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Using 3d Hologram in Distance Education

Güray Tonguç[*]

Betül Özaydın Özkara[**]

Abstract

In a last few decades the use of rich content web pages, where interaction is important, has become very common. Although the interaction is important, it's known that there are difficulties in practice, as a result, students feel loneliness, tend to drop out of distance education. In this study, the use of three-dimensional holographic materials as distance education course material was proposed to avoid the situation mentioned above. The current use cases of two/three dimensional hologram technologies with distance education have been put forward and it has been tried to determine the integration of these two technologies, what might be done later in order to increase productivity in education. By integrating three-dimensional hologram technology in distance education in the following years, it's considered that students who are in a different space will be more interested in the lessons, interact more with other students and instructors, increase their satisfaction with education.

Keywords

Interaction
Hologram
Learning Technology
Interactive Learning Environments
E-learning

Makale Hakkında

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[*] Ögr. Gör. Dr., Akdeniz University, Department of Informatics, 07070, Antalya, Turkey (Akdeniz Üniversitesi, Enformatik Bölüm Başkanlığı), guraytonguc@akdeniz.edu.tr, ORCID: 0000-0002-5476-711

[**] Dr. Ögr. Üyesi, Distance Learning Vocational School, Isparta University of Applied Sciences, 32200, Isparta, Turkey (Uzaktan Eğitim Meslek Yüksekokulu, Isparta Uygulamalı Bilimler Üniversitesi), betulozaydin@isparta.edu.tr , ORCID: 0000-0002-2011-1352

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Uzaktan Eğitimde Üç Boyutlu Hologram Kullanımı*

Güray Tonguç*
Betül Özaydın Özkara**

Özet

Son yıllarda etkileşimin önemli olduğu zengin içerikli web sayfalarının kullanımı oldukça yaygınlaşmıştır. Etkileşim önemli olmakla birlikte, uygulamada zorlukların yaşandığı, bunun sonucunda öğrencilerin yalnızlık hissettiği, uzaktan eğitimden ayrılma eğiliminde olduğu bilinmektedir. Bu çalışmada, yukarıda belirtilen durumdan kaçınmak için üç boyutlu holografik materyallerin uzaktan eğitim dersi materyali olarak kullanılması önerilmiştir. Uzaktan eğitim ile iki ve üç boyutlu hologram teknolojilerinin mevcut kullanım durumları ortaya konmuş, bu iki teknolojinin entegrasyonu ve eğitimde verimliliği artırmak için neler yapılabileceği belirlenmeye çalışılmıştır. Önümüzdeki yıllarda üç boyutlu hologram teknolojisini uzaktan eğitime entegre ederek, farklı alanda bulunan öğrencilerin derslerle daha fazla ilgileneceği, diğer öğrencilerle ve eğitmenlerle daha çok etkileşime gireceği, memnuniyetlerinin artacağı düşünülmektedir.

Anahtar Kelimeler

Etkileşim
Hologram
Eğitim Teknolojisi
Etkileşimli Eğitim Ortamı
E-Öğrenme

About Article

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INTRODUCTION

Moore and Kearsley (2011) state that the main principle of distance education is learning without the presence of teachers and learners in the same environment. As seen in Figure 1, in the computer and internet supported distance education system, students reach out for the resources offered to them through "Education Management System". Asynchronous and synchronous learning takes place in this environment. In the asynchronous learning process, communication refers to non-synchronous communication whereas synchronous communication refers to synchronous communication (Moore & Kearsley, 2011). In other words, students can access the lecture presentations made by the teacher in a synchronous manner, live in class hours, and at other times in asynchronous archive records. It can be accessed via a paging system, such as a pre-prepared web page format, animations, audio and video enriched course content, and a forum that allows communication between course participants.

* Ögr. Gör. Dr., Akdeniz University, Department of Informatics, 07070, Antalya, Turkey (Akdeniz Üniversitesi, Enformatik Bölüm Başkanlığı), guraytonguc@akdeniz.edu.tr, ORCID: 0000-0002-5476-711
** Dr. Ögr. Üyesi, Distance Learning Vocational School, Isparta University of Applied Sciences, 32200, Isparta, Turkey (Uzaktan Eğitim Meslek Yüksekokulu, Isparta Uygulamalı Bilimler Üniversitesi), betulozaydin@isparta.edu.tr , ORCID: 0000-0002-2011-1352

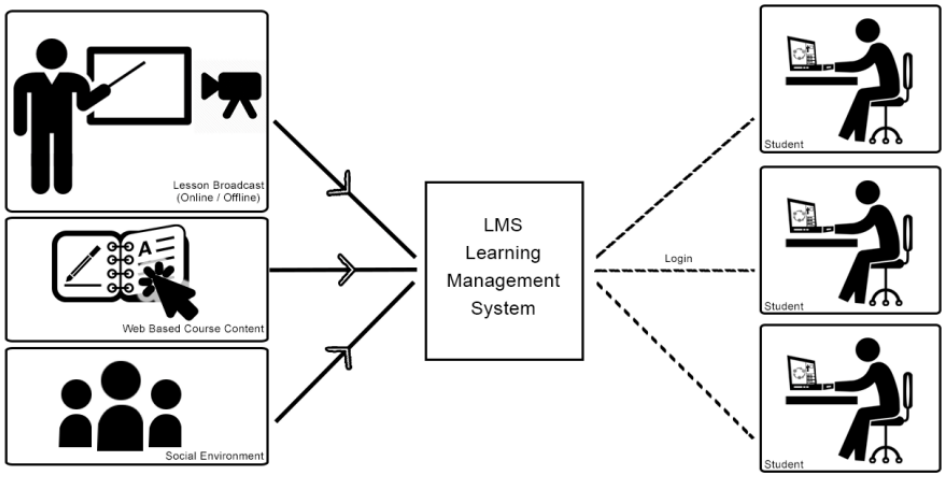


Figure 1. General handling of computer and internet supported distance education system

It is known that the history of distance education is based on the 1840s. (Rumble, 2001). One of the first universities to offer distance education diplomas was established in 1858 (Rao & Krishnan, 2015). As you can see, distance education is an old institution. Today, distance education continues to be widespread due to technological developments, opportunities and human needs. As education programs adopt the latest technologies for learning, the popularity of distance education is increasing. According to US reports, more than 12 million students at the university level during the 2006 - 2007 academic year studied in the distance learning environment (Parsad & Lewis, 2008). The other report; in the analysis made between 2012-2015, it was determined that general higher education enrollments in the USA decreased. However, it was determined that the tendency to distance education increased between these years. The number of students who took at least one course via distance education in 2015 is 29.7% of all students in higher education (Allen & Seaman, 2017). Turkey in the 2018-2019 academic year, the number of students enrolled in distance education university was determined to be 82 457. In the same year, the number of formal education students was 3.777.114, while the number of open education students was 3.880.931 (Yuksekoğretim Bilgi Yonetim Sistemi,2020). As seen, the number of distance education students is quite high. In a system that has so many students, it is seen as possible that students have expectations from the educational environment. One of the things that is needed to increase the quality is to provide interaction because it is known that interaction is crucial in the learning process. This situation is very important both in the synchronous and the asynchronous learning process in the distance education system where the students and the lecturers are away from each other. The history of distance education is expressed in five steps by Moore and Kearsley (2011). The first generation, called correspondence, includes home studies. Radio and television broadcasts, open universities, teleconferences and finally internet / web phases have formed the next generations. It has become possible to interact with the Internet / web generation through technology that has developed in the last stage.

It is possible to talk about different types of interaction in distance education. Moore (1989) refers to three types of interaction; student-student, student-teacher, and student-content. Anderson and Garrison (1998) mentioned teacher-teacher and content-content interaction among the types of interaction as seen in Figure 2. These types of interaction are crucial for the implementation of profound and meaningful learning.

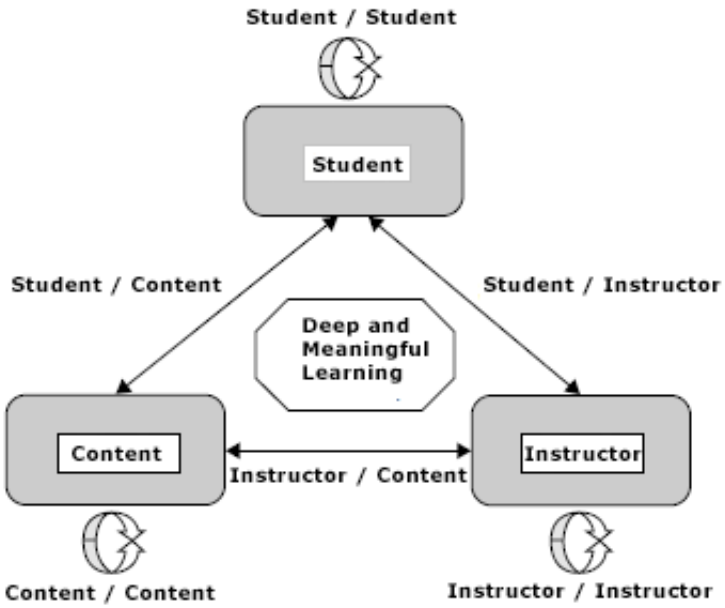


Figure 2. Interaction model in distance education (Anderson & Garison, 1998; Cited: Anderson, 2003, 133)

In student-student interaction, learning is realized as a result of students' sharing their ideas, knowledge and experiences with other students and discussions. Student-student interaction, which is a critical component in distance education, has been found to have many benefits as well as to increase motivation (Anderson, 2003).

Student-teacher interaction; this type of interaction, which takes place via teleconferencing or distance education, enables students to take advantage of the teaching teacher's experiences (Moore, 1989). Anderson (2003), using the results of different studies, stated that the interaction between student and instructor is an advantage, and it is an important influence on areas such as motivation, feedback and success.

Student - content interaction is expressed as the interaction of the student with the educational content in the online environment (Zhang, 2005). This type of interaction is of particular importance in adult education, as students spend most of their time with different educational content. The most important goal of student-content interaction in the online environment is to increase the content and process control of the learners along with participation (Zhang, 2005). In studies conducted in distance education it was found that student-content interaction was important (Daghan & Seferoglu, 2012), that this interaction led to an increase in performance (Northrup, 2001), and that both performance and satisfaction are higher if there is more student-content interaction (Zhang, 2005). Karatas, Ustundag and Gunes (2009) have noted that different levels of interaction can be achieved with content and classify it at four levels. According to this;

Level 1 interaction is passive interaction. text, graphics, charts and images can be used together. In this context, the students are provided with a back and forth button.

Level 2 interaction is there is limited interaction. In addition to the first level content, the content can include column matching, drop-down menus, multiple selection tools, and interactive animations. In this context, students cannot enter data but can follow their transactions.

Level 3 interaction is complex interaction exists. Students are allowed to make changes to information entries and graphical objects.

Level 4 interaction is level interaction. In this type of interaction, which is called real-time interaction, the student is included in an analogy which reflects the information contained in the content as it is. Real-time learning and evaluation are both involved and students interact with other students and teachers.

Many researchers emphasize the importance of interaction in the educational process (Anderson, 2003). This has also led to the fact that the most important role of the teacher in distance education is to provide high-level interaction (Kearsley, 2000). For this reason, it seems that there are many studies emphasizing the importance of interaction in distance education (Kauffman, 2015; Kuo, Walker, Belland & Schroder, 2013; Kuo, Walker, Schroder & Belland, 2014; Meyer, 2014; Navarro & Shoemaker, 2000; Summers, Waigandt & Whittaker, 2005). It has been determined that the majority of studies conducted are related to student satisfaction and performance (Anderson, 2003; Kauffman, 2015). Research on student satisfaction has also shown that distance education students value increased opportunities for interaction in online environments and that they prefer them (Navarro & Shoemaker, 2009; Vrasidas & Mclsaac, 1999). Studies related to interaction seem to emphasize social interaction (Augar, Raitman & Zhou, 2004; Muilenburg & Berge, 2005; Samuel, 2015; Thomas, 2002). Nandi, Hamilton and Harland (2015) also pointed out that although there are not many studies on student-content interaction, student-content interaction influences student satisfaction online, and is also ranked first (Chou, Peng & Chang, 2010; Strachota, 2006). It has also been determined that this interaction model is of great importance in terms of structuring knowledge in students (Nandi et al., 2015).

As you can see, interaction is considered to be one of the important elements of the educational process. Different methods can be used to increase interaction in the distance education environment. One of these methods is thought to be hologram. Aslan and Erdogan (2017) stated that hologram technologies are one of the methods that can be used to overcome the problem of not being able to practice as much as students in medicine, veterinary medicine and health discipline education. In this study, it is thought that one of the methods that can be used for solving the interaction problem in distance education is hologram technology.

Purpose

While interaction has a positive effect on the learning process, lack of interaction leads to tedious and difficult of education (Chang & Smith, 2008). It is also known that lack of interaction causes students to feel alone and isolated (Muilenburg & Berge, 2005). When compared with conventional education, it is seen that the drop-out rate in distance education is higher (Zhang, Zhao, Zhou & Nunamaker, 2004; Simpson, 2013). The distance education preferred by students due to their flexible structure was determined to have different factors in their drop out. It appears that lack of interaction appears to be among the reasons for dropping out of education (Willging & Johnson, 2009).

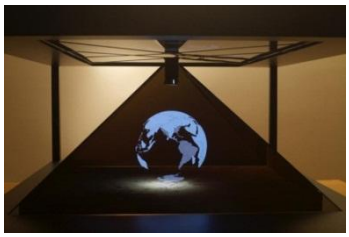
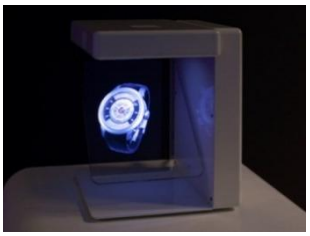
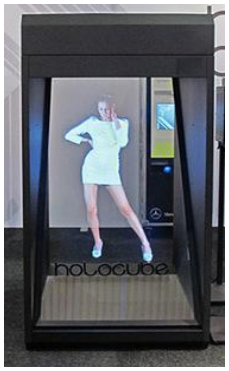
It seems that student-content interaction, one of the types of interaction in the distance learning environment, is important. By increasing this interaction, it is thought that the satisfaction and motivation of the students can be increased and they can be prevented drop out. One of the methods that can be used for this purpose is a three-dimensional hologram.

In this article, three dimensional hologram technology based tools have been suggested to be used in distance education in order to contribute to the solution of the aforementioned problem and several possibilities are examined in various aspects.

Hologram Technology and Existing Tools

Light is emitted as an electromagnetic wave consisting of an energy package called a photon. Light has properties such as frequency, wavelength, and amplitude like other waves (Beichner, 1995). In the color photograph, this information is also added to the wavelength (color) changes. Here, the picture is taken three times with three different color filters. In real life, images include not only amplitude and wavelength information, but also phase difference information which gives a sense of three dimensions.

Recording by recording the phase information of real images with laser beam is called hologram recording. The method used to obtain the hologram is called holography. Phase information is also recorded along with the brightness of the laser beam at any point during the processing of this information (Demirbilek, 2009). A hologram, therefore, is a three-dimensional photograph of a real object created with a laser beam. The hologram is formed by transferring three-dimensional visual information to the hologram plate with laser beams and storing and transferring the image to a multidimensional space by adding motion effects. Traces recorded to see the recorded hologram should be illuminated by a laser beam (Mehta, 2011).

Suitable for small size applications	 a. Pyrobox (Musion Turkey, 2014)	 b. Holocube HC10 (Holocube, 2016a)
Suitable for large size applications	 c. Omni-Suite (Baxter, 2013)	 d. Holocube HC70 (Holocube, 2016b)

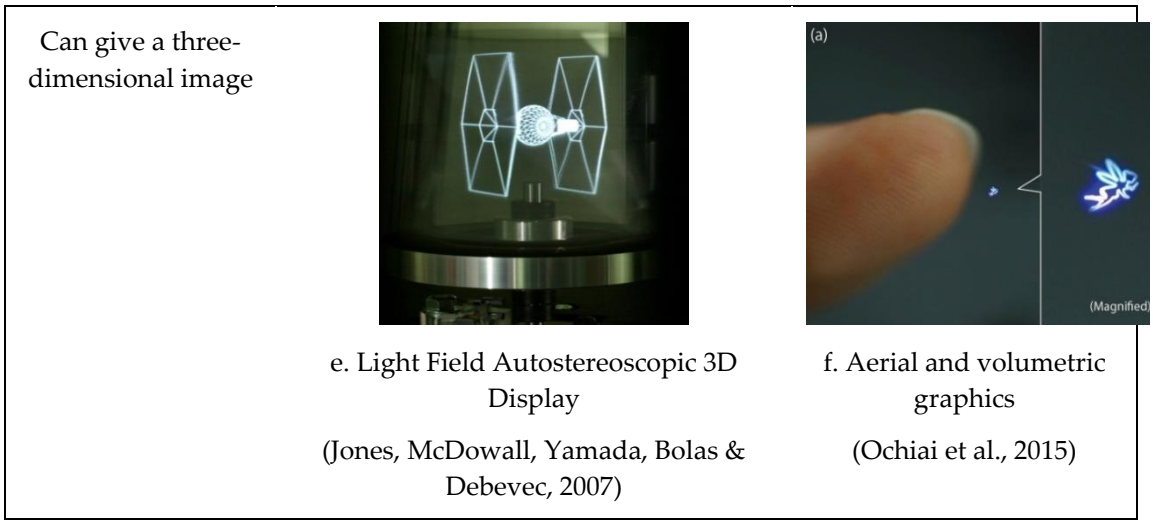


Figure 3. Certain devices that can be used to create hologram and hologram-like images

Currently, two methods are widely used for real-life transfer of computer generated hologram images. The image to be formed in the first method shown in Figures 3a, b, c, d is reflected on a thin, transparent, special screen. Also known as reverse projection film, this screen is mostly used in virtual showcases, virtual assistants, etc. applications. The image on the device shown in Figure 3.a reflects from the reflective plates placed in the pyramidal form of the two-dimensional images given inward from the top, resulting in an assembly result. Similarly, in the devices shown in Figures 3.b, c, and d, the two-dimensional images reflected from above are reflected on the transparent screen, allowing the images to hang in the air and awaken a three-dimensional feeling. Similar to this system, a three-dimensional image of artist Michael Jackson was created on stage during a prize-giving ceremony, five years after his death (Gallo, 2014). In 2013, a credit assessment company conducted interviews with customers physically located elsewhere (Baxter, 2013). In the device shown in Figure 3.e, the image is formed by a mirror mechanism rotating in the same way as reflected from the upper side and spreading around.

In the second method, usually called hologram, the images are formed in a way that the images are suspended in the air and are referred to as 3D holograms. In addition to the images that are attempted to be created by reflection, three-dimensional images are produced nearest to the reality by high-power laser beams forming the three-dimensional voxels in the air as in Figure 3.f.

How Can Hologram Technology be Used in Distance Education

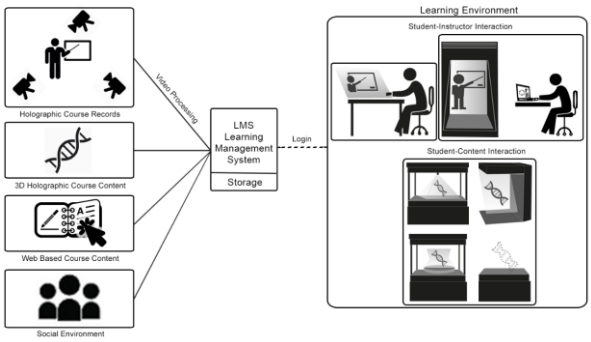


Figure 4. Recommended model for using hologram technology in distance education

In the model proposed in Figure 4, the traditional computer and internet supported distance education system is supported by the method of holographic image formation and the devices developed by considering this method.

In order to manage routine operations on the server side of the distance education system, related software is needed for training the management system, online or offline lecture / teleconference and course content publishing. Sakai and Moodle are among the widely used educational management system software. Adobe Connect, Big Blue Button, and Open Meeting are software for course publishing / teleconferencing. Although the number of people who can connect simultaneously with Adobe connect varies, it is seen that up to 1000 participants can be made for now (Adobe connect, 2020). It has been reported that up to 5 links have been successfully achieved with the current technology and technological infrastructure and special software are used to transfer the holographic images.

Some software is needed to organize distance education course contents and prepare them for publication. Design software such as Adobe Dreamweaver and Adobe Flash are used to prepare content for the web page, two-dimensional animation, and three-dimensional animation formats. For the preparation of three-dimensional hologram content, software such as Autodesk Maya or Adobe After Effect is usually required, although system specific software can be found.

In the existing distance education systems, the teacher's voice, image and screen display are transmitted to the students. This requires a computer system with an optional touch screen integrated in the studio, a camera with good quality images, and a microphone. Here, sound insulation and the quality of the used devices are increased and the quality of the image and sound broadcast is increased. In the proposed model, which is supported by three dimensional hologram technology, the hologram room where the course is to be carried out requires camera which can take 3 quality images., a microphone, a light system, a computer system and special devices for recording holographic images.

In a system using Adobe Connect for course publications, a 3-level (3/4) "Lan Connection" connection speed setting and a 1-hour course enrollment amount to approximately 100 MB of storage. Users are advised to have a minimum internet connection speed of 400 Kbps (Adobe Systems Incorporated, 2016) so that users can view lessons with a 1024x768 pixel resolution without any problems. In holographic views, approximately 5 minutes of content occupies 1 GB of storage space. This size is close to 120 times that of known distance education records. In 3D image transmission, the bandwidth requirement is changed according to the content size, and at least 20,000 Kbps (~ 20 Mbps) is recommended as the connection speed between the server and the student. There are also data transfer rate options in the holographic image transfer platform as well as in Adobe Connect software.

Contribution of The Work

Even if the usage of three-dimensional hologram technology does not seem possible in the near future, it may be possible to integrate with distance education if the required technological infrastructure is provided. In addition to traditional magnetic disks for the storage of holographic materials, the creation of storage units based on hologram technology, the development of cameras capable of recording hologram images in the normal environments instead of the dark scenes, the increase in fixed and mobile (DSL and GSM)

internet connection speeds It is among the developments. The development of 3-D and color holographic imaging technology is crucial to the quality of the course content in order to enable animation with richer colors. For the proposed system to be widespread among typical home users or distance education students, reasonable costs for three-dimensional hologram technology must be provided. In case of these developments that may occur in the coming years, it is useful to educate the human power of knowledge which is necessary to prepare the holographic contents. This study has brought the potential for use in the distance education environment in the coming years.

Results and Discussion

It has been determined that interaction in the distance education is important. Interaction increases motivation, satisfaction, performance, achievement of students and decreases dropout rate. It is emphasized that student-content interaction, one of the interaction types, is important in the studies conducted. It is thought that the student-content interaction will be achieved at the highest level thanks to the technology expressed as hologram. Although it is not yet a technology used in distance education, it is hoped that the use of three-dimensional hologram technology in the future will be an important development in distance education. Apple received a patent for hologram technology in 2010. This has given us the signals that holographic images may become widespread especially in the mobile environment (Kunz, 2010).

Existing devices that can be obtained by overcoming the cost problem, such as the above mentioned holographic image-generating devices, also produce two-dimensional images. The three-dimensional image producing devices are monochrome products that are still in operation in laboratories. 3D and color holographic imaging technology needs to be developed for these images to be rendered in richer colors and for better visual pleasure. It is understood that the above-mentioned hologram room will cost the initial installation costs to institutions that want to benefit from this technology according to the known distance education systems that can be carried out with a lower configuration. In addition, the holographic image recordings made in dark environments give better results, which is a disadvantage of the system for the time being. The standard desktop or laptop computer is sufficient for student participation in current distance education. But if holographic technology is to be utilized, the devices that need to be used to display three-dimensional holographic content will have serious costs with today's technology and prices.

As Cevik, Bardakcı & Kılıcer (2016) stated, three-dimensional hologram technology, which has the power to provide a highly innovative transformation in its educational vision and practices, is in the process of being developed and its costs are high, so concrete educational practices are limited. As mentioned above, holographic content retains about 120 times the amount of data currently stored in the unit during distance education. The increase in the amount of data directly affects the capacity of the server side storage units, internet connection speed and the server and students' quotas. As is known, the teleconferencing software used in distance education systems today is not suitable for transferring holographic image of teacher or holographic course material to students. Software developers need to make the necessary corrections or additions in their systems. High storage space may be needed to store the holographic content and related materials. As a solution to this problem, hologram technology based storage units as well as traditional

magnetic disks can be offered as a solution. If this system is used in distance education, it is obvious that more internet resources will be needed. In addition to the DSL connection types, the widespread use of GSM technology, which provides a more advanced communication infrastructure, will lead to distance learning using hologram tools.

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