects to be designed in three-dimensional design programs. Below are the cell designs designed with Fusion 360 by Dağlı (2022) in distance science education lessons (Figure 15).

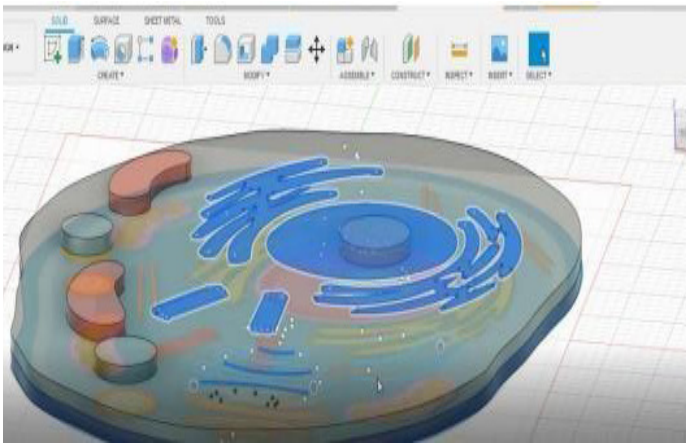


Figure 15. Screenshot of a cell model prepared with Fusion 360 (Dağlı, 2022)

D. Virtual/Augmented Reality Based Mobile Training Applications

Under this title, virtual/augmented reality-based mobile education applications have been introduced. VR and AR-based mobile applications are concentrated in the fields that will be included in the scope of science education today. These applications can be used in distance science education lessons in teaching subjects related to physics and earth sciences, especially astronomy, biology, and chemistry. Although there are many applications in the field of astronomy today, it is expected that the number of these applications will increase in all fields of science in the near future. In addition to the applications performed with virtual glasses, the number of smartphone applications is increasing day by day. Especially with the increasing popularity of smartphones, AR and VR-based applications integrated into them have become widespread (Huang et al., 2019). The easy accessibility and usability of smartphone applications contribute to the widespread use of these applications.

4D+ Flashcard apps

Augmented reality-based Flashcard applications can be used effectively in teaching science, especially to kindergarten and primary school children. There is a wide variety of applications such as Animal 4D+, Space 4D+, Dinosaur 4D+, Humanoid 4D+, History of Aircraft 4D+, and Ocean 4D+. 4D+ applications are mobile applications in which the scanned creature or object is animated by scanning the printed cards. It also has a voiceover feature. In both distance and face-to-face science education lessons, these applications can be used to increase students' interest in science and to ensure active participation in the lesson. Below are some application screenshots (Figure 16).

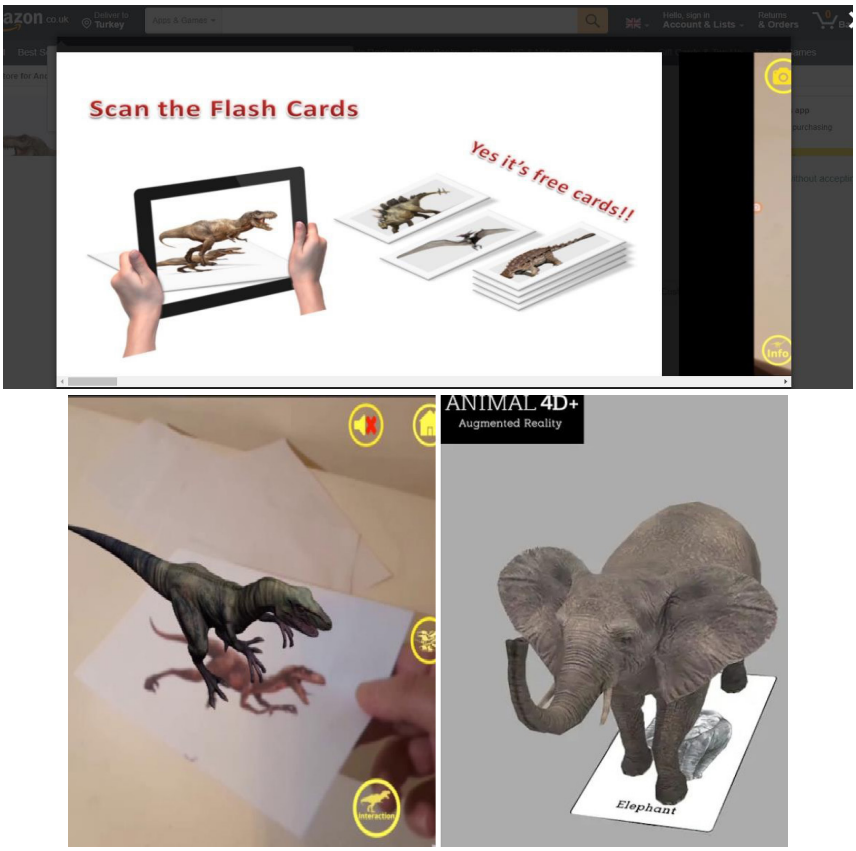


Figure 16. Screenshots from some apps made with the 4D+ Flashcard app

Mobile Apps for Astronomy

There are many mobile applications based on virtual reality and augmented reality related to astronomy. The names of some of these applications, the number and use of which are increasing day by day, are given below:
AR Solar System, Stellarium, GoSkyWatch Planetarium, Sky Guide, Star Walk, SkySafari, Universe2go, Celestron SkyPortal, Scope Nights, Night Sky, Sky Tonight, Cosmic Watch, Skyview lite, Solar System Scope, Celestia, Sky Map

With the majority of these applications, celestial objects that can be seen in the sky at a certain location and time can be easily seen by turning the smartphone towards the sky, you can make trips to the planets in the Solar system by clicking or touching them, and information about their structures, satellites, and sizes can be obtained. With some of these applications, long journeys can be made within the Milky Way Galaxy. With some, galaxies and the universe can be explored. Especially in city centers where the sky can no longer be observed easily due to city lights, it helps learners in astronomy-related subjects by showing the constellations and planets in the sky at that time and place to the users. Applications that offer to move and fun three-dimensional drawings can be effective in attracting students' attention in science lessons. In distance science education lessons, students can observe the position of the sky by downloading the application to their phones. After the lesson, they can try several features to reinforce what has been learned and apply it to different situations. In Figure 17, there are screenshots obtained with one of the mobile applications related to astronomy.

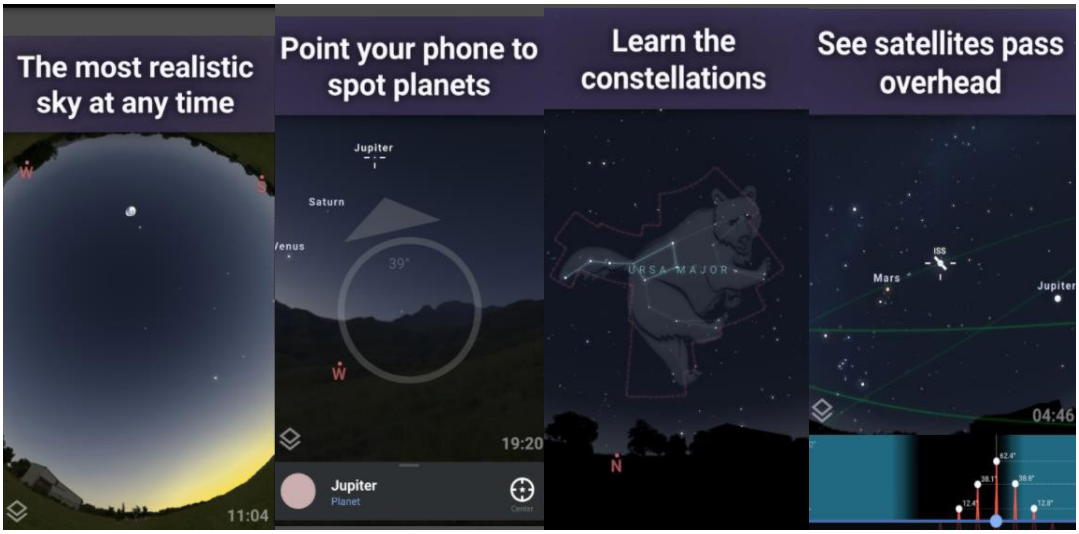


Figure 17. Screenshots from one of the astronomy-related mobile apps

Mobile Apps for Biology

One of the areas where VR and AR-based mobile applications can be used most is biology. For this reason, many applications are being developed to learn biology subjects. With these applications, human and animal bodies can be taught by discovering them. With the animation of plants that do not grow in the places where they live, students can be taught by showing them in three dimensions. Especially in the distance education process, these applications can be used to ensure that students actively participate in the lessons and learn by doing. Below are the names of some of these applications,

the number of which is expected to increase rapidly in the near future. Names of some biology-related applications:
Quiver, Human Anatomy Atlas, VR Biomolecules, Biology VR Apps, Class VR, Brainapse, Froggipedia, AR Eye, Arloon Plants, Holo-Human, VR Frog Dissection, 4D interactive anatomy, Visible Body, 3DBear, The body VR, In Figure 18, there are screenshots obtained with one of the mobile applications related to biology.

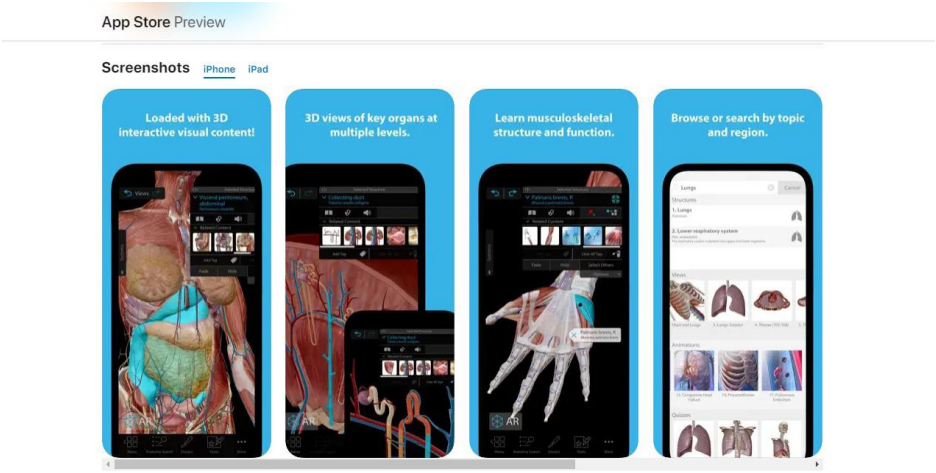


Figure 18. Screenshots from one of the biology-related mobile apps

Mobile Apps for Chemistry

Some chemistry subjects within the scope of science education are more abstract than other fields of science. Students especially have difficulty in imagining and visualizing these abstract subjects in their minds, and they can make false animations. AR and VR-based mobile applications can be especially useful, especially in teaching these abstract chemistry topics. Instead of showing students two- dimensional photographs, it may be more effective to show these topics from three-dimensional animated applications. The names of some of the applications related to chemistry are given below:
Elements 4D, Chemistry VR, Molecules AR/VR, In Figure 19, there are screenshots obtained with one of the mobile applications related to chemistry.

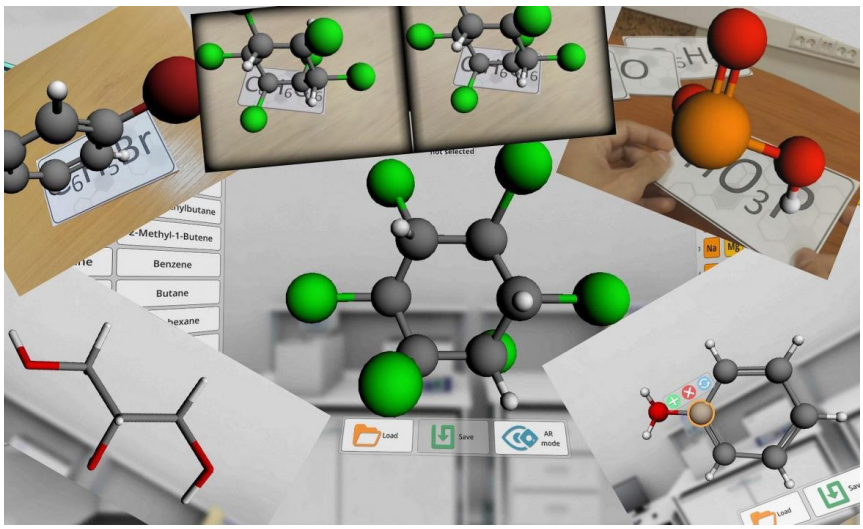


Figure 19. Screenshots from one of the chemistry-related mobile apps

Mobile Apps for Physics

In science education, AR and VR applications can be beneficial, especially in abstract subjects. For example, an application related to teaching the subject of electricity can contribute to better learning of this abstract subject. Below are the names of some applications related to physics:
Physics VR Apps, Galileo AR Physics, Big Bang AR, Physics Lab AR,

In Figure 20, there are screenshots obtained with one of the mobile applications related to physics.

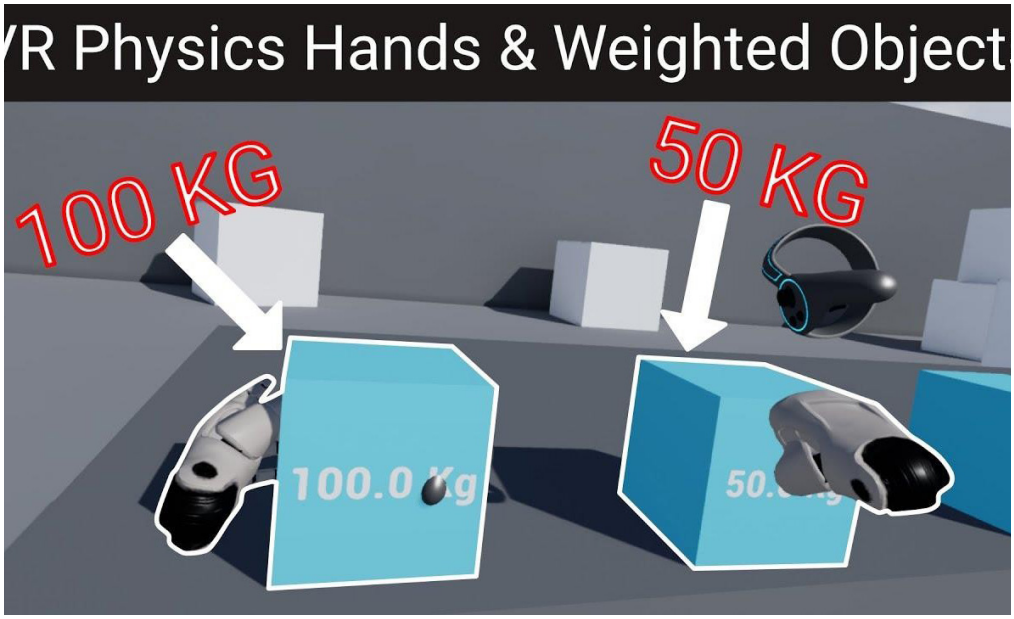


Figure 20. Screenshots from one of the physics-related mobile apps

E. Simulation Tools

Under this title, simulation tools that can be used in science education are introduced. Simulations are tools that can be used effectively in distance science education courses. Undoubtedly, one of the weaknesses of distance science education courses is the inability to conduct experiments and activities as in face-to-face education. This lack of distance science education courses can be covered with simulations. During and after the lesson, students can learn by exploring science concepts with simulations.

Nowadays, there are many simulation sites in different languages. However, two different simulation sites, which are accessible as open access and widely known around the world, are introduced here. Two- dimensional simulations here can be used effectively in all fields of science, especially physics.

Algodoo

Algodoo is a design application that will allow students to observe whether the drawn systems are working and to make projects (Özer and Canbazoğlu Bilici, 2021). Algodoo can be seen as a transferof science activities to the software world. This application is free to use on Google. It can be downloaded for free on computers and phones. Algodoo supports different languages. It has an easy-to-understand interface. Many features of the product that can be designed in Algodoo, such as size, mass, center of gravity, type, and density, can be adjusted. In fact, the environment suitable for the product can be selected or designed. For example, let us say a teacher wants to design an optics simulation for students. This teacher can add a black background to observe the state of light in Optics, select the material type glass, and design a mirror or lens. Using lasers, users can create any beam of any color they want. Below is a simulation screenshot of this application (Figure 21).

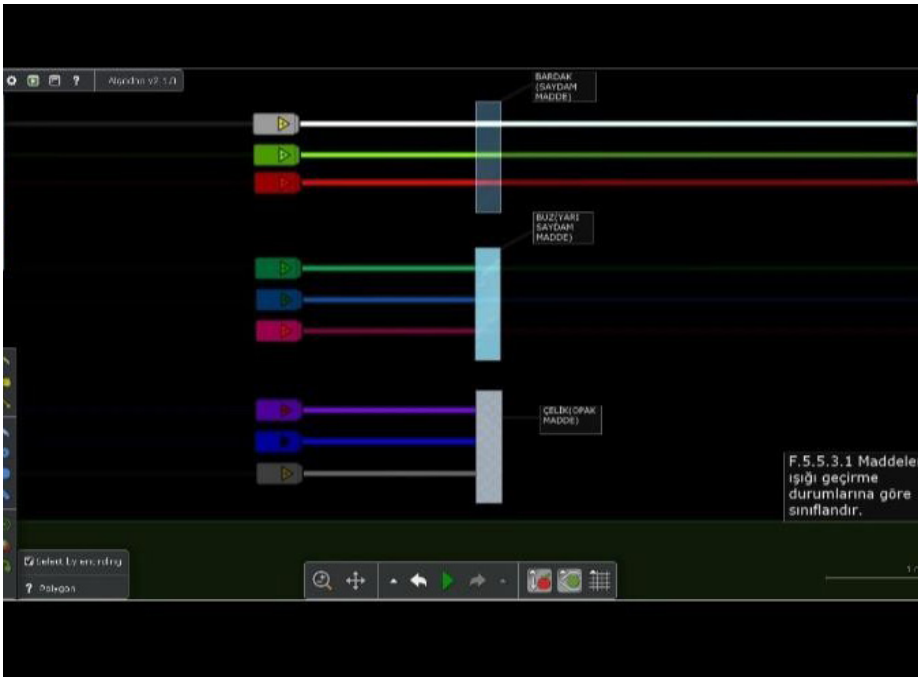


Figure 21. A screenshot from Algodoo apps

Many drawings and designs can be made in online science education lessons with Al-

godoo (Ünal, 2019). In distance science education lessons, Algoodo can be used to take the student out of the passive position and make them do activities related to the lesson. In the tools menu of Algodoo, there are many tools related to science such as engine, spring, inclined plane, wheel, laser and similar. There are many tools related to science. By using these tools, an effective and working simulation design can be realized in a short time. With Algodoo, many sensitive operations can be performed, from the colors and designs of the projects to the power and torque of the motors. The pre-preparation of teachers using Algodoo will make the lesson more effective (Ünlü, 2022). With Algodoo, it is possible to make thousands of more designs like the examples below.

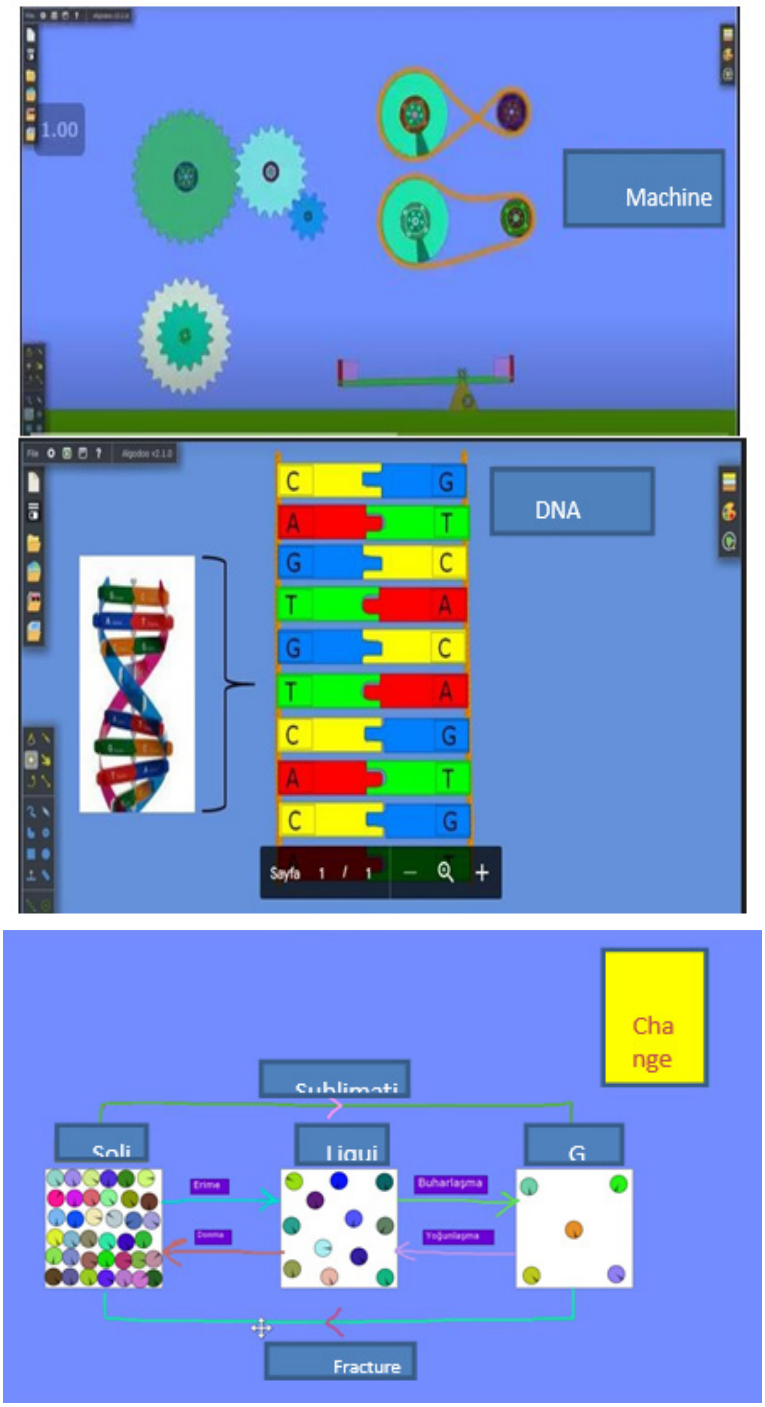


Figure 22. Different examples designed with Algodoo app

As seen in the pictures, applications can be designed, and simulations can be prepared for almost all subjects of science with the support of imagination with Algodoo.

Phet

It is a design application in which science simulations developed by the University of Colorado are offered as open access. This application, which is java-based as software, can be accessed via Google.The lack of experiments in distance science education courses can be covered by the simulations here. Since simulations allow students to learn by changing variables, simulations can be almost as effective as face-to-face experiments in the laboratory. Below are simulation screenshots from the PhET website (Figure 23).

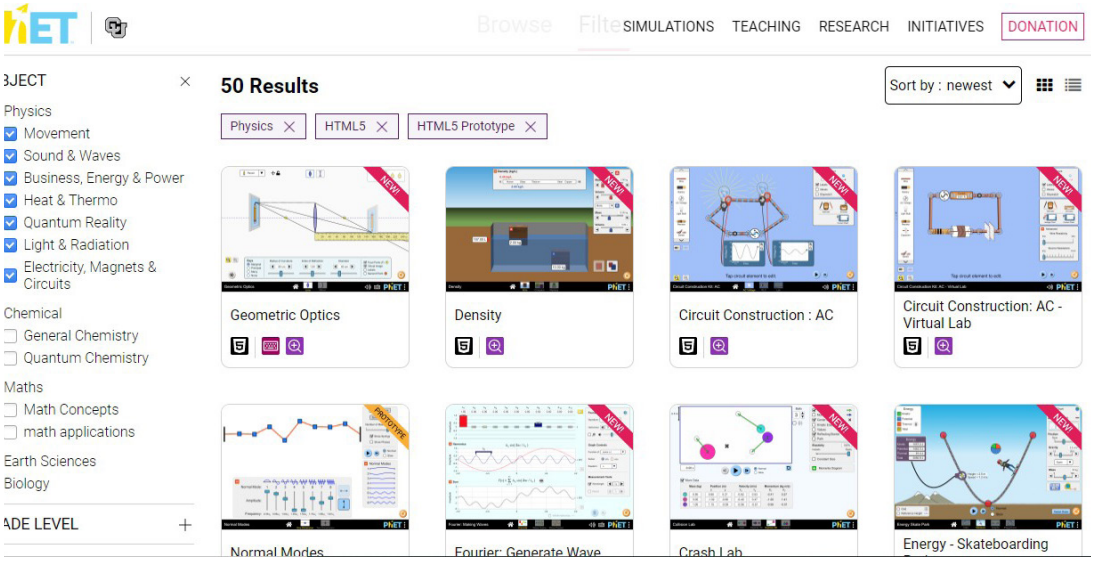


Figure 23. A screenshot from PhET simulations

The simulations here can be run directly over the internet as well as by downloading them tothe computer. Appropriate simulations can be selected according to the objectives of the course, and PhET simulations can help students discover science concepts by changing variables in distance science lessons.

F. Coding Tools

Coding continues to increase its impact in every field of education day by day. The most important of these areas is undoubtedly science education. In the past, science education projects, which were made with simple equipment designs, started to give way to coding-based projects. This situation has led to the transformation ofscience education into STEM education. Today's secondary school students have started to prefer coding-basedprojects in science projects. It is important for science educators to recognize and use coding tools in order to keep up with this rapidly developing trend.

Coding training can be carried out in two ways: block coding and text coding. The level of students between the ages of 7 and 15 is suitable for learning block coding. Block coding can be taught to students with different coding tools according to age level and this knowledge can be transferred to science lessons. Text-based codingcan be preferred to design much more original and high-level projects at high school and higher levels. Although some students can solve text coding at an early age, the idea of teaching al-

gorithms and coding with block coding is generally more accepted under the age of 15. The fact that block coding tools are easier to use than text coding tools allows them to be used in distance science education as well. Students who learn block coding can transfer this knowledge to science applications in their science-related projects and create very original projects. For this reason, this study is limited to the introduction of some globally known block coding tools. Text-based coding is not included in this section.

Code.org

Code.org is a platform designed for students to explore algorithms and coding. It allows the design of games and similar entertaining content with block codes over the web version. The application is easily accessible with a simple Google search and can be registered with a Google account. The application has ready-made training programs related to level coding. By passing through these levels, coding can be started. In the process, the practitioner can come to the level to create their own block code projects. With this application, teachers can follow the progress of their students in the field of coding. Teachers can observe students' designs and guide them and warn them of errors and omissions. Students can be attracted to software with Code.org (Karaduman, Akpınar, 2021; Çalışkan, 2020). The coding knowledge obtained with Code.org can be used in distance science education lessons by transferring it to science projects. Science teachers, especially those who have adopted STEM education, can create activities and projects involving science themes with code.org at the beginning in order to accustom students to coding. Students can teach algorithms and coding logic with code.org and transfer this knowledge to science lessons.

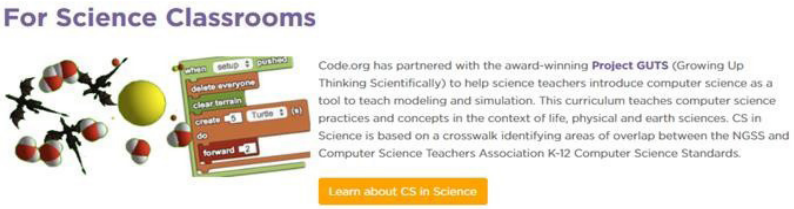


Figure 24. A screenshot from Code.org

Scratch

Scratch is a fun platform that can be used to teach algorithms and coding logic to younger age groups. With Scratch, animations and computer games can be designed using various media tools such as pictures, sound, and music. Scratch is a block coding program where projects can be realized with ready-made code systems. Children up to the age of fifteen can effectively use ready-made code blocks in Scratch and produce solutions to problems. Scratch can also be used in distance science education lessons. Especially in science-based STEM projects, Scratch can be used. Projects designed with Scratch in distance education can contribute to the permanent learning of students (Arseven & Şahbaz, 2022). Simulations, games, and many design products can be realized with Scratch. Some examples of applications that can be designed with Scratch can be seen below (Figure 25).

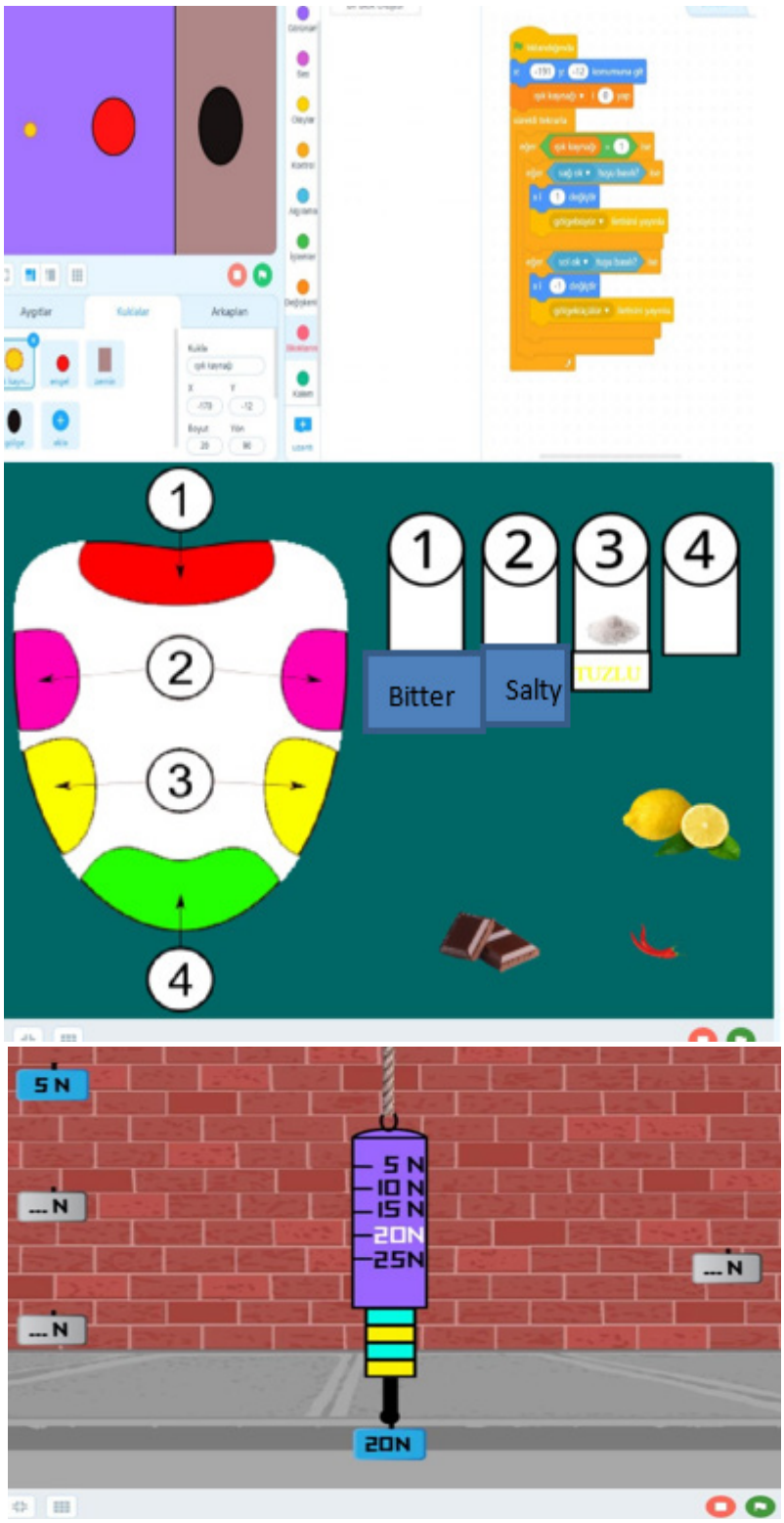
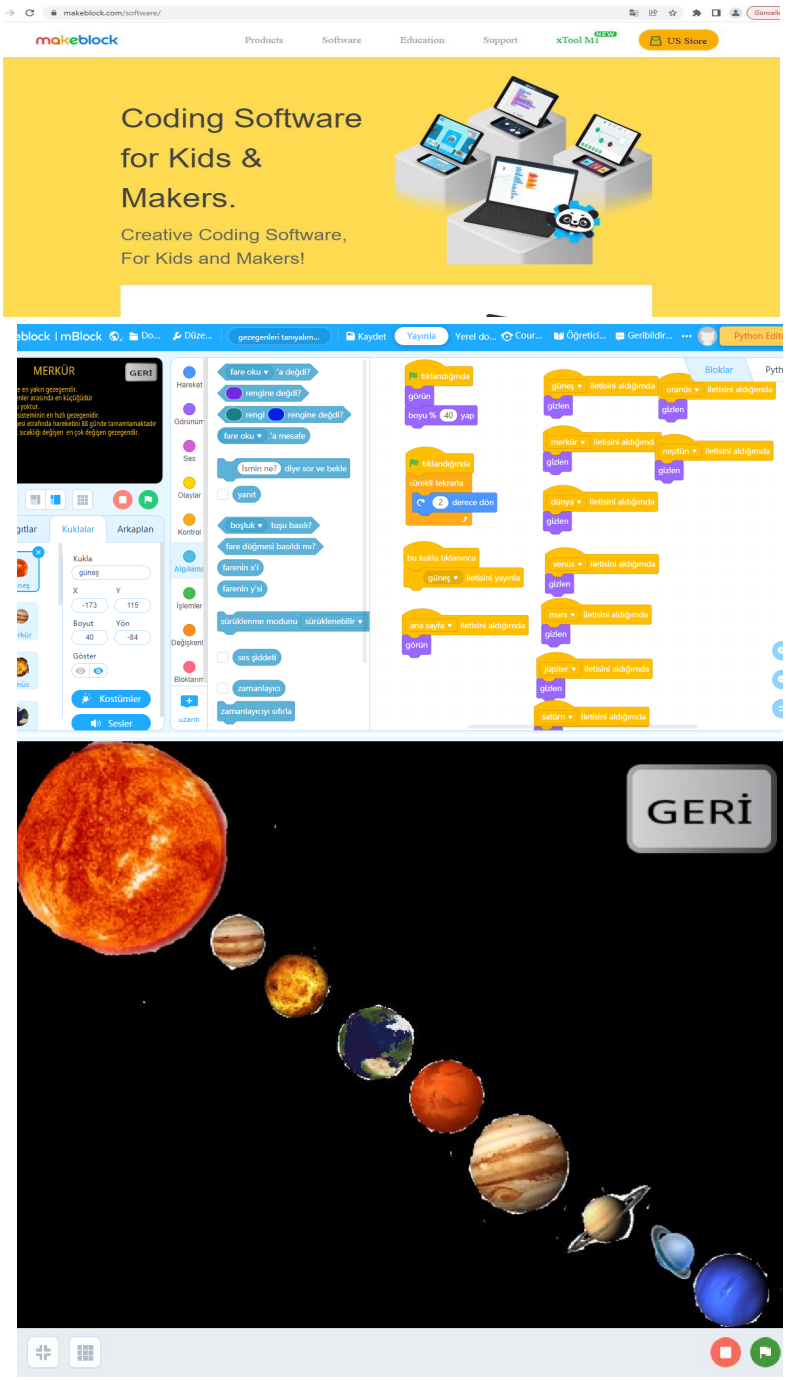


Figure 25. Some examples designed with Scratch

Mblock

Mblock application is a coding platform that includes ready-made code blocks, especially designed for young students to learn the software language easily (Karabak & Gunes, 2013). This program can be installed and run-on computers for free. The application includes a puppet and a layout based on ready-made code blocks that manage this

puppet. It also gives the user the opportunity to make the background and design inside the application. In addition to the block codes offered by the system, the user can also create their own codes. Mblock, which is preferred to learn more algorithms and coding, can be used more effectively in science education classes. Codes created with Mblock can be moved beyond the two-dimensional screen and sent to robot kits. In this way, students can contribute to creating more effective projects by using Mblock. In addition, teachers themselves can develop science projects with Mblock and use them effectively in line with the objectives of their lessons (Aksu, 2019). Project designs such as competitions and simulations can be realized with the Mblock application, which includes many ready-made puppets and materials related to the science lesson (Olgun, 2022). Below are some screenshots created with Mblock (Figure 26).



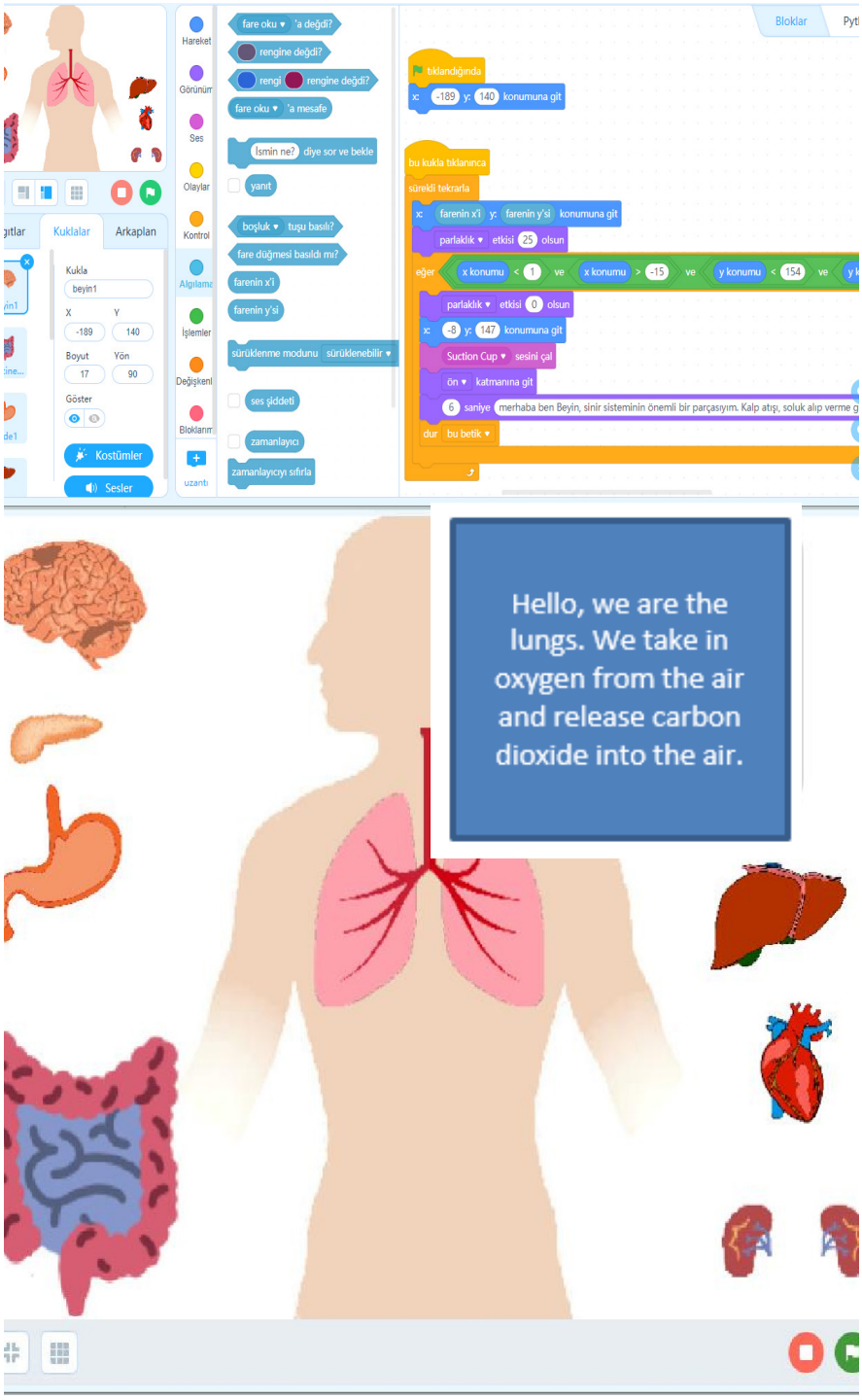


Figure 26. Some examples designed with Mblock

ArduinoBlocks

Arduino is a Microcontroller Card that has been used in coding since 2005 and is constantly being developed (Butuner & Uzun, 2021). Developed for the educational use of Arduino, ArduinoBlocks is one of the most effective software platforms that can be used effectively for teaching algorithms and coding, and also allows realizing projects with the Arduino microcontroller board. It can be transferred to sensor and robot sets created with ArduinoBlocks and effective projects can be created in this way. In this way, science education projects that students can develop by using their high-level

thinking skills can be realized with ArduinoBlocks. ArduinoBlocks can play an especially significant role in students' realization of science-based STEM education projects. In Figure 27, there are screenshots of some projects made using ArduinoBlocks.

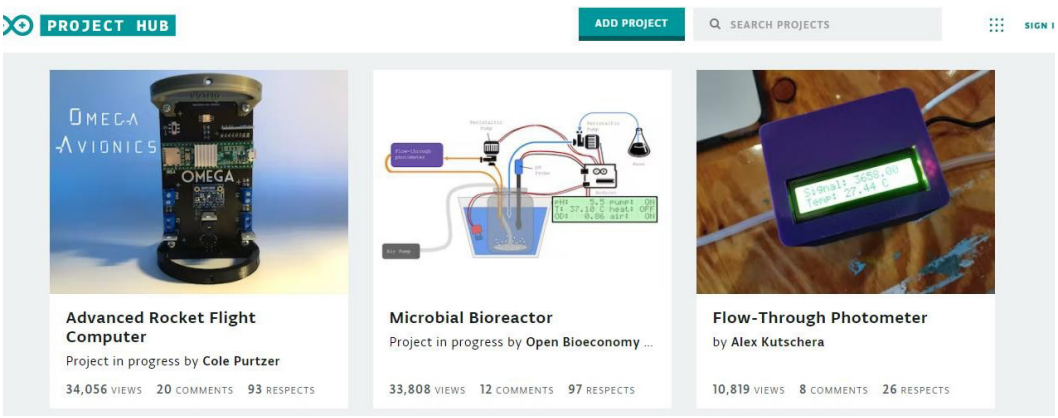


Figure 27. Screenshots of some projects made using ArduinoBlocks

G. Web 2.0-Based Measurement and Evaluation Tools

Web 2.0-based measurement and evaluation tools are becoming more popular day by day due to the widespread use of smartphones. Web 2.0 tools can be used effectively, especially in lessons where formative assessment is adopted. Active participation of students in the lesson can be ensured with the tests to be developed to evaluate the sub-sections of the lessons. These applications can be more fun, especially for students aged 10-15. These applications can also give quick and instant feedback to the teacher about the level of learning of the newly learned subject. The teacher can identify learning deficiencies by looking at the outputs. Can switch to a new topic by completing the missing learning? When Web 2.0 tools are used for this purpose, they can increase the effectiveness of the course (Ulker, 2021). Especially in conceptual-based secondary school science lessons, this type of assessment and evaluation approach can increase course success and interest in the course. Web 2.0-based assessment and evaluation tools can be used effectively in distance science education courses as well as face-to-face courses. Some of the commonly known and frequently used web 2.0-based measurement and evaluation tools are introduced below.

Kahoot

Kahoot is a digital portal that enables learning by means of video, pictures, and similar tools and is used to evaluate what has been learned. Since it is game based, it contributes to the increase of students' motivation. Teachers use Kahoot mostly for true/false tests, quizzes, discussions, or surveys(Ulker, 2022). However, Kahoot has too wide application areas to be confined to just one classroom environment. Games and tests developed with Kahoot can be easily used in online education. KahootWeb. It can also be considered as a 2.0-based digital test application (Korkmaz & Tetik, 2018). Questions prepared in a digital environment with Kahoot can be enriched with visual elements and a time limit can be set for these questions. The use of Kahoot can be extremely useful, especially in lessons such as science lessons where visual elements are dominant (Et et al., 2021).

In order to use Kahoot, it is sufficient to have internet and a device to connect to the in-

ternet. After the teacher has prepared the test, students can log in to the prepared test at kahoot.it. Students must enter the code sent by the teacher to log in to the system from here. Kahoot automatically generates this code for the administrator who prepared the test. Kahoot can present the options in the form of colored triangles, squares, and circles by gamifying the options instead of the options A, B, C, and D in the normal test. With Kahoot, new tests can be developed as well as previously developed tests. Old tests can be revised or used as is. In Figure 28, there are screenshots of the different steps of designing Kahoot.

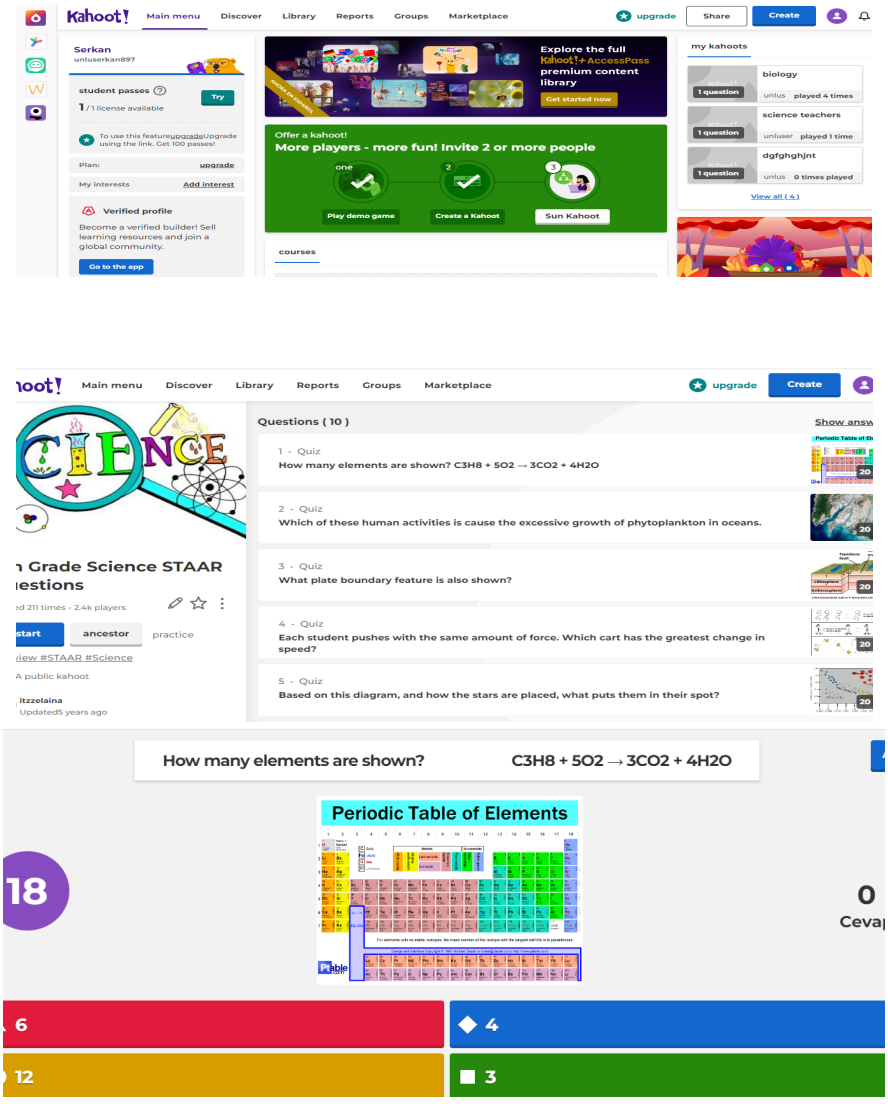


Figure 28. Screenshots about Kahooot

Quziz

Quiziz is a web 2.0 measurement and evaluation tool that is prepared using smart devices such as computers and phones, making learning environments enjoyable and enabling students to evaluate both face-to-face and with distance education (Ulker, 2022). With Quiz, test questions can be enriched with images and videos, and students' answers can be colored with emojis and visuals (Öztürk & Eren, 2020). With Quizizz's feature of adding visual, video, or audio recordings, subjects or concepts can be made more

understandable by students (Ulker, 2022). In Figure 29, there is a visual from the main page about the use of Quziz.

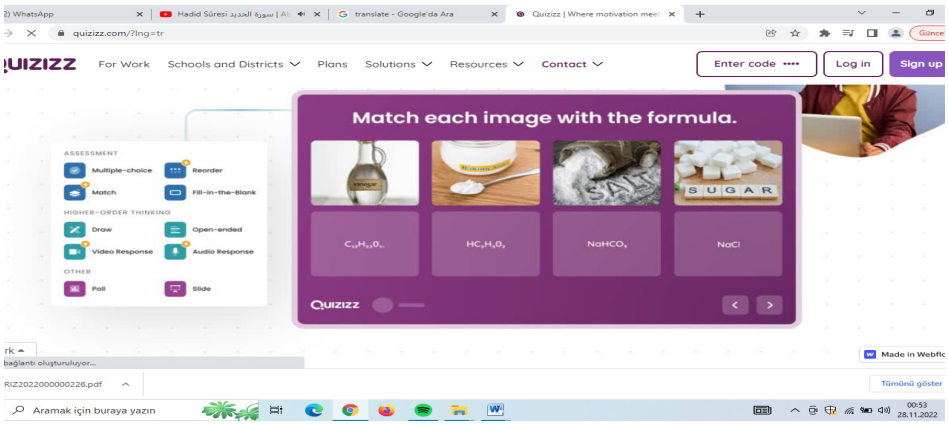


Figure 29. Screenshots from Quziz website

With Quziz, different entry options can be created according to teachers (A Teacher), students (A Student), and parents (A Parent). It offers teachers the option of assigning points according to the difficulty level of the questions. It provides teachers with documents about the results of the test, and offers options to download these outputs in different formats (Excel and similar). According to the answers given to the questions and the duration, Quziz offers the student a gift badge and congratulatory pictorial expressions. In this way, the studentcontinues to be interested in the questions.

Baamboozle

Baamboozle Application is a digital test game generally performed with teamwork (Gündüzalp, 2022). In this application, there are numbered boxes that are slightly more than the number of questions, and behind these boxes, there are surprises with questions. Teams choose a box with a common decision and if there is a question behind that box, they answer it. When the teacher comesto the conclusion of the correct answer, s/he marks the correct part on the screen. Behind the boxes are also rewards or punishments depending on luck. For this system, the teacher can prepare questions or use the prepared questions shared by someone else. Figure 30 includes a screenshot from the Baamboozle website.

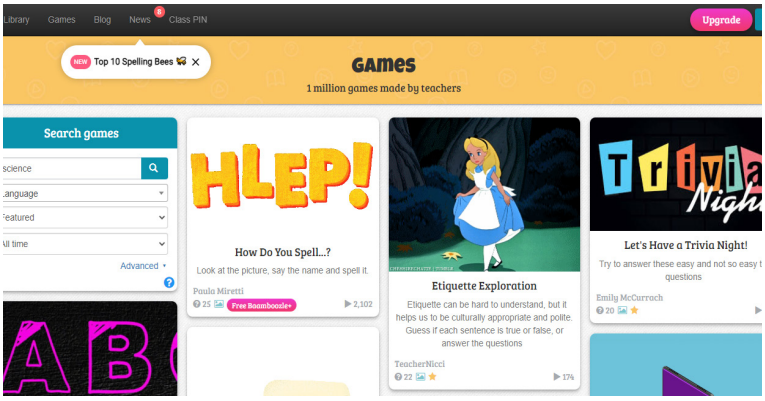


Figure 30. A screenshot from Baamboozle website

That Quiz

Thatquiz is a web application that contains ready-made templates for the preparation of true-false, multiple-choice tests, and fill-in-the-blank questions (Alifiani, Jiwandono, & Nursit, 2017). Funny questions can be prepared for students by making use of periodic tables, cells and similar visuals specially designed for some science subjects. In Figure 31, there are screenshots of two different application examples that can be made with That Quiz.

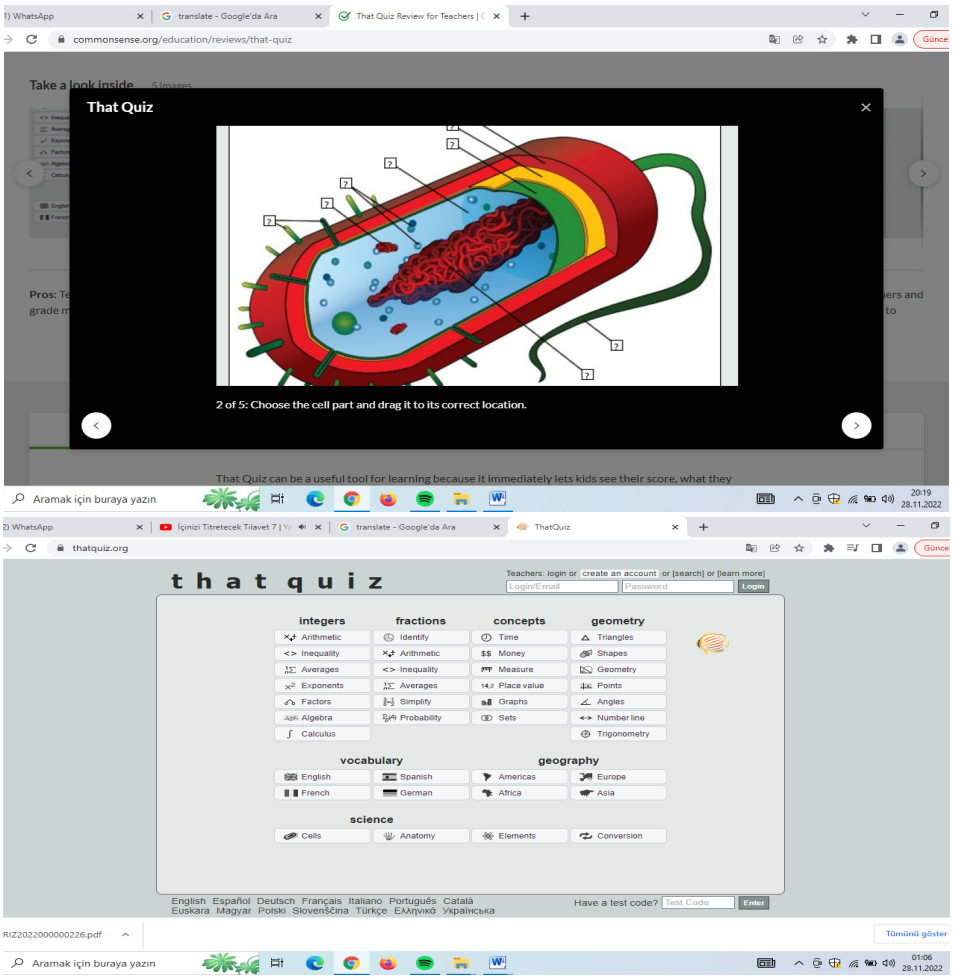


Figure 31. Screenshots from That Quiz website

Socrative

Socrative is a tool where you can create quizzes on the internet and give students instant feedback by solving them with their smartphones or tablets. It is a web application where true-false, multiple-choice, and short-answer questions can be prepared and directed to students (Ülker, 2022). Thanks to the Socrative application, the teacher can solve thequestion in many ways with the possibilities offered by the application. Teachers can adjust the question, the time allocated to the question, and the transition to the next question, in line with their wishes, and provide feedback to students to eliminate learning deficiencies related to erroneous solutions. It can contribute to students and teachers in the distance education process, thanks to its many features such as determining question type andadding visual video. Figure 32 shows the screenshots of the Socrative website.

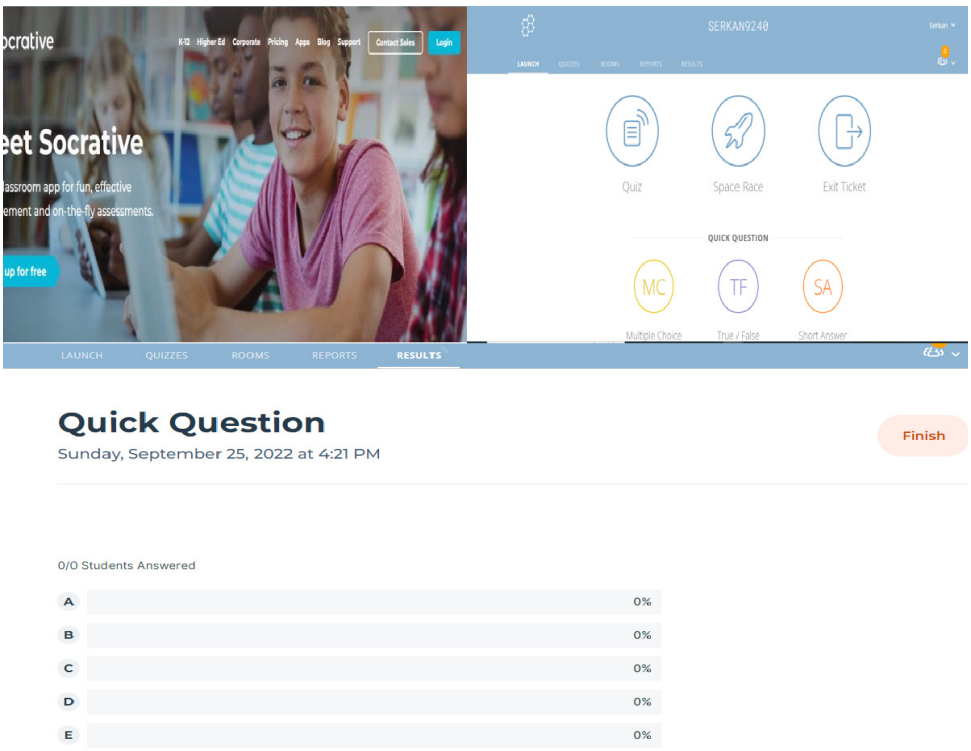
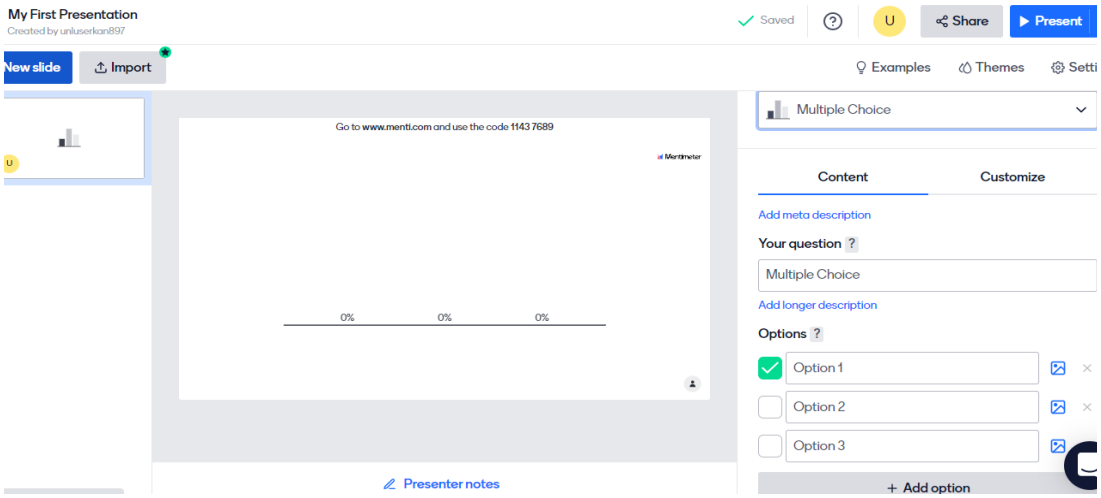


Figure 32. Screenshots from Socrative website

Mentimeter

Mentimeter is a measurement and evaluation tool that teachers use to take students' ideas about the subject and reflect them on the screen during the lesson (Cenesiz & Ozdemir, 2021). It is also a web application that helps to prepare evaluation products such as surveys and questions and answers. This application, which can be used to attract the attention of the students, to prepare entertaining content, and to increase motivation of the students, can also be used for presentation purposes (Celik, 2021). With this tool, immediate feedback can be provided in the learning environment and incomplete or incorrectly known issues/concepts can be corrected (Ulker, 2022). Figure 33 shows the screenshots of the Mentimeter website.



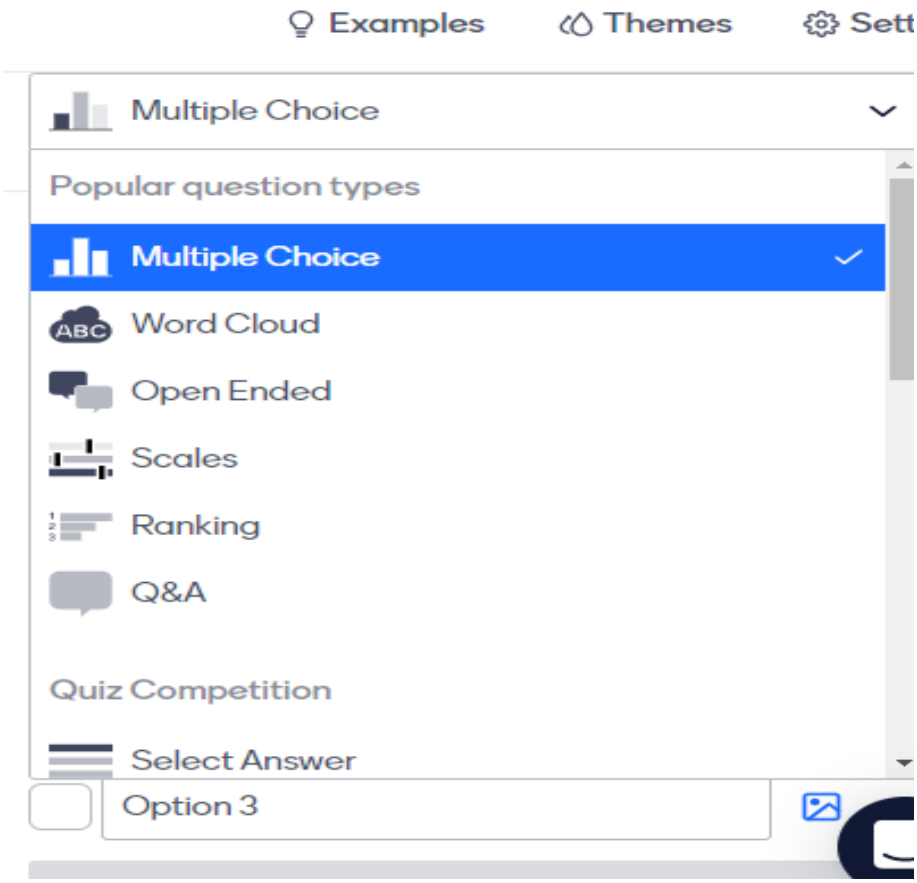
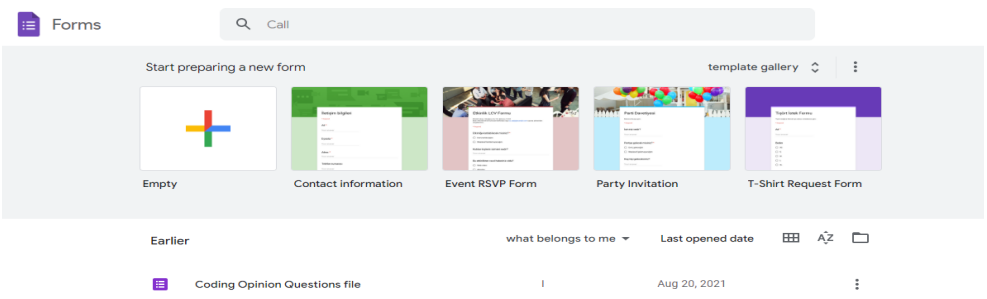


Figure 33. Screenshots from Mentimeter website

Google Forms

It is a free application that can be accessed on the web with a Google account and used to create online tests and surveys. With this application, questions such as surveys, tests, short answers, or long answers can be prepared using ready-made templates. The places of the questions can be changed, images can be added, and the number of stylish can be adjusted as desired. During the application, the answers given to the test can be followed and viewed moment by moment. The percentage values of the answers given during or after the test canbe learned and the answers can be saved in the form of an excel file. Figure 34 shows the screenshots of the Google Forms



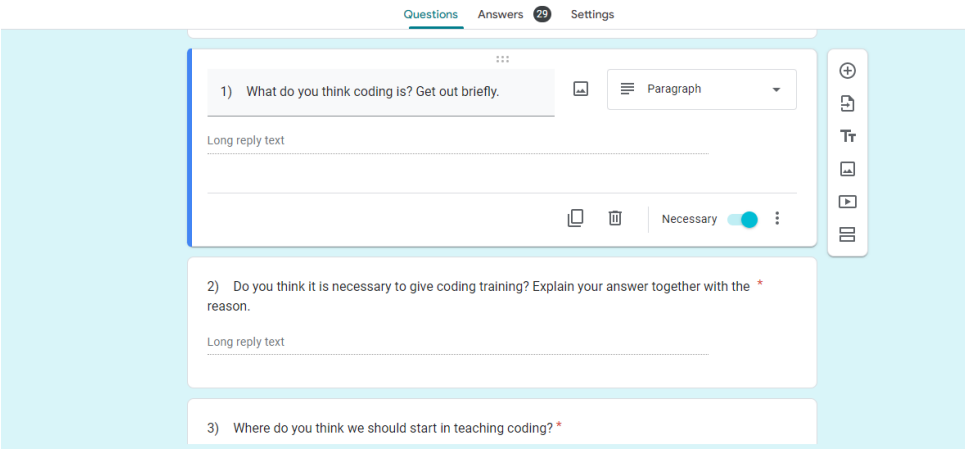


Figure 34. Screenshots from Google Forms

H. Digital Story and Presentation Preparation Tools

In the 21st century, it is of significant importance to use digital learning tools in educational environments, especially to integrate learning materials such as interactive videos, animations, simulations, educational films, digital stories into lessons as active learning tools (Izgi-Onbasili et al., 2022; Koyunlu- Unlu & Dokme 2020; Topal et al., 2020). Lessons become more interesting, especially thanks to advanced digital story and presentation design tools. Storytelling forms the basis of the digital story. The difference of digital stories from normal storytelling is that the story is supported with visual and auditory materials in the digital environment (Seckin-Kapucu & Yurtseven-Avci, 2020). Digital stories can be used for many different purposes in both face-to-face and distance science lessons. These can be listed as follows. 1- Digital stories can be used at the introductory stage to draw attention to the lesson. A digital story can be prepared to attract attention for almost any subject in science education. 2- They can also benefit from digital stories at the discovery stage in some subjects. 3- Digital stories can be used to adapt what is learned in the lesson to another situation. Students may be asked to prepare a digital story about the topic they have learned. It can also be seen whether the knowledge learned in this way can be adapted to another situation. 4- Digital stories can be used for measurement and evaluation purposes. It is possible to evaluate what has been learned based on the created digital story. 5- Digital stories can be used in science education classes to eliminate misconceptions with noteworthy content to be prepared. Misconceptions can be eliminated, especially with digital stories supported by refutation texts or conceptual change texts. Existing web 2.0-based applications can be used to create digital stories with such a multidimensional usage area. In addition to digital story tools, some digital presentation tools are introduced below.

StoryboardThat

StoryboardThat is a digital story platform where everyone can design their own story withbackground images, cartoon characters, and cartoon objects (Wahjuningsih, Santihastuti & Arifin, 2019). StoryboardThat offers many ready-made templates for easy design for people using theplatform. Quick and easy designs can be made by using these templates in the form of drag and drop during designs. The Storyboard Creator in StoryboardThat has been created in such a way thatpeople of all skill levels can benefit from it. With this application, effective science learning content can be prepared with cartoon

characters, especially for students up to the age of fifteen, andinteresting content can be created according to the student's level.

StoryboardThat basically consists of scenes, characters, texts (speech bubbles, boards), shapes, icons, and some scientific content (map, electrical circuit, test tube, etc.). With StoryboardThat, you can start the design by choosing one of the extremely many scenes. Again, a character can be selected from the rich character content and placed on the stage. All kinds of manipulations can be made on ready-made characters and these characters can be shaped according to the purpose. For example, the clothes, body shapes, facial expressions, and so on of the designed characters can be designed by the practitioner. Speech bubbles can be added to the prepared characters. A scientific content design can be done in a comic book environment. This content design can be voiced if desired. With these features, StoryboardThat contributes to the development of the creativity and imagination of the people who design using this platform. With StoryboardThat, students can also make designs and contribute to the development of their problem-solving, creativity, and critical thinking skills.

Figure 35 shows a screenshot of an example of an application made with StoryboardThat.

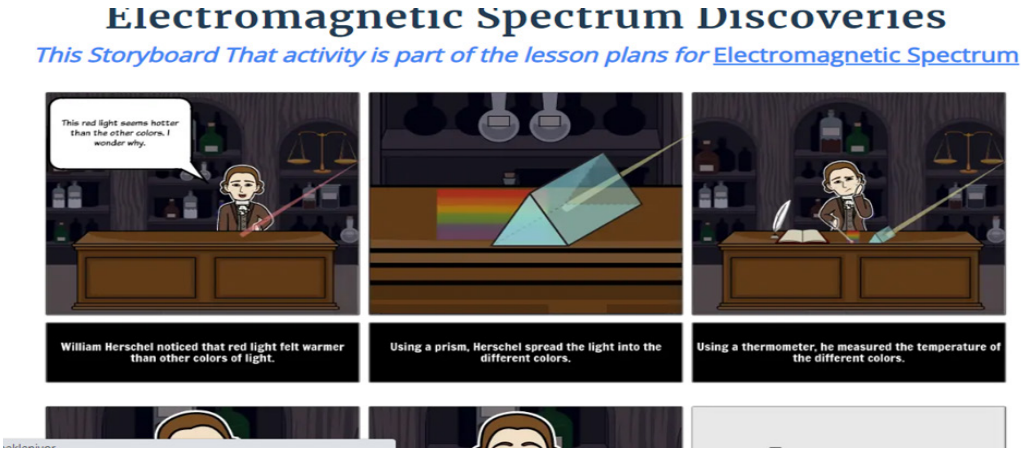


Figure 35. Screenshot of an app example made with StoryboardThat

Storyjumper

Storyjumper is a web application where digital stories are created for individuals or groups at all levels, from preschool to higher education. Digital stories prepared with Storyjumper can be turned into e-books. A comic book or digital storybook can be created with Storyjumper. This book can also be converted to audiobook format if desired. Storyjumper offers users lots of scene and character templates. These templates can be used whilepreparing digital stories. Sound and 3D materials can be added to the prepared stories. This application contributes to the development of students' creative writing skills and makes them willing to write (Fansa, 2020; Gökçe, 2021). 4-8. Considering that science teaching in classrooms is conceptually based, students' writing stories with Storyjumper using science concepts can contribute to both the development of their writing skills and their meaningful learning of science concepts. At the same time, students' misconceptions and mislearning can be corrected with dialogues developed using science concepts. Figure 35 shows a screenshot of an example of an application made with Storyjumper.

Figure 36. Screenshot of an app example made with Storyjumper

Powtoon

Powtoon is a cloud-based web program that helps create animated presentations and impressive videos. With this program, videos, pictures, and texts can be added to presentations (Baran et al., 2015). Powtoon allows the creation of animations and presentations with speech bubbles, shapes, pictures, characters, and many more materials. Pawtoon contains ready-made templates in various categories. Effective presentations and animations can be prepared by using these templates. Especially in science education, some abstract topics can be made more concrete in the minds of students by animation. In addition to animations, digital stories can also be prepared with Powtoon. Digital stories can be used to teach appropriate subjects in science education. Figure 37 shows a screenshot of an example of an application made with Powtoon.

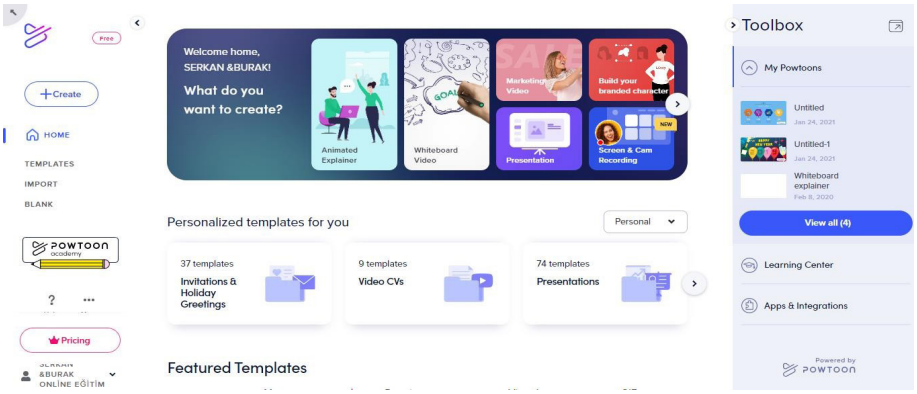


Figure 37. Screenshot of an app example made with Powtoon

Pixton

Pixton is a platform designed for creating comics or digital stories. It is an especially useful application with many characters and background drawings in its content (Yapıcıoğlu, 2020). Mutual dialogue practices can be prepared for concept teaching in science education. With mutual speech bubbles, content can be prepared in a way to correct misconceptions and wrong learning. Especially in concept teaching, effective content can be prepared with Pixton. Figure 38 shows a screenshot of an example of an

application made with Pixton.

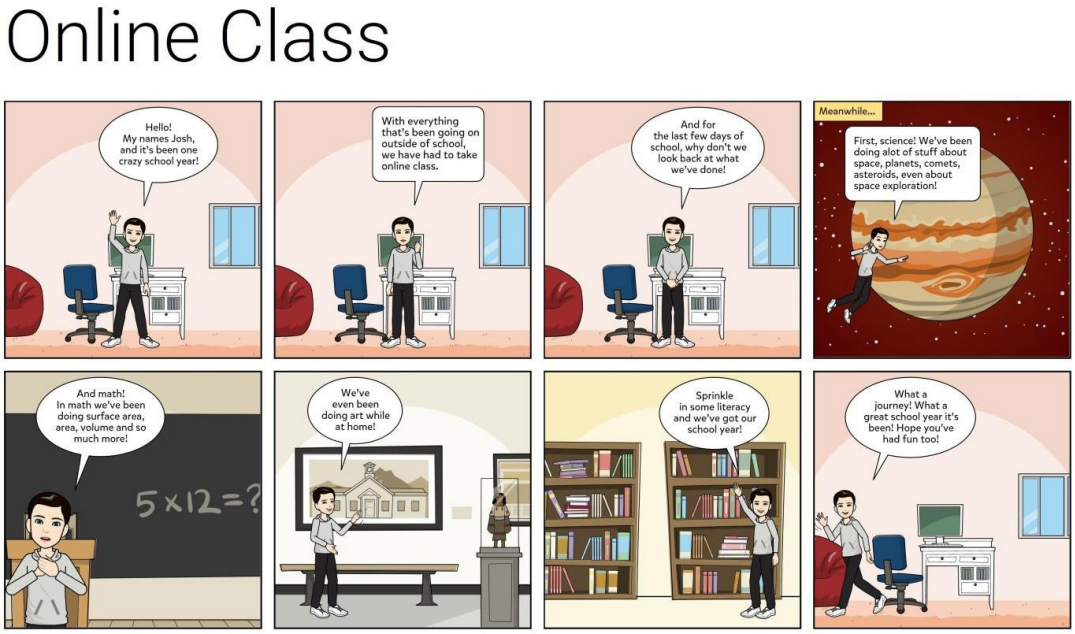


Figure 38. Screenshot of an app example made with Pixton

Glogster

Gloster is a cloud-based digital story creation and poster design platform. With Gloster, digital storiescan be created, and digital posters can be prepared by using multimedia media such as text, graphics,audio, and video together. Quick designs can be made by utilizing the many ready-made poster patterns in its content. Glogster is a platform that can be used to design or design posters with students in distance education courses as well as face-to-face education (Awada, Diab, & Faour, 2020). Previously made and saved designs can be seen in the Glogpedia section of Glogster. These designs can be used, or you can have an idea about what kind of designs can be made. This application can be used in both face-to-face and distance science education courses to improve design skills and to have students prepare effective and entertaining presentations. Figure 39 shows a screenshot of an example of an application made with Gloster.

Figure 39. Screenshots of examples made with Gloster

Infogram

Infogram is a platform established to create data literacy and provides the opportunity

to visualize and share data in a brief time. Infogram is one step ahead in data-based presentations compared to other presentation programs. Today, with big data coming to the fore, the importance of Infogram has started to increase day by day. Infogram is a presentation tool that can be preferred in presentations with statistical and mathematical content. Infogram can be used as an effective tool in presentations where tables and graphics are dominant. Although Infogram is used in many sectors, it can also be used as an effective tool in education (Chicca & Chunta, 2020). Today, the importance of research and data collection-based science education understanding in science education is increasing day by day. Infogram can be preferred in presentations of projects or performance assignments where quantitative data are collected from students. In addition, the use of mathematical content and skills increases as the grade level increases in science education, especially in physics and chemistry courses. Infogram can be used to prepare presentations on mathematical topics in science. Figure 40 shows a screenshot of an example of an application made with Infogram.

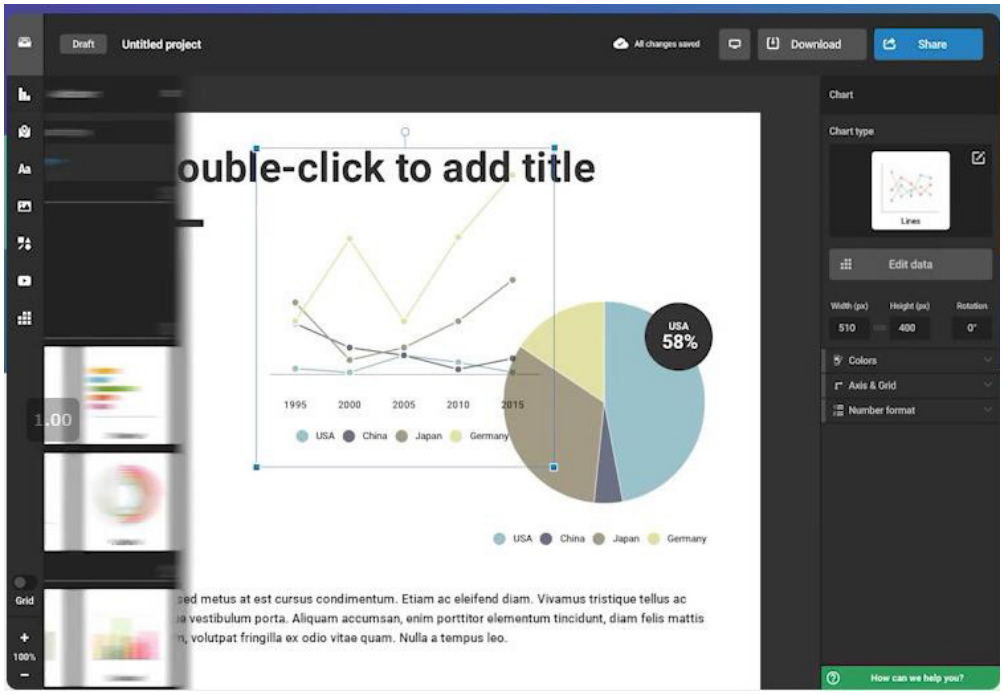


Figure 40. Screenshot of an app example made with Infogram

Time.graphics

It is a web presentation tool that can create chronological order and turn data into graphics. It has the ability to open and transfer file types containing Word, Excel and similar data to its own system. Time.graphics application can be used especially in presentations about the subjects given with their historical development in science education. For example, this application can be used when it is desired to prepare presentations that include the chronological development of any science subject, such as the historical development of the atom. Figure 41 shows a screenshots of two examples of an application made with Time.graphics.

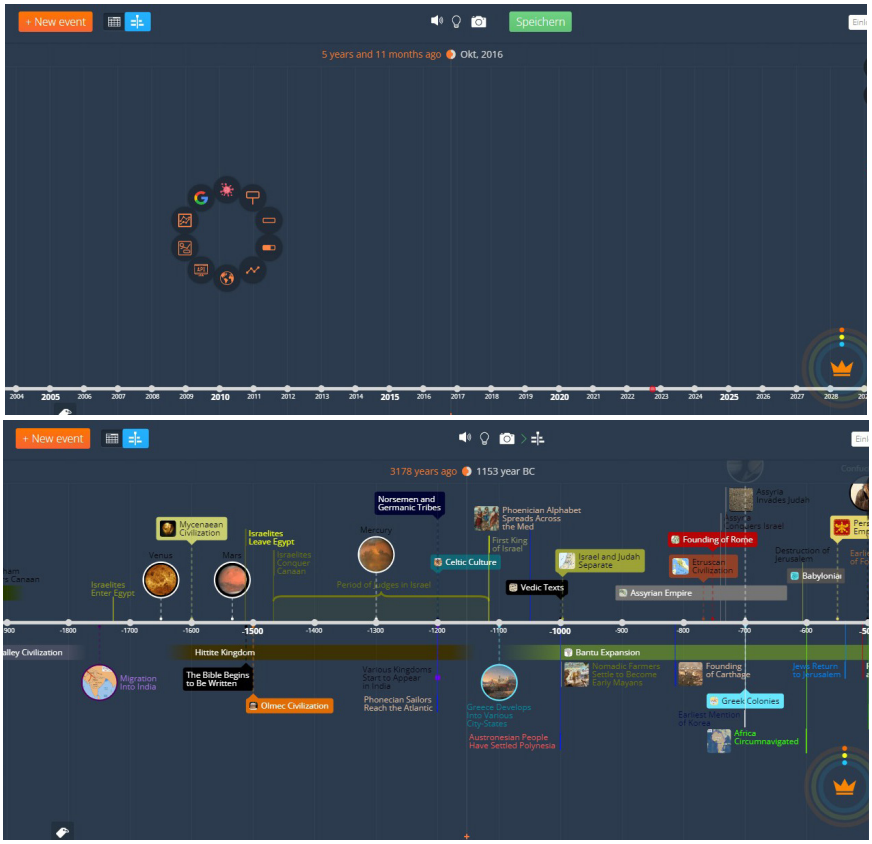
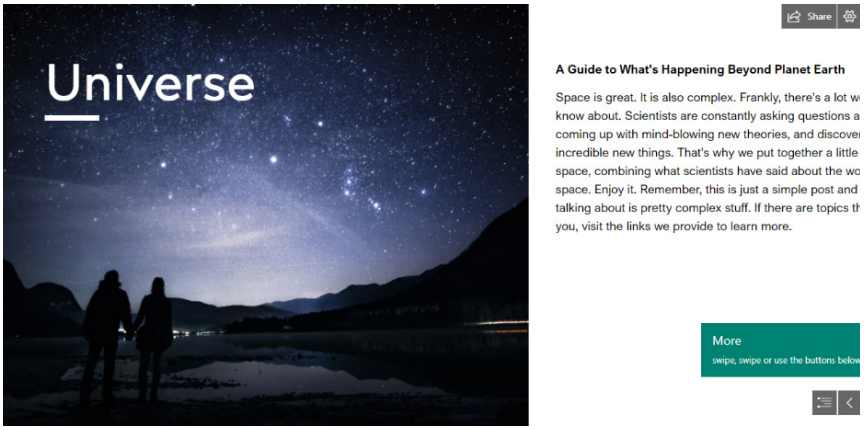


Figure 41. Screenshots of examples made with Time.graphics

Microsoft Sway

Sway is Microsoft Office's platform that makes it easy to create and share interactive reports, personal stories, and presentations. Microsoft Sway is a web application that can create visually impressive presentations, documents, and bulletins, and offers the opportunity to instantly share these prepared tools as it works integrated with social media (Akkaya, 2019). With Sway, impressive science contents and presentations can be prepared. Science stories can be prepared. Figure 42 shows a screenshots of two examples of an application made with Microsoft Sway.



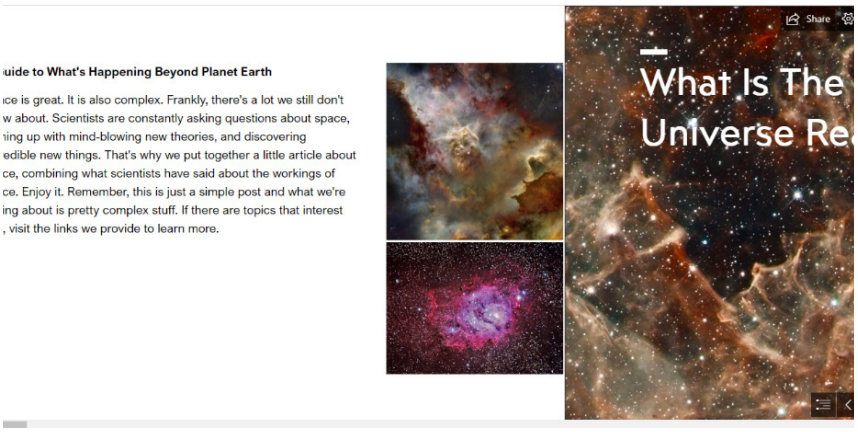


Figure 42. Screenshots of examples made with Microsoft Sway

Promo

Promo is a digital presentation application that can be used to create impressive and eye-catching videos. With Promo, you can create videos by adding audio and picture files, cropping and similar changes can be made on the videos created. Promo applications can be used to prepare effective science education videos. Figure 43 shows a screenshots of an example of an application made with Promo.

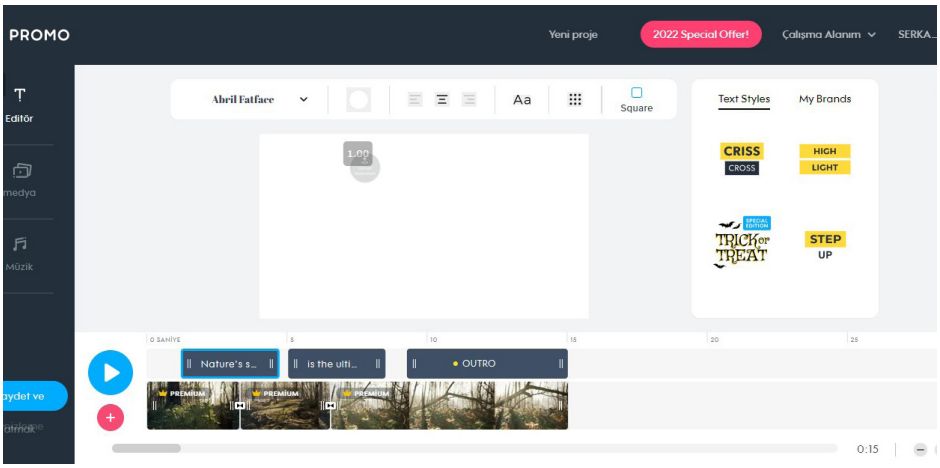


Figure 43. Screenshot of an example made with Promo

Canva

Canva is a web-based design app. With Canva, many materials such as infographics, posters, social media posts, presentations, invitations, cards, and advertising posts can be prepared professionally. In Canva, it is possible to design in many areas such as banners, sliders, business cards, Twitter cover photos, Instagram posts, wedding invitations, and Facebook posts. Canva can also be used as a program for editing and creating video content. With this application, which has a simple interface, audio, and text can be added to videos or designs can be made using ready-made template elements. With Canva, students can design banners and posters for their science projects. They can share their activities and projects by turning them into effective presentations. Figure 44 shows a screenshots of three examples of an application made with Canva.

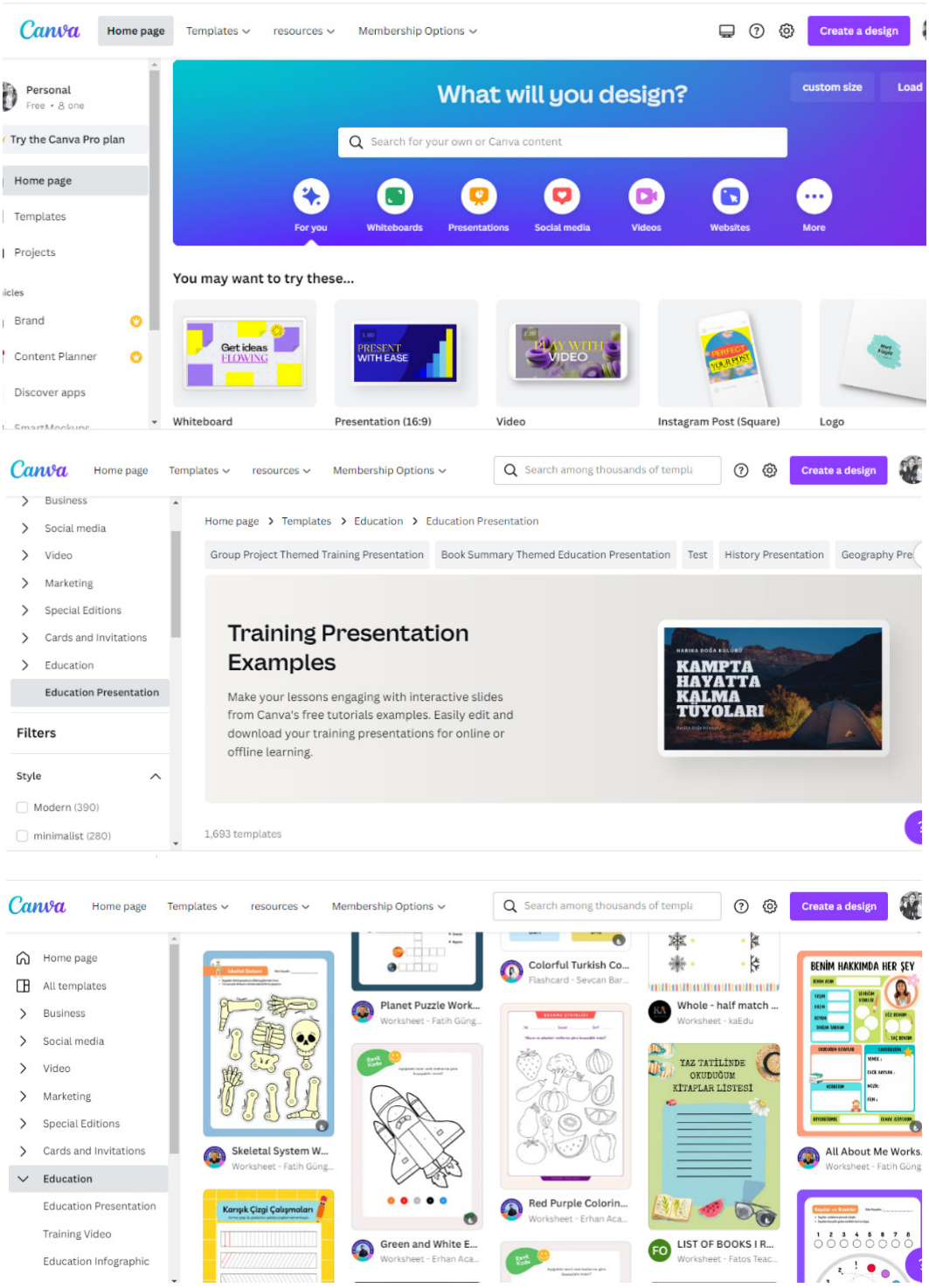


Figure 44. Screenshots of examples made with Canva

Creately

This application is a web tool that offers digitally ready-made diagrams in the form of templates and allows them to be edited on demand. It can be used to create many types of diagrams such as mind maps, Venn charts, Swot analyses, concept maps, and flow charts. Figure 45 shows a screenshots of an example of an application made with Creately.

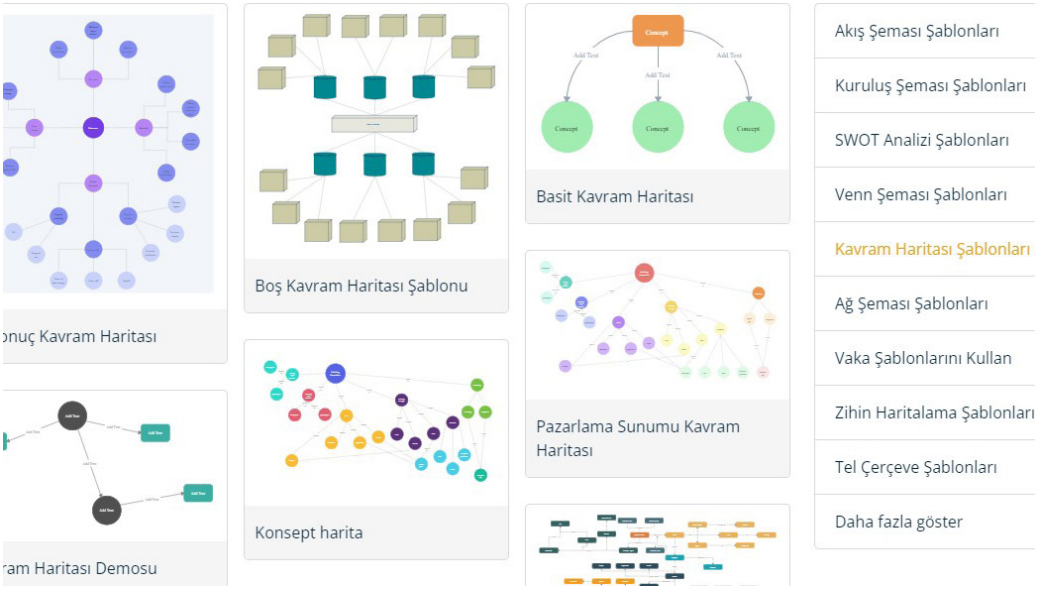


Figure 45. Screenshot of an example made with Createl

I. Classroom Management and Data Gathering Tools

The compulsory online education application during the Covid 19 process has also brought up the question of how to do classroom management in distance education. Discussions have begun on how to increase the quality of education in online classes, how to conduct exams, and how to evaluate projects and assignments. Some classroom management and data collection tools that can be used in distance education are introduced below.

Edpuzzle

Edpuzzle is one of the virtual classroom applications used effectively in both distance education and flipped classroom applications. With Edpuzzle, effective lessons can be taught by making use of videos on the internet. New arrangements can be made by adding sound and text to the videos. It can be checked whether the videos shared in the Edpuzzle environment are watched by the students. Edpuzzle is a web platform where preparations are made before and after the lesson in order to manage the online lesson process effectively, and it allows the lesson subjects to be learned before coming to the lesson (Ünlü, 2022; Kaya, 2018). Especially in flipped classroom applications, videos to be watched outside of class can be prepared on this platform. At the same time, homework can be done on the system. Students' work can be tracked. A conversation can be started with the students, and the activities of the students in the system can be observed. It can be said that Edpuzzle is remarkably successful in saving time in online lessons, preparing before the lesson, doing homework after the lesson, and following the students (Akdeniz, 2019). Figure 46 shows screenshot of a video example with an embedded question on EdPuzzle.

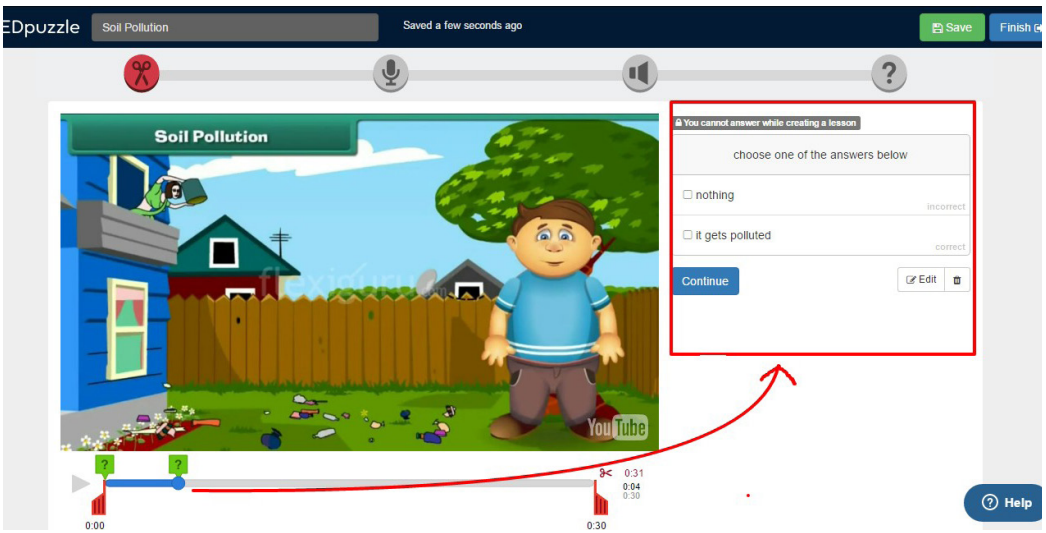
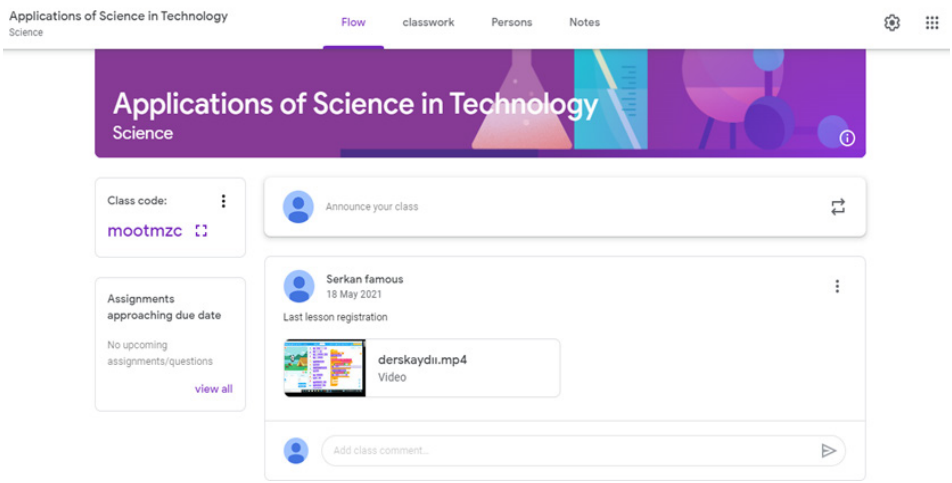


Figure 46. Screenshot of a video example with an embedded question on EdPuzzle. Retrieved from https://edpuzzle.com/media/5844d68ec1f9fb3e394dabeb/edit

Google Classroom

Google Classroom is a free web service developed by Google. This platform has been developed for educational purposes and its main purpose is to create assignments, distribute and collect assignments, and grade assignments. Google Classroom is actually a virtual classroom application. With this completely free application, teachers can create their own classes. With Google Classroom, they can assign assignments and projects to students, and edit the scores and deadlines of assignments and projects.

The Google Classroom platform can also be used as an e-portfolio if desired. If the documents here are not deleted, the progress of the students over time can be followed in the Google classroom environment. Google Classroom can also be used in flipped classroom applications. Any kind of document can be shared with Google classroom. If students will be asked to watch ready-made videos before coming to class, this can be done in the Google classroom environment. In Figure 47, there are screenshots from an application made with Google Classroom.



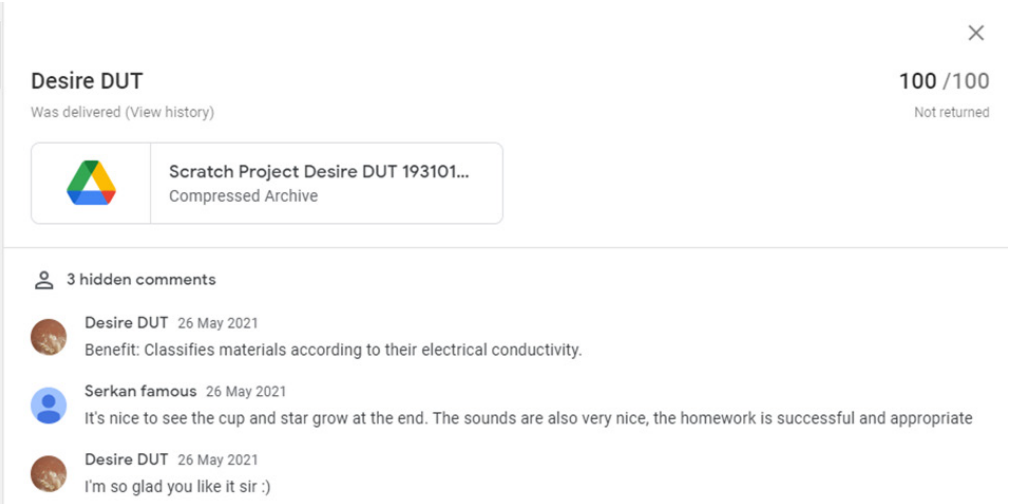
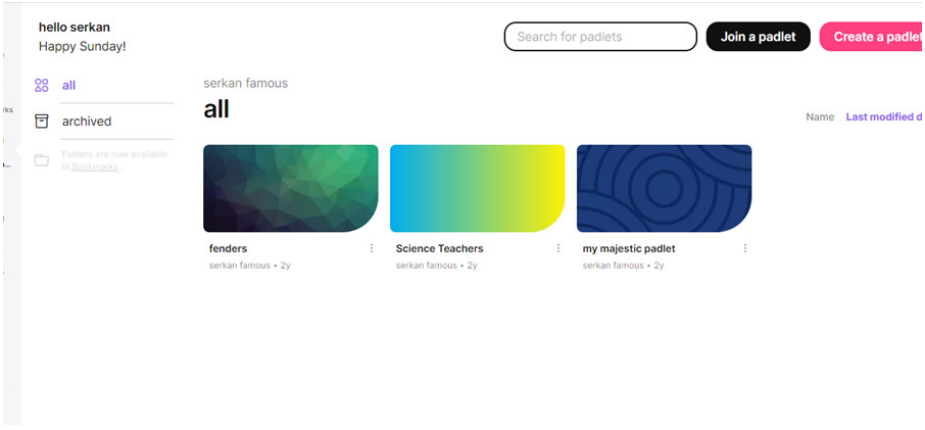


Figure 47. Screenshots from an application made with Google Classroom

Google Classroom can be used very effectively, especially in the distance education process. The compulsory distance education process that took place in the Covid-19 period has shown that virtual classroom applications such as Google classroom can be used very effectively in distance education. With Google Classroom, videos that are ready before can be shared, as well as videos of lessons can be recorded. Recorded videos can be watched again later. In this respect, Google classroom can be used effectively in the distance education process, like other virtual classroom environments.

Padlet

Padlet is a web platform designed to digitize boards used in classrooms. With the digitalization of the board, many digital sharing features have been added to the board. While only pictures and texts canbe shared on classical classroom boards, videos, photos, pictures, and many similar shares can be shared with Padlet. Padlet can make student and teacher interaction effective in distance education (Özdemir, 2017; Başkaya & Tursunovic, 2017). Announcements can be made with this digital board (Özipek, 2019; İnal and Arslanbaş, 2021). Outputs of research and performance assignments can be displayed on this board. In Figure 48, there are screenshots from an application made with Padlet.



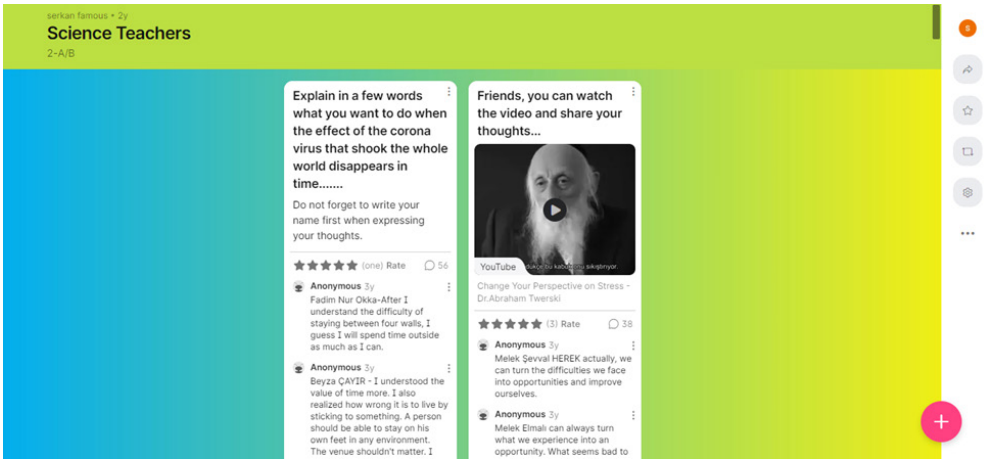


Figure 48. Screenshots from an application made with Padlet

Seesaw

Seesaw is a digital portfolio creation tool. Students can enrich their electronic portfolios created with Seesaw by adding photos, videos, drawings, texts, and links. Seesaw applicationwith a simple interface; It allows students to upload their work, the teacher to give feedback on the work, and the parents to follow the process and the student (Erdoğan & Şerefli, 2021). The strongest aspect of Seesaw is that it provides teachers with instant feedback on student work. At the same time, parents have an idea about what their children are doing at school. The fact that the application can be accessed by teachers, students, and parents makes it one step ahead of other applications. Figure 49, there are screenshots from an application made with Seesaw.

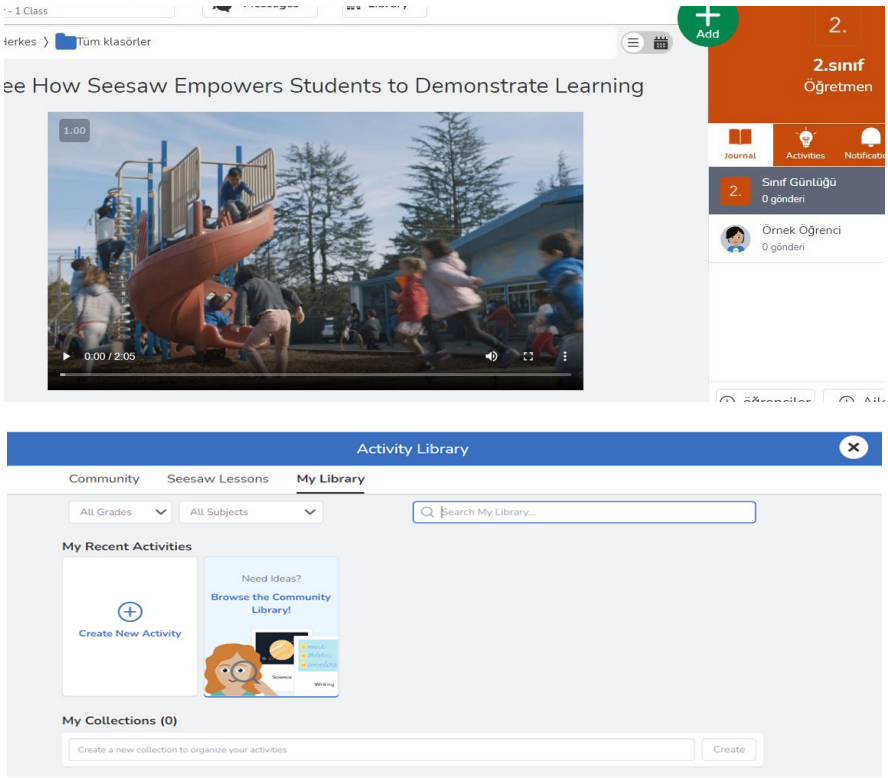


Figure 49. Screenshots from an application made with Seesaw

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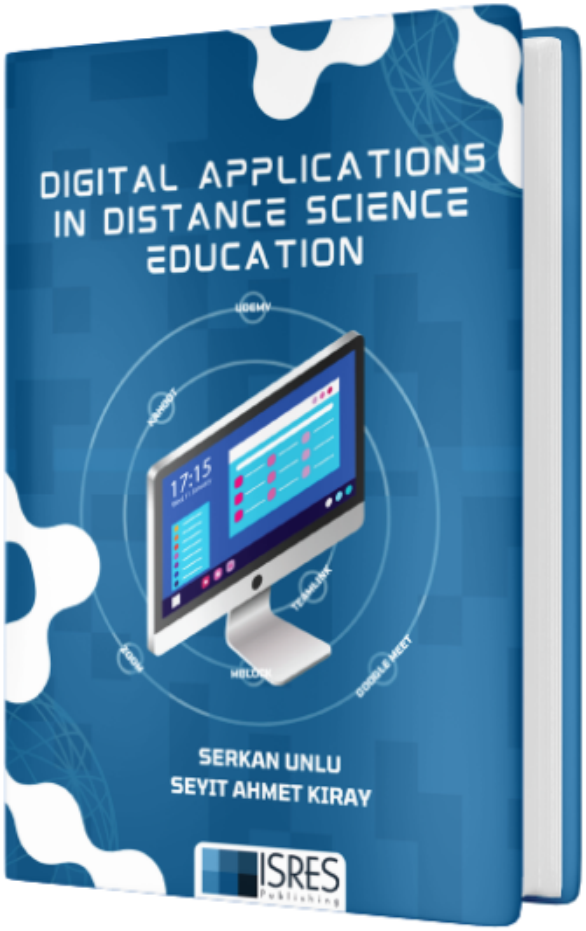

This book has been prepared to introduce common technological tools that can be used in science education in the distance education process. Although most of the applications introduced in the book are used in face-to-face education, this book focuses on their use in the distance science education process.

This book is reviewed by at least two international reviewers.

The purpose of the book is to provide the readers with the opportunity of a scholarly refereed publication in the field of Educational Technology.

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