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GAZ VE TOZ BULUTUNDAN 3B SANAL ÖĞRENME ORTAMINA

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Öz

Üç boyutlu sanal dünyalar öğrenme ortamları olarak kullanıcılarına yeni ufuklar kazandırmaktadırlar. Bununla birlikte, üç boyutlu öğrenme ortamlarının belirlenen hedeflere ulaşılmasında etkili olabilmeleri için dikkatli bir şekilde geliştirilmeleri gerekmektedir. Bu çalışmada Second Life'ta kış sporları teması altında bir öğrenme ortamının analiz, tasarım, geliştirme, uygulama ve değerlendirme süreci ayrıntılı olarak anlatılmaktadır. Analiz, tasarım, geliştirme ve uygulama aşamalarında dikkat edilmesi gereken unsurlardan bahsedilmektedir. Çalışmada, 3B sanal dünyalarda etkili bir öğrenme ortamı tasarımı sırasında kaçınılması gereken önemli faktörler tartıştıldığı için gelecek tasarımcılara rehber olması beklenmektedir.

Anahtar Kelimeler: 3B sanal dünya; 3B sanal öğrenme ortamı; Second Life; tasarım; geliştirme

FROM CLOUDS OF GAS AND DUST TO 3D VIRTUAL LEARNİNG ENVIRONMENT

Abstract

Three-dimensional (3D) virtual worlds represent a new horizon when used as learning environments. However, three-dimensional learning environments need to be carefully developed in order to be effective achieving the specified goals. In this study, the analysis, design, development, imlementation and evaluation process to create a learning environment in the form of an island with the theme of winter sports within Second Life (a virtual world) is described in detail. Steps to be noted in the analysis, design, development and implemetation phases are mentioned. We expect that this study will be helpful to future designers, as we discuss several crucial factors to consider and pitfalls to avoid during the design of an effective learning environments in this 3D virtual world.

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Keywords: 3D virtual World; 3D virtual learning environment; Second Life; design; development

Genişletilmiş Türkçe Özet

Üç boyutlu (3B) sanal dünyalar kullanıcı etkileşimi sağlamaları, gerçek bir ortamda olma hissini arttırmaları, büyük kullanıcı kitlelerine ulaşımı sağlamaları nedeniyle eğitim açısından daha zengin ve daha gerçekçi ortamlar geliştirilmesine imkan tanımaktadırlar (Dede, Ketelhut, & Ruess, 2002; Kapp & Driscoll, 2010; Messinger et al., 2009; Reisoğlu, Topu, Yılmaz, Yılmaz, Göktaş, 2017). Ayrıca 3B sanal dünyalar eğitimcilerin, istedikleri konulara yönelik etkileşimli ortamlar tasarlamalarına olanak tanımaktadır (Gül, Gu, & Williams, 2008; Jansen-Osmann, 2002; Jelfs & Whitelock, 2000; Omale, Hung, Luetkehans, & Cooke-Plagwitz, 2009). Bu doğrultuda, 3B sanal dünyalarda farklı öğrenme ortamlarının geliştirilmesine yönelik çalışmalar gerçekleştirilmektedir (Dickey, 2005; Maddrell, Watson, & Morrison, 2013; Minocha & Reeves, 2010). Bununla birlikte sanal dünyalarda içerik tasarımı, 3B nesnelerin kontrolü ve bu nesnelerin ortamla bütünleştirilmesi kolay bir süreç değildir (Smelik, Tutenel, Kraker, & Bidarra, 2011).Bu nedenle araştırmacılar geliştirilen ortamların tam olarak sanal dünyaların özelliklerinden yararlanmadıklarını, tasarım bileşenlerinin dikkate alınmadığını belirtmektedirler (Zarraonandia, Francese, Passero, Díaz, & Tortora, 2015). Tasarım bileşenlerinin, 3B sanal dünyalarda geliştirilecek ortamlarda öğrenme sürecini önemli derecede etkileyeceğini belirtmektedirler (Procter, Rouncefield, Poschen, Lin ve Voss, 2011). Bununla birlikte bu tür çalımalar genellikle tasarım sürecine odaklanmakta ortamın geliştirilmesine yönelik tüm süreci kapsamamaktadır (Gül, Gu, & Williams, 2008; Zarraonandia, Francese, Passero, Díaz, & Tortora, 2015).

Bu çalışmada ise 5, 6 ve 7.sınıf öğrencilerinin kış sporlarına yönelik farkındalıklarını arttırmaya yönelik 3b sanal öğrenme ortamının geliştirilmesi amaçlanmaktadır. Çalışmada geliştirilen 3B sanal öğrenme ortamının tüm yönleri, ihtiyaç analizinden uygulama aşamasına kadar ayrıntılı olarak açıklanmıştır. Böylelikle analiz, tasarım, geliştirme, uygulama ve değerlendirme aşamalarında dikkate alınan faktörler açıklanmaya çalışılmıştır. Çalışmanın, 3B sanal öğrenme ortamlarının geliştirilme sürecinde rol olan herkes için bir yol haritası olabileceği düşünülmektedir.

Çalışmada, tasarım tabanlı yaklaşım kullanılmıştır. Tasarım tabanlı yaklaşım eğitsel faaliyetlerin iyileştirilmesinde analiz, tasarım, geliştirme ve uygulama aşamalarının döngüsel olarak tekrarlanması nedeniyle kullanılmıştır (Wang & Hannafin, 2005). Çalışmanın farklı aşamalarında farklı katılımcılardan veriler toplanmıştır. Çalışmanın tüm aşamalarında, çalışma ekibinin günlüklerinden yararlanılmıştır. İhtiyaç analizinde 134 ilkokul ve ortaokul öğrencisinden, ortam analizinde 42 öğretmen adayından veri toplanmıştır. 118 ilkokul ve ortaokul öğrencisiyle uygulama gerçekleştirilmiş, kullanılabilirlik testi ise yedi öğrenciyle yürütülmüştür. Veri toplama aracı olarak çalışma ekibinin bir yıl boyunca tuttuğu günlüklerden, Yilmaz et al. (2015) tarafından geliştirilen kriter listesinden, ihtiyaç analizi, kullanılabilirlik testlerinden ve gözlemlerden yararlanılmıştır. Elde edilen veriler analiz, tasarım, geliştirme, uygulama ve değerlendirme aşamaları dikkate alınarak betimsel olarak analiz edilmiştir. Bulgular literatürdeki benzer çalışmalarla desteklenerek açıklanmıştır.

Yapılan analizler sonucunda 3B sanal öğrenme ortamlarının analiz aşamasında uygun konu seçimi, hedef kitlenin belirlenmesi ve ihtiyaç analizinin, içerik ve ortam analizlerinin gerçekleştirilmesi adımlarına dikkat edilmesi gerektiği belirlenmiştir. Gerçekleştirilen hedef grup analizinde, katılımcıların çoğunun kış sporları konusunda hiç deneyimi olmadığı belirlenmiştir. Bu nedenle, 5, 6, ve 7. sınıf öğrencilerinin kış sporlarına olan ilgi ve farkındalıklarını artırmak için 3B sanal öğrenme ortamı geliştirilmesine karar verilmiştir. Çalışmanın amacı Erzurum'da mevcut kış sporları tesislerinin kullanımını teşvik etmek ve kış sporları için yüksek ekipman maliyetinin üstesinden gelmektir. İçerik analizinde, her spor dalında deneyimli eğitmenler ve Beden Eğitimi bölümü öğretim üyeleri ile görüşmeler yapılmıştır. Bu röportajlarda kış sporları ile ilgili temel bilgiler belirlenmiştir. Her sporun içeriği "Nasıl oynanır? (Teknikleri nasıl uyguluyorsunuz ve kilit noktalar nelerdir?) "; "Kurallar nedir ve Puanlama sistemi nedir?"; "Hangi ekipman kullanılır?"; "Hangi üniformalara ihtiyaç duyuluyor?"; "Alan ve pist özellikleri nelerdir?"; ve "Yarışmacı profili nedir?" soruları temel alınarak hazırlanmıştır. Ortam olarak birçok kullanıcının aynı anda bağlanmasına ve sesli sohbet etmesine izin vermesi nedeniyle Second Life kullanılmıştır.

Tasarım aşaması analiz aşamasında alınan kararlar üzerine temellendirilmiştir. Bu aşamada, ortamın tasarımında yaşantı konisi, çoklu ortam tasarım ilkeleri, motivasyon, sosyal, durumsal öğrenme, öğretimsel, sosyal ve bilişsel buradalık, gibi pedagojik faktörlerin dikkate alınmasına karar verilmiştir. Bu doğrultuda senaryo ve öykü yaprakları geliştirilmiştir. Senaryolar ve öykü yaprakları, farklı spor türleri ile ilgili ayrıntılı bilgi içerecek şekilde hazırlanmıştır. Senaryolarda, içeriğin sunumu ve ortamda gezinmeye ilişkin akış haritası çizilmiştir. Öykü yaprakları senaryoları görselleştirmek için kullanılmıştır.

Geliştirme aşamasında, çoklu ortam materyalleri ve 3B sanal öğrenme ortamı, alınan pedagojik kararlar, senaryolar ve öykü yapraklarına göre geliştirilmiştir. Uygulama aşamasında 118 öğrenci ile uygulama yapılıştır. 3B sanal ortamda öğrencilerin karşılaştıkları sorunları belirlemek için yedi öğrenciye kullanılabilirlik testi uygulanmıştır. Uygulamada yapılan gözlemler ve kullanılabilirlik testinden elde edilen verilere göre değerlendirmelerde bulunularak ortamda gerekli düzenlemeler yapılmıştır. Uygulamadan önce, ortam tüm videoları tek bir yerde oynatacak şekilde tasarlanmıştı. Bu modelde, öğrenciler herhangi bir videoya tıklayarak ve ana ekranda videoyu izleyebiliyorlardı. Bununla birlikte, öğrenciler, yüksek sayıda avatar nedeniyle, ana ekranda videoları izlemekte zorlandılar. Bunu aşmak için her video için ayrı bölümler geliştirildi. Uygulama sırasında öğrencilerin çok fazla pano ve panolarda fazla içerik olması nedeniyle sıkıldıkları belirlendi. Bu nedenle Bilgi Evi'nde yer alan panolar ve içerlerinde yer alan içerikler azaltıldı. Alıştırma alanına her bir sporun temel hareketlerine yönelik bilgi, resim ve animasyonların yer aldığı küçük odalar eklendi. Değerlendirme öncesinde, uygulama alanı bir pist ve etrafında izleyicilerin oturabileceği tribünlerden oluşan bir ortam şeklinde tasarlanmıştı. Öğrencilerin alıştırma alanında öğrendikleri hareketleri uygulayabilmeleri için dört temel hareket tabelalar şeklinde pistin etrafına yerleştirilmişti. Ancak öğrencilerin bu tabelalara tıklayarak ve ekranın sağ üst tarafında çıkan "Evet/Hayır/İptal" seçeneklerini kullanarak hareketleri yapması sorunlara neden olmuştur. Pist etrafına yerleştirilen dört tabela kaldırılmış, bunların yerine bir tabela konularak öğrencilerin uygulamaları otomatik yapması sağlanmıştır.

Elde edilen bilgiler doğrultusunda, etkili bir öğrenme ortamı oluşturmak için tasarım mümkün olduğunca gerçekçi, esnek ve kalıcı öğrenmeyi güçlendirecek kadar ilginç olmalıdır. Pedagojik faktörler araştırmada hedeflenen kazanımları en iyi şekilde öğretmek için önceden belirlenmeli, ortama ve ortamdaki materyallere uygulanmalıdır. İçerik, araştırmanın kapsamı ve amacına uygun olmalıdır. İçerik çoklu ortam materyalleri ile desteklenmelidir. Kullanıcıların

3B öğrenme ortamlarında kaybolmalarını engellemek için yönlendirici ve bilgilendirici araçlarından yararlanılmalıdır.

Introduction

Three-dimensional (3D) virtual worlds provide three main components to their users: the fantasy of 3D space, avatars that serve as the visual representation of users, and an interactive chat environment for users to communicate with one another (Dickey, 2005, p.121). Therefore 3D virtual worlds are useful for education because they allow user interaction, enhance the feeling of being in a real environment, are available for large user populations, and can make educational environments visually richer and more realistic (Dede, Ketelhut, & Ruess, 2002; Kapp & Driscoll, 2010; Messinger et al., 2009; Reisoğlu, Topu, Yılmaz, Yılmaz, Göktaş, 2017). They also offer an attractive variety of possible learning environments (Dalgarno & Lee, 2010; Dickey, 2005; Ibáñez, García, Galán, Maroto, Morillo, & Kloos, 2011), allow educators to design interactive learning and teaching environments focused on topics of their choice, with whatever content they wish to use (Gül, Gu, & Williams, 2008; Jansen-Osmann, 2002; Jelfs & Whitelock, 2000; Omale, Hung, Luetkehans, & Cooke-Plagwitz, 2009). This environments allow designers to create fantastic objects and various realistic environments and use tools to facilitate social experiences (Hai-Jew, 2010). In this direction, studies have been conducted to develop different learning environments in 3D virtual worlds (Dickey, 2005; Maddrell, Watson, & Morrison, 2013; Minocha & Reeves, 2010). However, it is not an easy process for many designers to design content in virtual worlds, to control 3D objects, or to integrate these objects into the environment (Smelik, Tutenel, Kraker, & Bidarra, 2011). There is a need to discuss the relationship between student experience and engagement in the design of 3D virtual learning environments (Minocha & Reeves, 2010). Once design and development of 3D virtual learning environments have been done carefully, it is possible for users to freely explore the 3D environment,have fun and improve their knowledge and skills (Reisoglu, Yilmaz, Çoban, Topu, Karkus, & Göktas, 2015). On the other hand, researchers emphasized that the developed environments do not fully exploit the properties of virtual worlds and make recommendations for components to be considered in the design process (Zarraonandia, Francese, Passero, Díaz, & Tortora, 2015). The design components will affect the entire process of learning in environments developed with new technologies such as 3D virtual worlds (Procter, Rouncefield, Poschen, Lin ve Voss, 2011). However, those studies focus on the design process in general and do not provide detailed information about the other phases of the instructional design (Gül et al., 2008; Zarraonandia, Francese, Passero, Díaz, & Tortora, 2015).

In this study, a 3D virtual world was designed and developed as a learning tool to increase the awareness of students about winter sports, avoid incurring high educational costs for infrastructure and equipment, and to eliminate the need to wait for the proper seasonal conditions for these sports. In this way, the students' interest in and awareness of winter sports could be enhanced without any seasonal or financial barriers, or other risk factors. All aspects of this 3D virtual learning environment have been described in detail, from the needs analysis to the practical evaluation stage. This study was conducted to provide a road map for all involved in utilizing 3D virtual worlds as learning environments. The intention was not only to benefit the users, but also future designers, by indicating useful design methods and pitfalls to avoid while creating an effective 3D virtual learning environment. Consequently, this study addresses the issues that were considered in analysis, design, development, implementation and evaluation stages. The following research questions guided this study:

While developing the 3D virtual learning environment;

1. What factors were considered in the analysis stage?
2. What factors were considered in the design stage?
3. What factors were considered in the development stage?
4. What factors were considered in the implementation and evaluation stages?

Method

In this study, a design-based research model (Edelson, 2001) was used that focuses on the interactions of the learners, which is used in the design and development of innovative learning environments defined by Design Based Research Collective (2003). According to Wang and Hannafin (2005), design-based research; "Is a systematic and flexible method of research aims to improve the practices of teaching and learning theories and to develop context-sensitive design principles in the collaborative work of researchers and participants, while performing the analysis, design, development and implementation, evaluation stages cyclically in real practice environments. These stages are similar to the instructional design stages in terms of flexible, systematic and non-linear structures.

The Participants

At each stage of the study, data were obtained from different participants. Throughout the analysis, design, design, development, implementation and evaluation phases of the environment, the opinions of the study team were taken. Large-scale studies need to be managed well to be carried out effectively and in a coordinated manner (Nokes, Greenwood, & Goodman, 2003). Also, it is essential that the specialists on the study team be selected carefully by the coordinator to best fit the aim, scope, educational goals, and technical requirements of the study (i.e., they should be competent with the hardware and software). This study was managed by a coordinator with experience in technology integration in education, instructional design, instructional technologies, and 3D virtual learning environments. Other people took part in the study to conduct the curriculum development, instructional design, environment and material design, financial affairs, and to create the technical infrastructure. Some of the team members were responsible for more than one task, while others made contributions via cooperation. Figure 1 presents the participants roles in the study regarding the processes of analysis, design, development, implementation and evaluation. The researchers coordinated the activities carried out in the 3D environments, and to meeted the participants’ expectations regarding the technical, application, and equipment-related problems regarding the 3D virtual environment. The team described in Figure 1 below.

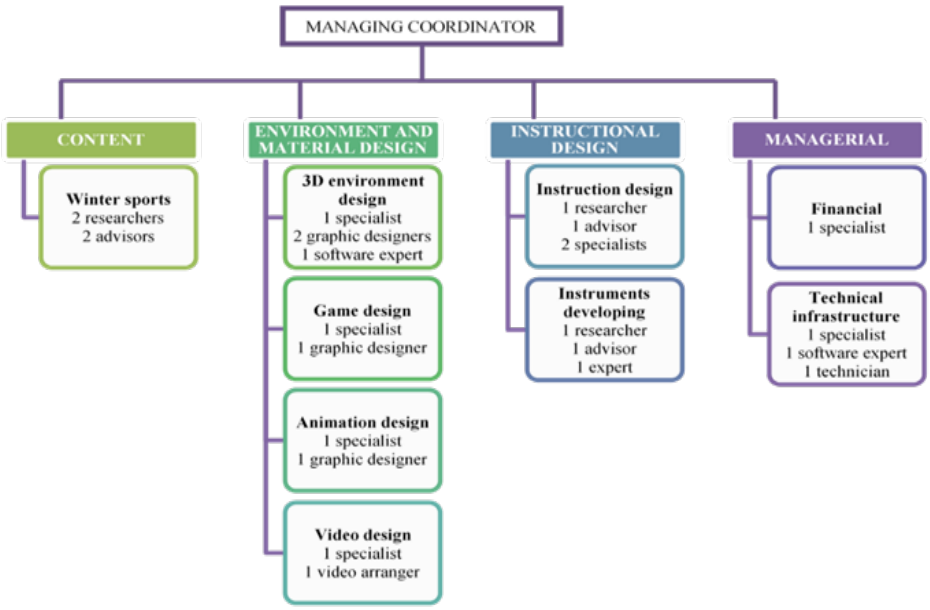

Figure 1. Task distribution in the study team

In order to carry out the needs analysis during the analysis phase of the study, a total of 134 students were employed, 43 of them were 5th grade, 46 were 6th grade and 45 were 7th grade students. 63 of these students are girls and 71 are males. While the environment analysis was conducted, opinions of 42 pre service teachers who were educated in the Department of Computer and Instructional Technology Education were taken. After the environment was developed, an implementation was conducted with 118 students, 25 of them were 5th grade, 51 were 6th grade and 42 were 7th grade students. 54 of these students are girls and 64 are males. Seven students, two girls and two boys at the 5th and 7th grade level and two girls and one boy at the 6th grade level participated in the usability test.

The Data Collection Tools

The ideas of the study team were obtained in the light of weekly meeting records and notes that the team members had taken in the process. The needs analysis scales in the literature were examined for needs analysis. A needs analysis survey was developed to identify students' demographic information, winter sports experiences, computer skills and playing digital game situations. In the analysis of the environment, the criteria list developed by Yilmaz, Reisoglu, Topu, Karakus and Goktas, (2015) was used. Observations, tasks that developed by study team about activities that students have to perform in the environment. Usability test was used to identify the challenges students experienced in the 3D virtual environment. In the development of usability test and needs analysis, the opinions of the two field experts were obtained and the necessary arrangements were made.

Data Collection Process and Data Analyse

In the analysis phase, the needs analysis questionnaire was applied to a group of 134 students before the environment was developed. In the environment analysis, 42 pre service teachers using the OpenSim platform were asked to develop environments and materials to create awareness of winter sports in 3D virtual worlds. After the completion of the development stage, preservice teachers were asked to complete the criteria list developed by Yilmaz et al. (2015). The criterion list consists of system features, usability, multimedia tools, software tools, security, cost, avatar features, activities, communication tools, learning environments, learning-teaching activities headings. In the analyses, design and development stages, the team members' design diaries were used as data. Each team member kept the design diaries for about one year. In the implementation stages, a seminar on the use of 3D virtual environment and materials was given to the students. The students are allowed to perform activities in the environment in line with the assigned tasks. The screen recordings of the students were taken and the process was recorded with video camera and sound recorder. During the implementation of the usability test students' completion status, times spent performing the tasks, and the difficulties they encountered while accomplishing the tasks were all recorded.

The collected data were categorized to correspond to the analysis, design, and development, implementation and evaluation stages of the 3D virtual learning environment. These are summarized in Figure 2. The data collected from participants were analyzed using the descriptive analysis methods. The findings are described by supporting similar studies in the literature. To ensure validity and reability, two field expert examined the findings.

Analiz	Tasarım	Geliştirme	Uygulama	Değerlendirme
• Topic selection • Target group selection • Need analysis • Content analysis • Environment and instrument analysis	• *Cone of experience* • *Motivation and control of the environment-objects* • *The design principles for the multimedia and 3D virtual environment* • *Multi-method learning* • *Social and Situational learning* • *Transformational play* • *Critical design ethnography* • *Cognitive, social, and instructional presence* • *Determining the knowledge type, content, and type of material* • *The design scenarios and storyboards*	• Preparing 3D virtual worlds and materials	• Pilot study • Usability test	• Making necessary arrangaments according to the opinion of study team, implementation activities and usability test

Figure 2. The details of analysis, design, and development stages

Results and Discussions

The Analysis Phase

The analysis phase forms the basis of the other steps. When content, student, technology is not analyzed well, important problems are encountered in 3D virtual learning environments (Kapp & Driscoll, 2010). For this reason, the analysis phase needs to be well structured. Otherwise, the whole process will be negatively affected.

Topic Selection

The 2011 Winter Universiade Games in Erzurum were influenced the selection of this topic. The number of spectators in those games was record breaking. Although Erzurum is a winter town, and it has many winter sports facilities (Karaca, 2012), the project team found that only a small number of local people regularly engage in any of those sports. The target group analysis conducted prior to the study also indicated that a majority of the participants in this study had no experience with winter sports at all. Due to these results, it was decided to launch an environment to increase the interest in and awareness of winter sports among the local people.

Target Group Selection and Need Analysis

It is important to help primary and secondary school students, who can not afford to do any of the winter sports, be aware of their interests and abilities without financial problems and risk factors. The study's target groups were students in the 5^{th}, 6^{th}, and 7^{th} grades and from 20 secondary schools in districts of appropriate socioeconomic status within Erzurum.

The training elements to be designed into the 3D virtual learning environment can be determined only after the characteristics and learning needs of the target group are identified. The learning activities should be selected after considering the students' experience (Mount, Chambers, Weaver, & Priestnall., 2009). A needs analysis questionnaire was developed by researchers in order to record demographic data, winter sports experience, and the computer and game skills of the students. This questionnaire was administered to 134 students (5th, 6th, and 7th grades). As a result of the analyzes, it was revealed that 47.8% of the students did not have experience of any of the winter sports. Among the winter sports that students were most interested in, there were artistic skates (16.7%) and speed skating (9.7%). 57.4% of the students were not interested in any winter sports. However, 85.8% of the students wanted to deal with a winter sport. On the other hand, it has been determined that the vast majority of students can easily use computers, play 3D computer games frequently, and think winter sports can be fun in 3D environment. In this direction, it has been decided that 3D virtual environment should be designed to enable students to have information about winter sports, sports clothes, movements and to learn sports movements and apply them in the virtual environment.

Content Analysis

At this stage, interviews were held with experienced trainers in each of the sports, and with two faculty members in the Physical Education department at Ataturk University. Basic knowledge about the focal winter sports was identified via these interviews. A specific training sequence was also developed to help the students gain the appropriate knowledge more easily. The content of each sport was divided into topics such as "How do you play it? (How do you implement the techniques, and what are the key points?)"; "What are the rules, and what is the point scoring system?"; "What equipment is used?"; "What uniforms are needed?"; "What are the field and track characteristics?"; and "What is the competitor profile?".

Instruments and Environment Analysis

There are various 3D virtual media platforms, which offer designing features, and structural and communication tools to develop 3D virtual environments (Merrick et al., 2011). For this study, Second Life and OpenSim were pilot tested in order to find the best platform specifically for this study. OpenSim was preferred at first, as it is free and allows researchers to manage the server (OpenSimulator, 2012). Forty-two preservice teachers from the department of Computer Education and Instructional Technology at Ataturk University were asked to prepare a 3D virtual learning environment on OpenSim to teach winter sports. The OpenSim platform was assessed using the criteria list. Obtained data revealed that the OpenSim platform offered some advantages. As stated above, it is free to use and permits researchers to administrate the server. On the other hand, it also entailed some barriers, such as that only a small number of users could use the environment at one time, and there was an insufficient number of existing servers that could accommodate the platform. Other barriers were additionally faced during the cooperative design process. It was found to be unsuitable for this type of study. For these reasons, design team selected Second Life. Second Life permits many users to connect simultaneously and also allows smooth voice chatting (Coban, Karakus, Karaman, Gunay, & Goktas, 2015). However, it is a fee-required system and does not allow server administration. Design team decided to analyze the technical infrastructure of the platform as well, in order to avoid barriers in later stages of the study. The hardware, software, and the Internet facilities of the computers to be used in the implementation stage were checked in the schools involved in the study. Shortcomings and breakdowns were corrected accordingly.

The Design Stage

The environment was designed based upon the findings obtained in the analysis stage. The compliance of the environment with the study aim was assessed in the first stage to ensure smooth progress in subsequent stages (Kapp & Driscoll, 2010; Morrison, Ross, & Kemp, 2007). The study team held weekly meetings to discuss and solve barriers that were encountered. They assessed and compared the aim of the study, the students' profiles, the needs analysis results, features of the learning environment, pedagogical factors guiding the study, and the compliance between the content and the multimedia elements. The factors taken into consideration during the design and development of the 3D virtual environment and multimedia materials are explained below.

Identifying the Pedagogical Factors

Today 3D virtual worlds bring new challenges and opportunities to design education which require the consideration of new pedagogical approaches when employing emerging design fields (Gül et al., 2008, p.582). Based on the various features of 3D virtual environments, situational and experiential, user-oriented, motion-based, discovery-oriented design principles should be pursued (Kapp & Driscoll, 2010). 3D virtual environments should be designed in a way that attract the users' attention. They should also keep their cognitive loads at an optimum level, and let the users interact with each other without being bored or getting lost within the media, so that learning can take place in a shorter period. This learning environment was designed according to these pedagogical principles, and with consideration given to the target groups' needs analysis and skills to be trained. The pedagogical factors and their implications for the design are described below.

Cone of experience/Motivation and control of the environment-objects. In this study, situational learning environments were created, so that the students could feel like they were having real-life experiences, as was suggested by Dale (1946) in the "Cone of Experience." The students were told that they could shape and move their representative avatars as they wish in the media. It is stated that they can perform learning activities by interacting with objects in the environment.

Though 3D virtual environments normally are based on the principle of allowing the users to enjoy full freedom of movement (navigation) within the environment. But users were prompted to follow a certain route in this study. The reason for this is that interaction with the environment-objects could be enhanced by controlling the novice users' navigation route (Mount, Chambers, Weaver, & Priestnall, 2009), and motivation could thereby be preserved (motivation tends to drop if nothing happens in the environment due to failures of the users to productively interact with the environment-objects). Therefore design of the learning environment should be made by considering the issues have a positive effect on student motivation providing attractive design, student enjoyment and confidence, and an instructional value (Yilmaz, Topu, Coban, & Goktas, 2013). To help the students to remain interested, an attempt was made to indicate an optimal path to follow while learning the subject. Comprehensive rubrics (footprints and signboards) and guidelines were prepared in various file and presentation formats to guide the users. Also, teleports were used to indicate transition portals in the environment (this is a transition tool that is specific to virtual environments). This helped the students switch to the next areas in the sequence, so they would not get lost.

The design principles for the multimedia and 3D virtual environment/Multi-method learning. It is important to design multimedia materials effectively for the environment to be interesting, similar to reality, flexible, and to increase permanent learning (Mayer, 2001). In addition, the 3D virtual environment principles of Kapp and Driscoll (2010) need to be taken into account because 3D virtual worlds are equipped with many features. In this study, an "Information House" was designed to provide theoretical information using audiovisual materials, and a "Dressing Room" was designed where the avatars could put on special uniforms for each sport via animations. An "Exercise" area was designed to provide detailed illustrations for the sports movements via animations and images. Using the avatar, the user could perform each movement. A "Performance" area was developed to exhibit all of the movements that can be done with the avatar. In animations attention has been paid to reflect the movements related to winter sports well, allow the demonstration of dangerous movements, offer opportunities to simplify complex movements (Alessi & Trollip, 2001). In the videos attention has been paid to ensure the video content is consistent with the winter sports and matches the student's level, the video is of sufficient length and avoid distractions.The videos were recorded with professional winter sport trainers. The layout of the learning environment and the areas designed for each of the winter sports are displayed in Figure4.

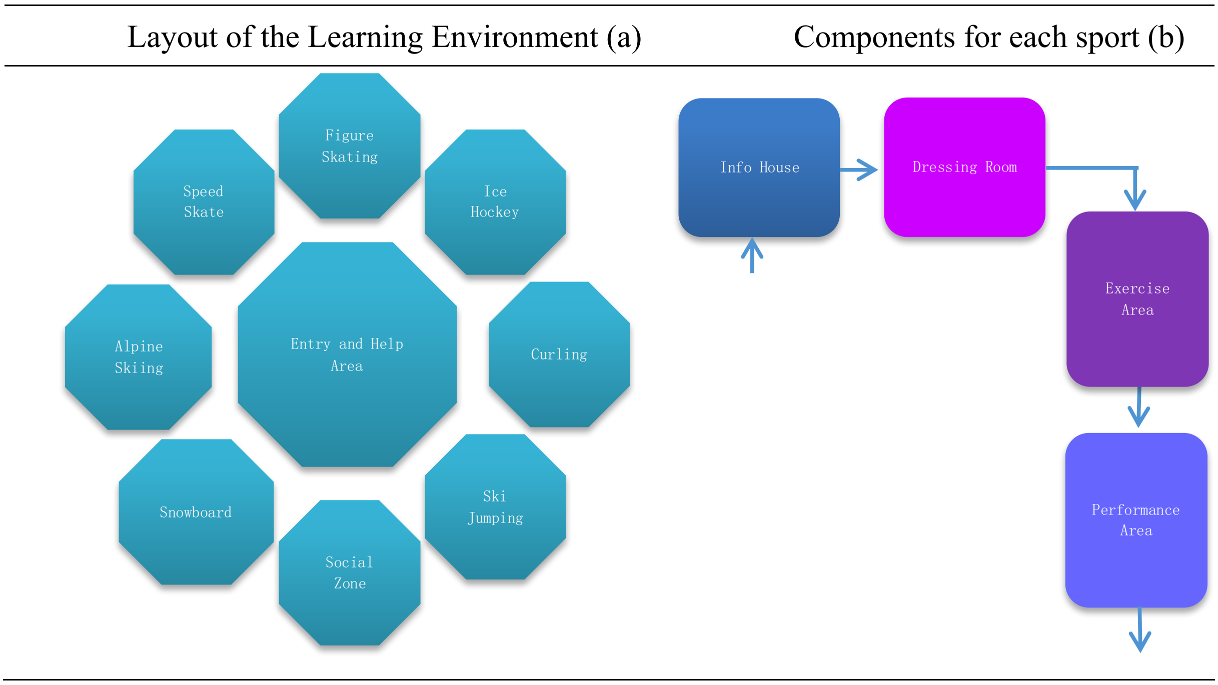

Figure 4. Layout (a) and areas for each of the winter sports (b)

3D virtual worlds contain several types of materials and allow users to interact with them at their option. However, the manner of integrating the materials into the environment to best train users must be carefully considered. Multimedia materials (videos and animations, etc.) in the environment need to be designed in a way that is suitable for the selected content, and so they can be accessed by several methods. They also must be coherent, consistent, applicable to audiovisuals, without redundant knowledge, attention-grabbing, and designed with an optimum cognitive load (Mayer, 2005; Mayer & Clark, 2007).

Social and Situational learning. In learning environments, to make learning fun it is important that learners feel integrated in the environment and that they become socialized (Holmberg, 1983, 2003). As Holmberg suggested, this also helps to increase motivation and effective learning. 3D virtual learning environments permit the expression of information through social interactions (Ibáñez et al., 2011). Users move in the environment by means of avatars, which can also express their feelings and ideas (Messinger et al., 2009; Papagiannidis, Bourlakis, & Li, 2008). In this study, the virtual environment was designed to be flexible enough for students to interact with both objects and other users in the environment, while they engaged in activities. For example, the students could access the information in the Information House, and perform exercises and implementations actively. Moreover, both written and voice communication media were used to permit the students to communicate easily with each other, and exchange information. A social activity area was provided for them to learn through interaction with one another.

According to situational learning, learning takes place as individuals become engaged in realistic contexts, both interacting with others and practicing provided tasks (Young, 1993; Ibáñez et al., 2011). In this study, the situation or context where learning was to take place was related to the purpose and subject of the environment. The target group analysis showed that a majority of the students knew almost nothing about these winter sports. Due to this finding, virtual experiences were designed to make the students aware of these sports and to help them to eventually play these sports in actual facilities in Erzurum. Winter-like media with weather and soil conditions suitable for winter sports and realistic uniforms were designed for each sport. Performance areas were formed to look as much as possible like the real size and layout of the physical sports venues. Sports halls were designed in the environment for the indoor sports such as figure skating, ice hockey, curling, and short track, ice skating; playing courses were designed for the outdoor sports like alpine skiing, ski jumping, and snowboarding. To increase the sense of realism, videos demonstrating the winter sports, information offered by trainers about these sports, and visual representations of famous athletes were added.

Transformational play and Critical design ethnography. According to transformational play, the user should be placed in a situation to help him/her to understand both the content and its context (Barab, Pettyjohn, Gresalfi, Volk, & Solomou, 2012). The purpose of developing the 3D virtual environment was to enable students to act like a winter sport athlete and to interact with the content, objects, environment, and other students. For example, the students could wear figure skating uniforms and perform the same movements that they practiced in the Perofrmance area. In this way, the relationship between the content and the environment was strengthened. The goal was to let the students feel like they were training in the same way as famous figure skaters while learning.

Critical Design Ethnography refers to designing for a certain context, while also considering uses for future times and cultures (Barab & Squire, 2004). Though this environment was intended for students in Erzurum, all of the elements of the tool are adaptable to any environment. Furthermore, the highboards for ski jumping, sports halls, and skiing centers look like their equivalents in most winter sports centers, though these were designed to be similar to the real examples in Erzurum. Critical design ethnography also targets social change. Despite an abundance of opportunities, the current percentage of young people who are already specialized in any winter sport remains very low, especially in the eastern parts of Turkey, due to the lack of infrastructure. The available infrastructure in Erzurum suffices for those sports. The 3D virtual environment in our study is modestly expected to raise consciousness in order to turn Erzurum into a special place where winter sports athletes can be trained.

***Cognitive, social, and instructional presence*.** Studies in the literature suggest that educational experience along with instructional, social, and cognitive presence components can be investigated more effectively in 3D virtual learning environments. Instructional presence is defined as designing, facilitating, and guiding social and cognitive presence, which influences the acquisition of learning outcomes that are meaningful for individuals and valuable in educational terms (Arbaugh & Hwang, 2006). Social presence refers to students presenting themselves as real individuals with their own characteristics to a community (Shea & Bidjerano, 2009). Cognitive presence is about in-depth thinking, discussion, and mental activities that influence meaningful learning (Carlon et al., 2012). Thus, a teacher was present in the environment for instructional presence, and various materials were used such as boards, video, and animations to present the content. Regarding social presence, the students were provided with written and voice communication options and asked to use gestures and mimicking. Lastly, cognitive presence was ensured by providing students with opportunities to search varied areas for learning content.

Determining the knowledge type, content, and type of material

When designing any learning environment, it is important to properly present the content and corresponding technological tools after they have been combined with the pedagogical approaches (Niramitranon, Sharples, & Greenhalgh, 2010). Displaying the content in its proper context and as neatly as possible helps the users relate the virtual tools to real life experiences (Kapp & Driscoll, 2010). For the content analysis, experienced athletes from all of the selected sports, trainers, and faculty members of Physical Education were interviewed to identify the most important content for inclusion. In addition, study team contemplated what chronological order of presentation would be most suitable for learning these crucial points.

Multimedia materials were selected for the winter sports in the 3D environment, after considering the context, scope, content, and convenience to suit the students' needs. The materials were selected by knowledge type. Designers, first planned to design an Information House containing all of the above elements regarding the sports. The house was designed with slides on the first floor and videos on the second. Teleports were inserted instead of stairs between the two floors. Later, the structure was changed to a single-storey house because students might not move between the floors, if they did not notice the teleports. Finally, on one part of the building were placed boards illustrating basic features of the winter sports; and in the other part were video representations showing the most important movements, both step-by-step and overall. In the Exercise and Performance areas, where students can put into practice the psychomotor skills they have learned, the intent was to show them the most important movements of the winter sports. Animations were thought to be more effective to indicate the right movements at the right times.

It is very difficult to give feedback on actions, mimicking, and movements conducted with an avatar in the 3D virtual platform. Therefore, certain controlling elements were inserted to prevent missteps by the avatars rather than developing a feedback strategy. As an example, the students were initially hindered by partly illegible boards in the Help Area, where they entered the island. Guidance in this key area was therefore insufficient, and so the students might tend to skip the Help Area when they noticed other interesting areas. Thus, the Help Area was redesigned as a closed space that prevented the students from leaving before they had learned what they were supposed to learn in that section. Therefore, a teleportation point was added to the last Panel and the students were allowed to be teleported to the other areas only on the Condition that they read the Panel. Moreover, the boards were numbered and footprints were used as guides, so the users could not get lost and could access any point they wished without wasting time.

The design scenarios and storyboards

Scenarios and storyboards were prepared to contain detailed information concerning the winter sports island and the different types of sports. In the scenarios, the flow of the content and of the optimal navigation path both inside and among the different areas for each sport were mapped. The storyboards were used to illustrate the scenarios. These included relevant materials for each type of knowledge and for guidance.

The Development Stage

The multimedia materials and 3D virtual learning environment were developed according to the pedagogical decisions, scenarios, and storyboards. Written and visual instruction guidelines were prepared for the students and the teachers separately.

Implemantation and Evaluation Stage

In implementation stage, 118 primary and secondary school students took part in the implementation. During the implementation phase, the students were advised to first visit the Help area, change their avatar profiles, teleport to the short track (a winter sport) area using the island's map, head to the Information House, read the boards, and watch videos there. Furthermore, they could wear the short track uniforms in the Dressing Room, practice short track positions with their avatars in the Exercise area, and lastly, try to perform the movements learned on the short track pist area. In addition to this, facilities were made available for the students to interpret the footprints, signs, and teleports, and to communicate with their peers online and have voice chats in the same 3D environment.

The students were observed by instructional design experts, two graphic designers, and one software expert throughout the implementation. The barriers and shortcomings encountered were recorded in a table by the study team. The usability test was used to determine the barriers faced by students in the 3D virtual environment. The barriers found in the usability test were also added to the table. Then the table, the 3D virtual environment, and the multimedia materials were re-examined by two Instructional Technologies specialists who were asked to propose solutions to discovered difficulties in cooperation with the study team. The design and development stages were conducted simultaneously, and previous decisions regarding the pedagogical factors and materials selection were amended as needed.

Before the first evaluation, the environment had been designed to play all videos in a single environment. In that model, the students could click on any video topic and watch that video on the main screen. However, the students had difficulties playing and watching the videos on the main screen, due to the high number of avatars. To overcome this, separate segments were developed for each video, and the videos were located with each relevant sport (Figure 5a). As a result, the students could go to any section and watch the videos they needed without facing any problems. In the first evaluation it was observed that the students became bored while reviewing the information boards, due to the high number of boards in the hall in first design. Later, the information on the boards was reduced, enriched with visuals, and presented systematically; and the boards were numbered to enhance guidance (Figure 5b). Small rooms were added into the Exercise area for the basic positions and movements of each sport. Then, three screens were placed in the rooms to demonstrate "information," "position," and "video" (animations) for each figure (Figure 5c). The students could imitate the figures with their avatar once they clicked on the animation screen. Titles for the figures were inserted in the small rooms for clarification. In this way, the students could read about any sport from the illustrated boards, watch videos, see animated figures, and practice the selected sport freely. In other words, they could access the materials via several methods which suit their own learning styles. As a consequence, learning difficulties due to individual user differences were avoided. In the first version of the environment, the application area was designed as an environment consisting of a track and stands around which viewers could sit. Four basic movements were placed around the track in order to enable the students to practice the movements they learned in the field of practice. However, it caused problems for the students to click on these signs and make movements using the "Yes / No / Cancel" options on the upper right of the screen. Four signs placed around the track were removed, and a sign was put in place to provide students with the ability to perform automatic applications (Figure 5d).

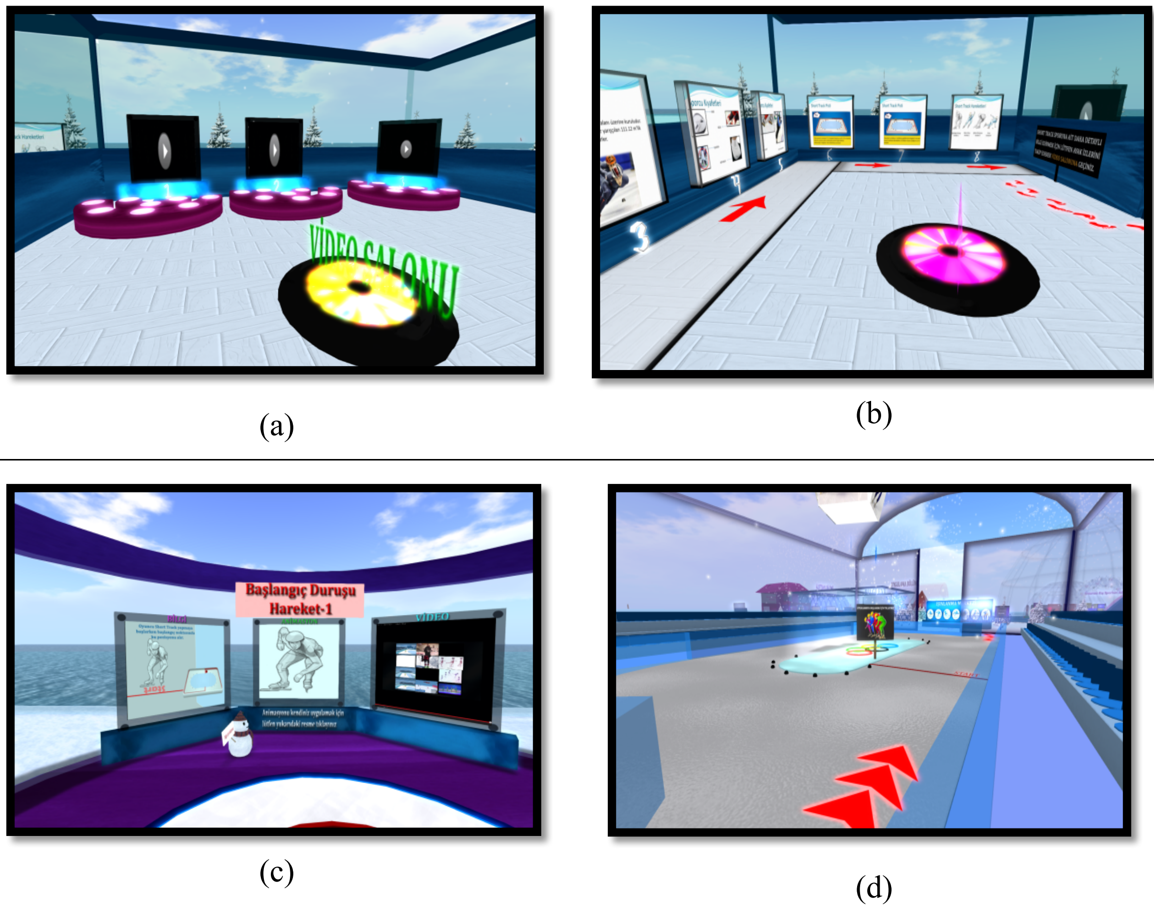

Figure 5. Video hall (a), Presentation hall (b), Exercise area (c), and Performance area (d) after the implementation

Conclusions and Recommendations

Providing a detailed information about the analysis, design, development, implementation and evaluation phases of the 3D environment is important to identify mistakes and barriers encountered throughout the study and to share the experience gained. This process contributes to the development of more efficient learning environments by avoiding the similar barriers in further studies. Therefore, the development of simple and user-friendly 3D virtual learning environment was described in detail.

In the analysis phase, needs and content analysis should be carried out after the target group and topic are identified. Care must be taken to ensure that the topic matches the educational level of the target group. The training elements to be designed into the 3D virtual learning environment can be determined only after the characteristics and learning needs of the target group are identified. Ih the content analysis, expert opinions should be used based on the determined topic. In the analysis of the environment, designs should be made in accordance with the needs of the target group and the content, and the selection of the most appropriate technology or tools should be carried out.

In design phase, it is important to integrate relevant pedagogical approaches when using a technological tool to develop a learning environment (Niramitranon et al., 2010). Appropriate padagogical approaches should be selected taking into account the technology features to be used and the environment should be designed to reflect the basic characteristics of these approaches. Once pedagogical approaches have been identified, storyboards and scenarios should be developed taking into account the technology features. In this way, student motivation, interaction in the environment, social interaction can be increased. Figure 6 summarizes how pedagogical approaches and environment characteristics are integrated in this study. Bearing this in mind, the 3D environment was designed with multimedia materials which were congruent with the context, scope, content, and students' needs. Likewise, the environment was designed to be visually attractive, as this is thought to promote interaction within the environment (Clark & Maher, 2001). if any learning material require voice communication between students and teacher, designers should make another options to provide this material. To create an effective learning environment, the design should be interesting, as realistic as possible, flexible, and capable of reinforcing permanent learning. A social place is a good idea for a large 3D world. This study showed that students mostly communicated with others in social area, they experienced different dance figures, asked questions to others, showed what they explored in the environment.

In the development phase, the environment is developed according to the decisions made in the design phase. For this reason, it is thought that when the analysis and design stages are well planned, less problems may be encountered in the development stage.In the implementatin and evaluation process, the developed environment should be applied to the target group. Since 3D learning environments might be enourmously large, students should be guided with appropriate tools to prevent student's loss in the environment. The experience of target group in the developed environment should be determined by observations, screen recordings or interviews.

As a conclusion conducting a project to use 3D virtual worlds in education is a long and challenging process. It requires many decision making points and plans might not be run properly because of technical, personal and pedagogical issues. However, after overcoming these challenges, it provides a real like experience, effective collaboration and motivation for students.

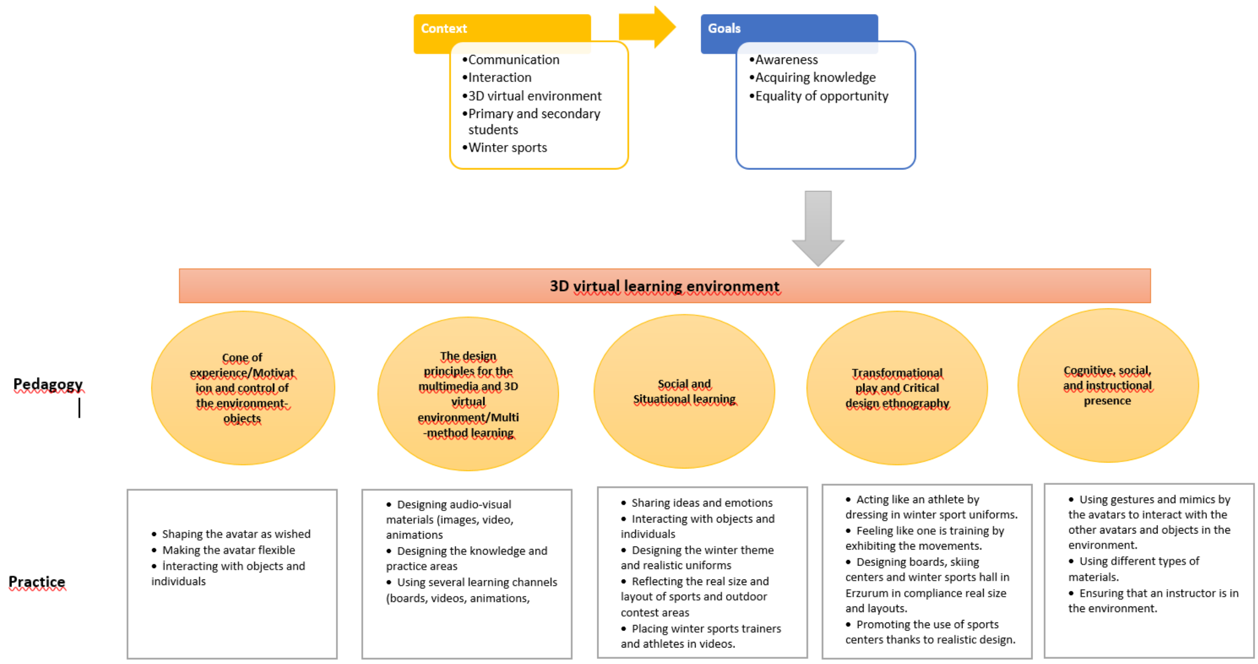

Figure 6. A representation of the theoretical and pedagogical factors in the 3D virtual learning environment

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