Croatian Journal of Education
Vol.17; No.4/2015, pages: 1037-1069
Preliminary communication
Paper submitted: 30th January 2014
Paper accepted: 6th June 2014
doi: 10.15516/cje.v17i4.1239

The Development of a Criteria List for the Selection of 3D Virtual Worlds to Design an Educational Environment

Rabia M.Yilmaz[1], Ilknur Reisoglu[2], F. Burcu Topu[1], Turkan Karakus[1] and Yuksel Goktas[1]
[1]*Kazim Karabekir Faculty of Education, Ataturk University*
[2]*Faculty of Education, Recep Tayyip Erdogan University*

Abstract

The purpose of this study was to develop a criteria list to be considered during the selection of 3D virtual world platforms for educational purposes. As the first step in this process a draft list was created by the researchers based on literature review and heuristic investigation. The draft list was reviewed and revised by 2 internal and 4 external experts, and then used as a questionnaire. The items in the finalized criteria list were divided into three categories as follows: 50 items of technical specifications (system/program features, usability, software tools, multimedia tools, security, and cost), 21 items of interaction specifications (avatars, activities, communication tools) and 8 items of educational specifications (teaching/learning activities). Ultimately, the developed criteria list will be helpful for identifying and eliminating the deficiencies and constraints of virtual worlds used for educational purposes.

Key words: *3D virtual worlds; criteria list development; educational environment design; virtual learning environments.*

Introduction

Nowadays, many researchers are seeking a new virtual world platform since Second Life removed its educational discount. However, the important question is which virtual world they need to turn to. Various virtual world platforms which help users to create 3D environments have constantly been developed and marketed. At present, there are nearly 90 virtual world platforms (Kzero, 2011). Although such characteristics as providing life-like 3D environments, using avatars and communicating with other

users are common in 3D virtual world platforms (Dickey, 2003), platforms may differ according to their purpose. These differences may include features to add animation, create new objects, utilize readily available objects, and customization in many other ways. Suggestions might differ from context to context but before purchasing a virtual world platform researchers should consider several criteria in order to avoid changing the platform in the middle of the project.

3D virtual worlds stand out as a type of technology that allows students to build and share their own knowledge and sometimes to learn by creating their own virtual environments (Girvan, 2008; Huang, et al., 2010; Shih & Yang, 2008). In these environments students are provided with opportunities to design objects and materials, to learn concepts, to apply their knowledge to different authentic tasks, to master and solve the actual problems, and to undergo virtual experiences. Besides, these platforms might be designed as communication, simulation, research areas and virtual campuses (Alarifi, 2008; Hew & Cheung, 2010; Prasolova-Førland, 2008).

In recent years, virtual worlds with 3D media features and synchronous and asynchronous interaction have greatly raised the interest of educational researchers (Girvan & Savage, 2010; Huang et al., 2010). This is due to the fact that 3D virtual worlds are independent of time and place (Dickey, 2005a), they can be adapted for self-directed learning and may provide life-long learning (Heid & Kretschmer, 2009), and they can enhance collaborative working skills (Harris & Rea, 2009). They also allow easier access to information resources, provide opportunities for students to demonstrate their knowledge and capabilities (Dickey, 2005b), and promote interaction via objects, models, and tools (Dickey, 2005b). Due to their educational potentials, some researchers regard 3D virtual worlds as the learning environments of the future (Clarke & Dede, 2005; Salmon, 2009). This has generated academic discussion about the potential of virtual worlds as an educational medium (Choi & Baek, 2011; Girvan & Savage, 2010). Educational researchers have conducted studies to explore the application of instructional principles in 3D virtual worlds (Lok et al., 2006), and to facilitate learning via their employment (Girvan & Savage, 2010; Shih & Yang, 2008).

Recently, the convenience of 3D virtual worlds for educational practices, activities and applications has been a popular research topic. However, a review of the related literature reveals only a limited number of studies that specify what kinds of educational activities can be successfully conducted, what kinds of research topics, learning theories and learning activities can be used in 3D virtual environments (Duncan et al., 2012; Messinger et al., 2008). However, all those studies classify the features of platforms which have already been designed for learning purposes, but they do not address the platforms which are used to create learning environments.

In classification studies on 3D virtual worlds, inherent specifications (Bell, 2008; Warburton, 2009), software and training tools (Dickey, 2005a, 2005b), learning/teaching activities conducted (Richter, 2010; Kay & FitzGerald, 2008), learning

materials associated (Richter et al., 2007), and educational affordances (Dalgarno & Lee, 2010; Warburton, 2009) have been examined. Generally, studies that compare two popular virtual world platforms, or compare virtual world platforms to real-world applications, are more prominent (Dickey, 2005a). Despite the scope of this research, the relevant literature lacks studies that discuss the potential uses of virtual world platforms as an educational medium, and which provide a thorough classification for assessing all of the specifications of virtual world platforms in an educational context. They also fail to offer implications pertaining to educational policy and practices, since they focus on different areas such as business, commerce, etc. (Messinger et al., 2008). It is also important to note that educational studies on 3D virtual worlds have only recently begun to appear in the literature.

Richter et al. (2007) stated that educators lack effective evaluating methodologies for many new technologies, and that this is an obstacle in the adaptation process of virtual worlds. Considering the recent interest in the use of virtual worlds for educational purposes and the lack of appropriate academic assessment studies, it would be useful to develop a criteria list that will help teachers to select a virtual world platform that can meet educational needs and which can help them to identify deficiencies in the existing platforms. Tergan (1998) also approves the idea of appropriateness of criteria lists for any kind of software evaluation. Since virtual worlds can function as a learning environment, instructional designers' perspectives are important as well. Thus, in the present study, the goal was to develop a criteria list that may help instructional designers, developers, and educators to evaluate all virtual world platforms for educational purposes.

The Development of the Criteria List

Criteria lists are defined as item lists which are structured intuitively according to certain categories (Tergan, 1998). In this study, a criteria list was used to reveal the

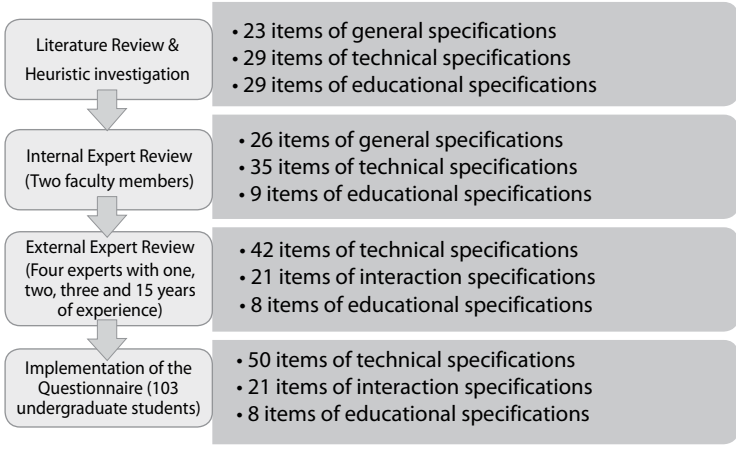

Figure 1. Phases of development of criteria list

strengths and weaknesses of virtual world platforms and to investigate their potential for practical applications. In the development process of this list, the phases of literature review, heuristic investigation and eliciting expert opinions followed by revisions, and conducting a questionnaire were implemented. A summary of the processes is shown in Figure 1. These phases are further elaborated in the following sections.

Literature Review and Heuristic Investigation

The researchers in this study also made use of the literature on virtual worlds to form categories for the criteria list. In addition, a heuristic investigatory approach was adopted, since this method seems to be a useful and efficient way to develop checklists, considering the nature of the new technologies and related theories (Tergan, 1998). Using the heuristic approach, the researchers who had 3 years of experience in the 3D virtual world and PhD in the field of instructional technology wrote items and revised the categories of the criteria list based on their experiences and observations of virtual worlds. To create a draft of the criteria list a heuristic investigation and literature review were used. Items that were created as a result of literature review and heuristic investigation are shown in Appendix 2. According to Appendix 2, entire items under usability category, some items under applications/activities category, system/program features, programming tools, software tools, avatars, and communication tools were pointed out by heuristic investigation while others were developed through literature review.

The Internal Expert Review

The criteria list in this study was first reviewed by 2 internal faculty members, who had expertise in Instructional Technology and 3 years of experience in virtual worlds (OPENSIM and Second Life). Following a face-to-face discussion with those experts, the criteria list was revised with regard to wording issues. Items covering the categories of usability, security, cost, multimedia tools, software tools, communication tools, avatars, and teaching/learning activities were updated (see Appendix 2). It was decided to evaluate each item within the range of 1-5. Virtual world experts excluded modified items and approved or added new items which are based on heuristic investigation and literature. The items of the finalized criteria list are shownin Figure 1.

The External Expert Review

The revised criteria list was then sent to 4 different experts to obtain their opinions. Two of them have Second Life experience and two of them have Active Worlds experience. They were requested to scale 70 items in the list within the range of 1-5 in accordance with their importance for the list. They were also asked to give their opinions, if they had any. Thus, the main groups of categories and some of the items within them were changed, and some items were improved in terms of wording (see Appendix 2). These experts' opinions helped the researchers to re-organize the main category groups. The items of the finalized criteria list are shownin Figure 1.

Implementation of the Criteria List as a Questionnaire

In the evaluation process, users of the list may give crucial feedback and provide empirical data (Tergan, 1998). The reorganized criteria list was converted into an online format and sent to 103 undergraduate Computer Education and Instructional Technology students: 46 females and 57 males. Of these students, 34 were sophomores, 32 were juniors, and 36 were seniors. The purpose of the questionnaire was to evaluate the importance of the items presented in the criteria list from the perspective of novice instructional designers. All of the students participating in the study had been working on the design of a 3D virtual world (Second Life and OPENSIM) for about one year. The students were required to evaluate the items in the criteria list by choosing the level of importance that they thought was appropriate for the items. Each item was evaluated on a 'yes', 'partially', and 'no' basis. They were also encouraged to express their opinions related to the criteria list. The mean values for each main group and category in the criteria list are presented in Table 2.

Table 2

Mean values for each main group and category in the criteria list

Categories	N	Mean	S
1. Technical Specifications	103	4.38	.68
System Features	103	3.99	.84
Usability	103	4.25	.62
Multimedia Tools	103	4.50	.62
Software Tools	103	4.39	.59
Security	103	4.46	.75
Cost	103	4.57	.72
2. Interaction Specifications	103	4.22	.62
Avatars	103	4.24	.70
Activities	103	4.20	.69
Communication Tools	103	4.21	.68
3. Educational Specifications	103	4.19	.60
Teaching/Learning Activities	103	4.20	.60

The responses of the students indicate that almost all of the items are important to novice instructional designers. In accordance with the responses of the students, 7 new items were added to the technical specifications group in the criteria list (see Appendix 2). The final form of the criteria list is presented in Appendix 1.

Reliability Analysis of the Final Version of Criteria List

After finalizing the criteria list, Second Life platform, which is one of the most popular virtual world environments, was evaluated by four experts using the criteria list. One male and three female experts had at least 2 years of experience in designing Second Life. A correlation coefficient was used to calculate inter-rater reliability, which shows the degree of agreement among the raters (Ozcelik et al., 2009). The intra-class correlation coefficient showed an agreement of .89 among the four raters.

The Main Groups and Categories of the Criteria List

In this part of the paper, the main category of the finalized criteria list is explained in detail. The entire criteria list is given in Appendix 1.

Technical Specifications

In a 3D virtual world, designing should be technically easy, and errors that may occur during the design process should be easily resolvable. The number of technical problems has an impact on the motivation of designers. That is why technical specifications are addressed in the first group of the criteria list. The categories of system features, usability, multimedia tools, software tools, security, and cost are all included in this group.

System Features

Based on their system/program features, 3D virtual world platforms provide users with readily available objects and personalization features, and they support the use of different file types, like videos, music, and images (Messinger et al., 2009). A plug-in installation may be required in order for the system to work effectively. These are important features, as they can affect hardware that is necessary for 3D virtual world applications, as well as interactions and applications that can be initiated in the platform. Therefore, a category of system features was included in the criteria list.

Usability

Usability involves the issues of access, scheme, direction finding, and aesthetics (Yildirim et al., 2004). When 3D virtual world platforms are examined in terms of usability, features such as chat window, the use of a virtual environment, menus providing options to change objects and avatar features, and the use of integrated web scanners stand out (Dickey, 2003). These medium components need to be designed in such a way that they facilitate user communication and interaction. Consequently, the category of usability was added to the criteria list. In this category, items were written concerning the following features: convenient program installation, easy access to the environment, smooth transition among environments, opportunity to work locally, easy uploading of local operations to the server, easy use of interface, simple interface, available help menu options, adequate resources for different languages, synchronous help, platform update, easy movement of avatars, prevention of object interference with avatars.

Multimedia Tools

While users are surfing virtual worlds in the form of avatars, the system/program presents synchronous audio-visual feedback to the users (Jones, Morales, & Knezek, 2005). To create life-like experiences, designers are provided with opportunities to add audio files, videos, animations, and simulations to the 3D virtual environments; to display web pages and make presentations and to integrate 3D objects obtained from

different resources into the virtual environment (Boulos, Hetherington, & Wheeler, 2007; Dickey, 2005b; Jung & Kang, 2010; Warburton, 2009). From an educational perspective, these features offer students opportunities to interact, experience, and practice in 3D virtual environments. Therefore, support for multimedia tools is an important part of the virtual worlds. The items in this category are related to the following features: allowing to add audio files, video and animation, supporting different file types (xml, raw, mpeg, avi, mp4, ppt, jpeg etc.), adding slides/making presentations, adding 3D and 2D objects, displaying web page, creating simulation, sharing and duplication of newly added objects.

Software Tools

3D virtual world platforms offer designers easy access to information resources, readily available objects or avatars, and information gathering tools, depending on the software tools that they possess (Jonassen, 1999). Designers and developers can create virtual environments which reflect their imagination, depending upon the potential of the avatar and object libraries offered by the 3D virtual world applications. Designers and developers can also add options such as copy, delete, rotate, and move with the given objects, and they can prepare more interactive and attractive activities by adding scripts to the objects or avatars (Dickey, 2005b). Since these features help students to reflect on what they have learned (Winn, 2002), the category of software tools was needed on the criteria list. In this category, items pertaining to the following features were constructed: the use of readily available objects, a possibility of modification of readily available objects, availability of an object library, availability of an avatar library, interaction among objects in the environment, easy object mounting/installation, user interaction with objects, display of the object creators, undo feature, track of students' behavior, logging user message, interaction between users and objects, script writing/adding, and advanced programming.

Security

Users can create their own identities and profiles using their user names and passwords in 3D virtual world platforms. They can block other users from seeing their IDs, and manage their platform (Dickey, 2003). Moreover, a user can limit the access to 3D platforms that other users construct, and can control others so as to remove their ability to change or delete objects that s/he had created (Dickey, 2005b). Hence, security in virtual world applications to be used for educational purposes is an important matter, and should be closely monitored to control potentially unethical user behavior. Due to such features of virtual worlds, the category of security was added to the criteria list. In this category, items were written based on the features as follows: creating profiles via user name and password, authorizing users, controlling platform and object features (changing, deleting, locking, limiting), protecting the platform from external effects, controlling problems like abuse, humiliation, insult, etc., monitoring user errors, automatic user error recovery.

Cost

It should be noted that in many cases virtual worlds are not purchased individually but institutionally. Even in this case institutions might not allow researchers to purchase virtual islands for a long time. Therefore, 3D virtual world platforms for educational purposes should not impose heavy financial burden on institutions and educators. In 3D virtual worlds, certain applications require users to pay a membership fee, whereas others do not. In some platforms, membership is free but objects to be added to the platform, learning environments to be established, scripts to be written (Warburton, 2009), and updates require payment. Besides, the platforms offering server service require a considerable amount of fee to cater for a large body of users. Hence, the criteria list covers the category of cost. Items which were included in this category might be seen in Appendix 1.

Interaction Specifications

One important reason for the use of 3D virtual worlds in education is that they create learning environments which look like real life. However, in order to provide learning experiences that are similar to real-life learning, they must offer a sense of reality, satisfactory interaction of objects and other components in the platform, and components which pertain to real life. Thus, interaction was created as a main group of categories in the criteria list. Here, the categories of avatars, activities, and communication tools were investigated.

Avatars

Users can choose avatars from 3D virtual worlds' avatar libraries. Avatars are representations that users employ in virtual environments; they communicate and can interact with other avatars (Boulos et al., 2007; De Noyelles, 2011; Dickey, 2005a; Kohlera, Matzler, & Füller, 2009). They can walk, scroll, fly, run, and put their hands up (Dickey, 2005b). In addition, to facilitate a wider range of observations in the platform, users can change the visual perspective of avatars, for example, to see from the back of an avatar's head, or to zoom far into an image (De Noyelles, 2011). Furthermore, they can communicate with each other by using non-verbal strategies, such as eye-contact, gestures, and body posture (Pojanapunya & Jaroenkitboworn, 2011). Due to these features, avatars are regarded as an important component of virtual platforms. That is why the category of avatars was included in the criteria list. In this category, the following features have been turned into items: changing the attributes of avatars, arranging avatar profile, adding animations for avatar motions, avatars' use of gestures, motion control (flying, walking, sitting, etc.), and making eye contact via avatars.

Activities

In learning environments within 3D virtual worlds, users can meet and socialize with other users, do shopping, visit different places, build settings, join in physical

activities, attend institutional and academic activities, and participate in social activities (Partala, 2011; Rymaszewski et al., 2006). In educational terms, these kinds of activities are crucial for students to improve their experience, comprehension, and implementation skills. The number and quality of activities allowed by platform is an important issue to provide a comprehensive learning experience. This is why there is a need for activities category in the criteria list. Within this category, the features from which items are generated are as follows: building settings (structures, mountains, roads, trees, waterfalls, etc.), setting up art galleries/exhibitions, giving/listening to lectures, performing social activities (dancing, singing, listening to music, giving/watching concerts, athletic activities), offering culture-specific objects/materials, and playing games.

Communication Tools

Communication among users is important, since they work together and exchange ideas with each other in educational activities. Today, 3D virtual worlds allow users to benefit from synchronous, asynchronous,text-based or voice-based communication opportunities (Pojanapunya & Jaroenkitboworn, 2011). In the communication process, user names generally appear on the avatars' heads to allow users to recognize and remember each other (Dickey, 2003). Users can create contact lists or send messages to other users in different 3D virtual environments (Dickey, 2005b). Ease of use of these tools and their attractiveness should be provided by the platform since most of the time users have to use the standardized platform itself. Communication among users is important since they work together and exchange ideas with each other in educational activities. It is the reason behind the inclusion of the communication tools category in the criteria list. In this category, the items are written in line with these features: written communication, voice communication, synchronous interaction, asynchronous interaction, communication with other platforms, signboard-like message objects, and features of muting and blocking unwanted users.

Educational Specifications

The last main group in the criteria list is educational specifications, which contains a great diversity of educational methods and tools. The categories of learning environments and learning/teaching activities were placed within this group. In 3D virtual worlds, individuals can experience 3D art, perform 3D shows, present multiple pictures and texts, and interact with museums and libraries (Boulos et al., 2007; Jung & Kang, 2010). According to Kay and Fitzgerald (2008), in 3D virtual world platforms users can be provided with demonstrations and presentations, 3D presentations, simulation and role-playing, data visualization and simulations, the ability to find hidden objects, 3D archeology, reenactment of the past, and language and culture activities. Additionally, 3D virtual worlds promote learning environments in which socialization, creative thinking, research and constructivist learning are stressed

(Burgess et al., 2010). Activities conducted in 3D virtual environments improve students' critical thinking, active learning and problem-solving skills (Dickey, 2005a; Iqbala et al., 2010; Wrzesien & Raya, 2010). Although educational activities depend on the requirement of the project, the selected platform should be flexible enough to provide required activities and more.

Conclusion

In this study, a criteria list is suggested to designers to use while evaluating and choosing 3D virtual worlds. However, the reliability of the study is limited to the current applications owing to the rapid advancements in 3D virtual world applications. In the development process of the criteria list, certain phases were followed. These phases include the review of the related literature, using heuristic approach, obtaining expert opinion and implementing the list as a questionnaire to the students enrolled in the Department of Computer Education and Instructional Technology.

Criteria lists help vendors and users compare the appropriateness and effectiveness of different programs and technologies available on the market in learning and teaching activities (Tergan, 1998). Based on the chosen features or technology components, various dimensions for different kinds of features such as technical specifications, instructional purposes, activities or target audience can be found in criteria lists (Bronstein, 2007). Hence, for the related technology, developing a standardized list that can be easily found and time-saving is essential (Bangert-Drowns & Kozma, 1989). In the current study, the criteria list developed for 3D virtual worlds is considered to be effective in the selection of the most appropriate virtual world platform to be used for educational purposes. It is also believed to be helpful for comparison and evaluation of virtual world platforms in terms of system specifications, usability, multimedia tools, software tools, security, cost, avatars, activities, communication tools, learning environments, and learning/teaching activities. Furthermore, it is thought to be a reliable and economical data collection instrument for the evaluation of 3D virtual world platforms in educational aspects.

Currently, numerous virtual world platforms have been developed (Kzero, 2011), and their number is increasing day by day (Dieterle & Clarke, 2009). Specifications of developed virtual world platforms are being upgraded every day as well. In this respect, attempts to reveal the strengths and weaknesses of 3D virtual world platforms are considered necessary as they play an important role in both the development of the platforms and the use of virtual worlds within educational contexts (Warburton, 2009). It is believed that the criteria list developed in the present study will help to diagnose and eliminate the shortcomings and constraints of the categories – system features, usability, multimedia and software tools, security and costs which constitute the technical dimension of 3D virtual world platforms. It is also expected that the criteria list will offer focal points concerning the development of 3D virtual world platforms to the educators and instructional designers.

Educators do not have effective methods in evaluating numerous novel technologies, which poses an obstacle in the adaptation process of virtual worlds (Richter et al., 2007). The developed criteria list with its main dimensions and detailed categories is considered to present different perspectives to the virtual world studies restricted to traditional classroom activities. It is also believed to guide educators and designers on the use of 3D virtual worlds, revealing their educational affordances and to present an educational standpoint to future researchers on 3D virtual world.

"Tasks, means and time" are crucial in the integration of emerging technologies into the effective educational practices of teachers (Soloway et al., 2000). The concept of "task" consists of projects and activities that students carry out in the learning process. Accordingly, items related to learning and teaching activities in the criteria list developed for 3D virtual worlds will be fruitful to compare different platforms in educational aspects. In addition, the use of the criteria list for determining learning environments to be created in 3D virtual world platforms will contribute to the evaluation of usability and functionality of these platforms in the learning and teaching process (Bangert-Drowns & Kozma, 1989; Tergan, 1998).

In brief, the present study differs from similar studies on 3D virtual worlds in terms of dimensions and categories, items and the target audience it covers. As a result, this study with its dimensions is expected to generate new ideas and present broader perspectives to researchers, practitioners and instructional designers on which learning environments can be created in virtual worlds.

Acknowledgements

This study was conducted under the scope of "Effect of Virtual and Multimedia Environment on Interest and Awareness Towards Winter Sports" project granted by The Scientific and Technological Research Council of Turkey issued with the number "111K516".

References

Alarifi, S. A. (2008). *An exploratory study of higher education virtual campuses in Second Life.* M.A. Thesis. University of Nottingham, UK.

Bangert-Drowns, R. L., & Kozma R. B. (1989). Assessing the design of instructional software. *Journal of Research on Computing in Education, 3*(21), 241-62. http://dx.doi.org/10.1080/08886504.1989.10781876

Bartle, R. (2004). *Designing virtual worlds*. Indianapolis: New Riders Press.

Bell, M. (2008). Toward a definition of "Virtual Worlds". *Journal of Virtual World Research, 1*(1), 3-5.

Boulos, M. N., Hetherington K. L., & Wheeler, S. (2007). Second Life: An overview of the potential of 3D virtual worlds in medical and health education. *Health Information and Libraries Journal, 24,* 233–245. http://dx.doi.org/10.1111/j.1471-1842.2007.00733.x

Bronstein, Dawn M. (2007). *The efficacy of a web site evaluation checklist as a pedagogical approach for teaching students to critically evaluate internet content.* Doctoral Thesis. Nova Southeastern University.

Burgess, M. L., Slate, J. R., Rojas-LeBouef, A., & LaPrairie, K. (2010). Teaching and learning in Second Life: Using the Community of Inquiry (CoI) model to support online instruction with graduate students in instructional technology. *Internet and Higher Education, 13*, 84–88. doi: 10.1016/j.iheduc.2009.12.003 http://dx.doi.org/10.1016/j.iheduc.2009.12.003

Choi, B., & Baek, Y. (2011). Exploring factors of media characteristic influencing flow in learning through virtual worlds. *Computers & Education, 57*, 2382–2394. doi: 10.1016/j.compedu.2011.06.019. http://dx.doi.org/10.1016/j.compedu.2011.06.019

Clarke, J., & Dede, C. (2005). *Making learning meaningful: An exploratory study of using multi user virtual environments (MUVES) in middle school science*. Paper presented at the American Educational Research Association Conference, Montreal.

Dalgarno, B., & Lee, M. J. W. (2010). What are the learning affordances of 3-D virtual environments?*British Journal of Educational Technology, 41*(1), 10–32. http://dx.doi.org/10.1111/j.1467-8535.2009.01038.x

De Noyelles, A. M. (2011). *Learning between worlds: Experiences of women college students in a virtual world*. Doctoral dissertation.University of Cincinnati.

Dickey, M. D. (2003). Teaching in 3D: Pedagogical affordances and constraints of 3D virtual worlds for synchronous distance learning. *Distance Education, 24*(1), 105–121. http://dx.doi.org/10.1080/01587910303047

Dickey, M. D. (2005a). Three-dimensional virtual worlds and distance learning: two case studies of Active Worlds as a medium for distance education. *British Journal of Educational Technology,36*(3), 439–451. http://dx.doi.org/10.1111/j.1467-8535.2005.00477.x

Dickey, M. D. (2005b). Brave new (interactive) worlds: A review of the design affordances and constraints of two 3D virtual worlds as interactive learning environments. *Interactive Learning Environments, 13*(1–2), 121 – 137. http://dx.doi.org/10.1080/10494820500173714

Dieterle, E., & Clarke, J. (2009). Multi-user virtual environments for teaching and learning. In M. Pagani (Ed.), *Encyclopedia of multimedia technology and networking* (pp. 2-11). Hershey, PA: Idea Group, Inc. http://dx.doi.org/10.4018/978-1-60566-014-1.ch139

Duncan, I., Miller, A., & Jiang, S. (2012). A taxonomy of virtual worlds usage in education. *British Journal of Educational Technology, 43*(6), 949–964. http://dx.doi.org/10.1111/j.1467-8535.2011.01263.x

Erlandson, B. E., Nelson, B. C.,& Savenye, W. C. (2010). Collaboration modality, cognitive load, and science inquiry learning in virtual inquiry environment. *Education Tech Research Dev., 58*, 693–710. http://dx.doi.org/10.1007/s11423-010-9152-7

Girvan, C. (2008). *Communal constructivism: An appropriate pedagogy for use in Multi-User Virtual Environments.* Doctoral Thesis. The University of Dublin.

Girvan, C., & Savage, T. (2010). Identifying an appropriate pedagogy for virtual worlds: A communal constructivism case study. *Computers* & *Education, 55*, 342–349. http://dx.doi.org/10.1016/j.compedu.2010.01.020

Harris, A. L., & Rea, A. (2009). Web 2.0 and virtual world technologies: a growing impact on IS education. *Journal of Information Systems Education, 20*(2), 137-144.

Heid, S., & Kretschmer, T. (2009). LLL3D's contribution to teaching and learning with 3-D MUVEs in higher education.*British Journal of Educational Technology, 40*(3), 568-571. http://dx.doi.org/10.1111/j.1467-8535.2009.00946.x

Hew, K. F., & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K- 12 and higher education settings: A review of the research. *British Journal of Educational Technology, 41*(1), 33–55. http://dx.doi.org/10.1111/j.1467-8535.2008.00900.x

Hollander, J. B., & Thomas, D. (2009). Commentary: Virtual planning second life and the online studio. *Journal of Planning Education and Research, 29*, 108-113. http://dx.doi.org/10.1177/0739456X09334142

Huang, H. M., Rauch, R., & Liaw, S. S. (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. *Computers* & *Education, 55*, 1171–1182. http://dx.doi.org/10.1016/j.compedu.2010.05.014

Iqbala, A., Kankaanrantaa, M., & Neittaanmäkia P. (2010). Engaging learners through virtual worlds*. Procedia Social and Behavioral Sciences, 2*, 3198–3205. http://dx.doi.org/10.1016/j.sbspro.2010.03.489

Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 215-247). NJ: Lawrence Erlbaum Associates.

Jones, J.G., Morales, C., & Knezek, G.A. (2005). 3-dimensional online learning environments: Examining attitudes toward information technology between students in Internet-based 3- dimensional and face-to-face classroom instruction. *Educational Media International, 42*, 219-236. http://dx.doi.org/10.1080/09523980500161254

Jung, Y., & Kang, H. (2010). User goals in social virtual worlds: A means-end chain approach. *Computers in Human Behavior, 26,* 218–225. http://dx.doi.org/10.1016/j.chb.2009.10.002

Kay, J., & FitzGerald, S. (2008). *Educational uses of Second Life*.Retrieved on June 1, 2012 from http://sleducation.wikispaces.com/educationaluses.

Kohlera, T., Matzler, K.,& Füller, J. (2009). Avatar-based innovation: Using virtual worlds for real- world innovation. *Technovation, 29*, 395–407. http://dx.doi.org/10.1016/j.technovation.2008.11.004

KZero.(2011). Universe.Retrieved on May 12, 2012 from http://www.kzero.co.uk/blog/category/radar-chart/

Lok, B., Ferdig, R. E., Raij, A., Johnsen, K., Dickerson, R., Coutts, J., Stevens, A., & Lind, D. S. (2006). Applying virtual reality in medical communication education: Current findings and potential teaching and learning benefits of immersive virtual patients. *Virtual Reality, 10* (3–4), 185–195. http://dx.doi.org/10.1007/s10055-006-0037-3

Lorenzo, C.M., Sicilia, M. Á., & SánchezS. (2012). Studying the effectiveness of multi-user immersive environments for collaborative evaluation tasks. *Computers & Education, 59*, 1361–1376. http://dx.doi.org/10.1016/j.compedu.2012.06.002

Mancuso, D. S., Chlup, D. T., & McWhorter, R. R. (2010). A study of adult learning in a virtual world. *Advances in Developing Human Resources, 12*(6), 681-699. http://dx.doi.org/10.1177/1523422310395368

Messinger, P. R., Stroulia, E., Lyons, K., Bone, M., Niu, R. H., Smirnov, K., & Perelgut, S. (2009). Virtual worlds — past, present, and future: New directions in social computing. *Decision Support Systems,* 47, 204-228. http://dx.doi.org/10.1016/j.dss.2009.02.014

Messinger, P., Stroulia, E., & Lyons, K. (2008). A typology of virtual worlds: Historical overview and future directions. *Journal of Virtual Worlds Research, 1*(1), 1-18.

Ozcelik, E., Karakus, T., Kursun, E., & Cagiltay, K. (2009). An eye-tracking study of how color coding affects multimedia learning. *Computers & Education, 53*, 445–453. http://dx.doi.org/10.1016/j.compedu.2009.03.002

Partala, T. (2011). Psychological needs and virtual worlds: Case Second Life. *International Journal of Human-Computer Studies,69*(12), 787-800. http://dx.doi.org/10.1016/j.ijhcs.2011.07.004

Peppler, K., A., & Solomou, M. (2011). Building creativity: collaborative learning and creativity in social media environments. *On the Horizon, 19*(1), 13-23. http://dx.doi.org/10.1108/10748121111107672

Pojanapunya, P., & Jaroenkitboworn, K. (2011). How to say "Good-bye" in Second Life. *Journal of Pragmatics, 43*, 3591–3602. doi:10.1016/j.pragma.2011.08.010. http://dx.doi.org/10.1016/j.pragma.2011.08.010

Prasolova-Førland, E. (2008). Analyzing place metaphors in 3D educational collaborative virtual environments.*Computers in Human Behavior,* 24, 185–204. http://dx.doi.org/10.1016/j.chb.2007.01.009

Richter, J. (2010). Taxonomies of virtual world-based learning activities/applications?/online/. Retrieved on September 15, 2012 from https://lists.secondlife.com/pipermail/educators/2010- April/039401.html

Richter, J., Anderson-Inman, L., & Frisbee, M. (2007). Critical engagement of teachers in Second Life: Progress in the SaLamander Project. In D. Livingstone, & J. Kemp (Eds.), *Second Life Community Conference 2007 Education Track Proceedings* (pp. 24-26). Chicago, IL.

Rymaszewski, M., Au, W. J., Wallace, M., Winters, C., Ondrejka, C., Batstone-Cunningham, B., & Rosedale, P. (2006). *Second life: The official guide*. Canada: John Willey & Sons.

Soloway, E., Jackson, S. L., Klein, J., Quintana, C., Reed, J., Spitulnik, J., & Scala, N. (1996, April). Learning theory in practice: Case studies of learner-centered design. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 189-196). ACM http://dx.doi.org/10.1145/238386.238476

Schmidt, M., Laffey, J. M., Schmidt, T. C., Wanga, X., & Stichter, J. (2012). Developing methods for understanding social behavior in a 3D virtual learning environment.*Computers in Human Behavior, 28*, 405–413. http://dx.doi.org/10.1016/j.chb.2011.10.011

Shih, Y.C., & Yang, M.T. (2008). A collaborative virtual environment for situated language learning using VEC3D. *Educational Technology & Society, 11*(1), 56–68.

Soloway, E., Jackson, S. L., Klein, J., Quintana, C., Reed, J., Spitulnik, J., ...& Scala, N. (1996, April). Learning theory in practice: Case studies of learner-centered design. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 189-196). ACM. http://dx.doi.org/10.1145/238386.238476

Tergan, S. O. (1998). Checklists for the evaluation of educational software: Critical review and prospects. *Innovations in Education & Training International, 35*(1), 9-20. doi:10.1080/1355800980350l0.

Van Schaik, P., Martin, S., & Vallance, M. (2012). Measuring flow experience in an immersive virtual environment for collaborative learning. *Journal of Computer Assisted Learning, 28*, 350–365. http://dx.doi.org/10.1111/j.1365-2729.2011.00455.x

Warburton, S. (2009). Second Life in higher education: Assessing the potential for and the barriers to deploying virtual worlds in learning and teaching. *British Journal of Educational Technology, 40*(3), 414–426. http://dx.doi.org/10.1111/j.1467-8535.2009.00952.x

Winn, W. (2002). Current trends in educational technology research: The study of learning environments. *Educational Psychology Review, 14*(3), 331 – 351. http://dx.doi.org/10.1023/A:1016068530070

Wrzesien, M., & Raya, M. A. (2010). Learning in serious virtual worlds: Evaluation of learning effectiveness and appeal to students in the E-Junior project. *Computers & Education*, *55* (1), 178-187. http://dx.doi.org/10.1016/j.compedu.2010.01.003

Yildirim, S. Goktas, Y., Temur, N., & Kocaman, A. (2004). A Checklist for a Good Learning Management System (LMS). *Turk Egitim Bilimleri Dergisi, 4* (2). (in Turkish). http://www.tebd.gazi.edu.tr/arsiv/2004_cilt2/sayi_4/455-462.pdf

Rabia M. Yilmaz
Kazim Karabekir Faculty of Education, Ataturk University
25240, Erzurum, Turkey
rkufrevi@atauni.edu.tr; rabia.kufrevi@gmail.com

İlknur Reisoglu
Faculty of Education, Recep Tayyip Erdogan University,
Zihni Derin Yerleşkesi – Fener Mahallesi 53100 Merkez, Rize, Turkey
ireisoglu_boteb@hotmail.com

F. Burcu Topu
Kazim Karabekir Faculty of Education, Ataturk University
25240, Erzurum, Turkey
burcutopu@hotmail.com

Turkan Karakus
Kazim Karabekir Faculty of Education, Ataturk University
25240, Erzurum, Turkey
turkan.karakus@gmail.com

Yuksel Goktas
Kazim Karabekir Faculty of Education, Ataturk University
25240, Erzurum, Turkey
yuksel.goktas@hotmail.com

Appendix 1

The Criteria List for the Evaluation of 3D Virtual Worlds Used in Educational Environment Design

The Platform in Evaluation: ……..

A. TECHNICAL SPECIFICATIONS		Yes	Partially	No
1. System Features				
For efficient operation of 3D virtual worlds	do not require high-quality computer hardware.			
	server service is available.			
	plug-in support exists.			
2. Usability				
In 3D virtual worlds	program installation is easy.			
	access to the environment is easy.			
	smooth transition among environments is easy.			
	users can work locally.			
	local operations are easily uploaded to the server.			
	interface use is easy.			
	interfacing is simple.			
	a help menu is available.			
	adequate resources are available for different languages.			
	synchronous help is available.			
	the platform can be updated.			
	moving avatars is easy.			
	objects do not interfere with avatars.			
3. Multimedia Tools				
For efficient operation of 3D virtual worlds	audio files can be added.			
	different file types (xml, raw, mpeg, avi, mp4, ppt, jpeg etc.) are supported.			
	slides can be added.			
	3D object can be added.			
	2D object can be added.			
	videos can be added.			
	animations can be added.			
	webpages can be displayed in the platform.			
	simulations can be created.			
	newly added objects can be shared/duplicated.			
4. Software Tools				
In 3D virtual worlds	readily available objects can be used.			
	modifications to readily available objects can be made.			
	an object library exists.			
	an avatar library exists.			
	interaction among objects in the platform is possible.			
	object mounting is easy.			
	object creators can be displayed.			
	the undo feature is available.			
	students' behavior can be tracked.			
	user message logs can be kept.			
	interaction between users and objects is supported.			
	scripts can be written/ added.			
	advanced programming is possible.			

5. Security				
In 3D virtual worlds	profiles can be created via user name and password.			
	users can be granted different authorizations.			
	platform and object features can be controlled (changing, deleting, locking, limiting).			
	the platform can be protected from external effects.			
	problems like abuse, humiliation, insult, etc., can be controlled.			
	user errors can be controlled.			
	user errors can be recovered automatically.			
6. Cost				
In 3D virtual worlds	program installation is free of charge.			
	server service cost is reasonable			
	membership is free of charge.			
	cost-free updating is available.			
B. INTERACTION SPECIFICATIONS		Yes	Partially	No
7. Avatars				
In 3D virtual worlds	attributes of avatars can be changed.			
	avatar profiles can be customized.			
	animations for avatar motions can be added.			
	avatars can use gestures.			
	motion control (flying, walking, sitting, etc.) is possible.			
	eye contact via avatars is possible.			
8. Activities				
In 3D virtual worlds	building is possible (structures, mountains, roads, trees, waterfalls, etc.).			
	art galleries/exhibitions can be set up.			
	lectures can be given or watched.			
	social activities (dancing, singing, listening to music, giving/watching concerts, athletic activities) can be performed.			
	culture-specific objects/materials are offered.			
	games can be played.			
9. Communication Tools				
In 3D virtual worlds	written communication is possible.			
	voice communication is possible.			
	video conferencing is possible.			
	the creation of the groupis possible.			
	synchronous interaction is possible.			
	asynchronous interaction is possible.			
	communication with other platforms is possible.			
	signboard-like message objects are available.			
	it is possible to prevent unwanted users / silencing.			
C. EDUCATIONAL SPECIFICATIONS		Yes	Partially	No
In 3D virtual worlds	demonstrations and presentations can be made.			
	role-playing activities can be conducted.			
	simulation-based activities can be conducted.			
	activities that are otherwise challenging and expensive in real life can be performed.			
	cultural activities can be conducted.			
	fun elements exist.			
	educational environments about every topic can be organized.			
	rewards can be given.			

Appendix 2

Development Process of Criteria List

LITERATURE REVIEW & HEURISTIC INVESTIGATION		INTERNAL EXPERT REVIEW	EXTERNAL EXPERT REVIEW	IMPLEMENTATIONOF THE QUESTIONNAIRE
GENERAL SPECIFICATIONS 1. Purpose of the Environment	Reference	GENERAL SPECIFICATIONS 1. Purpose of the Environment		
Information investigation	Bartle, 2004; Jung & Kang, 2010; Yee, 2006	√	Excluded this part	
Information share and practice	Erlandson, Nelson, & Savenye, 2010	x/Information share		
Collaborative work	Lorenzo, Sicilia, & Sánchez, 2012; Van Schaik, Martin, & Vallance, 2012	√		
Improvement of creative skills	Peppler & Solomou, 2011	√		
Improvement of social relationships	Schmidt, Laffey, Schmidt, Wanga, & Stichter, 2012	√		
Entertainment	Bartle, 2004; Jung & Kang, 2010; Yee, 2006	√		
GENERAL SPECIFICATIONS 2.Usability	Reference	GENERAL SPECIFICATIONS 2.Usability	TECNICAL SPECIFICATIONS 2.Usability	TECNICAL SPECIFICATIONS 2.Usability
Program installation is easy	Heuristic investigation	√	√	√
Access to the environment is easy	Heuristic investigation	√	√	√
Interface use is easy	Heuristic investigation	√	√	√
The elements disturbing the concentration are removed	Heuristic investigation	x/ interfacing is simple	√	√
There is a helpmenu to use the interface	Heuristic investigation	x/a help menu is available	√	√
		+/the platform can be updated	√	√
			+/synchronous help is available	√
			+/moving avatars is easy	√
			+/ objects do not interfere with avatars	√
				√
				+/users can work locally.
				+/local operations are easily uploaded to the server.
				+/adequate resources are available for different languages

LITERATURE REVIEW & HEURISTIC INVESTIGATION		INTERNAL EXPERT REVIEW	EXTERNAL EXPERT REVIEW	IMPLEMENTATIONOF THE QUESTIONNAIRE
GENERAL SPECIFICATIONS 3. Applications/ Activities	Reference	GENERAL SPECIFICATIONS 3. Applications/ Activities	INTERACTIVITY SPECIFICATIONS 2. Activities	INTERACTIVITY SPECIFICATIONS 2.Activities
building is possible (structures, mountains, roads, trees, waterfalls, etc.).	Partala, 2011; Rymaszewski et al., 2006	√	√	√
art galleries/exhibitions can be set up.	Partala, 2011; Rymaszewski et al., 2006	√	√	√
social activities (dancing, singing, listening to music, giving/watching concerts, athletic activities) can be performed.	Partala, 2011; Rymaszewski et al., 2006	√	√	√
games can be played	Heuristic investigation	√	√	√
lectures can be given/watched	Partala, 2011; Rymaszewski et al., 2006	√	√	√
			Culture-specific objects/materials are offered.	√
GENERAL SPECIFICATIONS 4. Security	Reference	GENERAL SPECIFICATIONS 4. Security	TECHNICAL SPECIFICATIONS 5. Security	TECHNICAL SPECIFICATIONS 5. Security
profiles can be created via user name and password.	Dickey, 2003		√	√
users can be granted required priorities.	Dickey, 2003; Rymaszewski et al., 2006; Warburton, 2009	x/ users can be granted required authorizations.	x/ users can be granted different authorizations.	√
platform and object features can be controlled (changing, deleting, locking, limiting).	Dickey, 2005b	√	√	√
the platform can be protected from externaleffects	Dickey, 2005b	√	√	√
problems like abuse, humiliation, insult, etc., can be controlled	De Noyelles, 2011	√	√	√
		+/ user errors can be controlled	√	√
			+/ user errors can be recovered automatically	√

GENERAL SPECIFICATIONS 5. Cost	Reference	GENERAL SPECIFICATIONS 5. Cost	TECHNICAL SPECIFICATIONS 6. Cost	TECHNICAL SPECIFICATIONS 6. Cost
cost of the program is reasonable	Warburton, 2009	√	√	x/program installation is free of charge.
cost of the membership is reasonable	Warburton, 2009	√	√	√
		+/ cost-free updating is available	√	√
				+/server service cost is reasonable

LITERATURE REVIEW & HEURISTIC INVESTIGATION		INTERNAL EXPERT REVIEW	EXTERNAL EXPERT REVIEW	IMPLEMENTATION OF THE QUESTIONNAIRE
TECHNICAL SPECIFICATIONS 1. System/program features	Reference	TECHNICAL SPECIFICATIONS 1. System/program features	TECHNICAL SPECIFICATIONS 1. System features	TECHNICAL SPECIFICATIONS 1. System features
Requirement of a high quality hardware	Heuristic investigation	√	x/ do not require high-quality computer hardware.	√
server service is available.	Warburton, 2009;	√	√	√
plug-in support exists.	Messinger et al., 2009	√	√	√
Suport for different types of files (xml, raw, mpeg, avi, mp4, ppt, jpeg)	Messinger et al., 2009	√	Excluded	
TECHNICAL SPECIFICATIONS 2. Multimedia tools	Reference	TECHNICAL SPECIFICATIONS 2. Multimedia tools	TECHNICAL SPECIFICATIONS 3. Multimedia tools	TECHNICAL SPECIFICATIONS 3. Multimedia tools
audio files can be added	Dickey, 2005b; Warburton, 2009	√	√	√
slides can be added/presentations can be made	Dickey, 2005b; Warburton, 2009	√	√	√
3D object can be added	Dickey, 2005b; Warburton, 2009	√	√	√
videos can be added	Dickey, 2005b; Warburton, 2009	√	√	√
animations can be added	Dickey, 2005b; Warburton, 2009	√	√	√
Web sites can be browsed	Dickey, 2005b; Warburton, 2009	√	x/ webpages can be displayed in the platform	√
Simulations can be created	Dickey, 2005b; Warburton, 2009	√	√	√
		2D object can be added	√	√
			+/ different file types (xml, raw, mpeg, avi, mp4, ppt, jpeg etc.) are supported	√
			+/ newly added objects can be shared/duplicated	√

TECHNICAL SPECIFICATIONS 3. Software tools	Reference	TECHNICAL SPECIFICATIONS 3. Software tools	TECHNICAL SPECIFICATIONS 4. Software tools	TECHNICAL SPECIFICATIONS 4. Software tools
scripts can be written/ added	Heuristic investigation	√	√	√
readily available objects can be used	Dickey, 2005b	√	√	√
modifications to readily available objects can be made	Dickey, 2005b	√	√	√
an avatar library exists	Dickey, 2005b	√	√	√
an object library exists	Dickey, 2005b	√	√	√
		+/ interaction among objects in the platform is possible	√	√
		+/ student behavior can be tracked	√	√
		+/user interaction with objects is possible.	x/interaction between users and objects is promoted	√
		+/ advanced programming is possible	√	√
			+/ user message logs can be kept	√
				+/object mounting and installation is easy.
				+/the undo feature is available.
				+/object creators can be displayed.
LITERATURE REVIEW & HEURISTIC INVESTIGATION		INTERNAL EXPERT REVIEW	EXTERNAL EXPERT REVIEW	IMPLEMENTATION OF THE QUESTIONNAIRE
TECHNICAL SPECIFICATIONS 4. Avatars	Reference	TECHNICAL SPECIFICATIONS 4. Avatars	INTERACTIVITY SPECIFICATIONS 1. Avatars	INTERACTIVITY SPECIFICATIONS 1. Avatars
attributes of avatars can be changed	De Noyelles, 2011; Dickey, 2005a; Kohlera, Matzlera, & Füller, 2009	√	√	√
avatar profiles can be customized	De Noyelles, 2011; Dickey, 2005a; Kohlera, Matzlera, & Füller, 2009	√	√	√
animations for avatar motions can be added	Heuristic investigation	√	√	√
avatars can use gestures	Dalgarno & Lee (2010); Pojanapunya, & Jaroenkitboworn, 2011	√ √	√	√
motion control (flying, walking, sitting, etc.) is possible	Dickey, 2005b	√	√	√
eye contact via avatars is possible	Pojanapunya, & Jaroenkitboworn, 2011	√	√	√
Avatars can be authorized as admin	Heuristic investigation	Excluded		

TECHNICAL SPECIFICATIONS 5. Communication tools	Reference	TECHNICAL SPECIFICATIONS 5. Communication tools	INTERACTIVITY SPECIFICATIONS 3. Communication tools	INTERACTIVITY SPECIFICATIONS 3. Communication tools
written communication is possible	Dalgarno & Lee (2010)	√	√	√
voice communication is possible	Dalgarno & Lee (2010)	√	√	√
video conferencing is possible	Heuristic investigation	√	√	√
group formation is possible	Heuristic investigation	√	√	√
synchronous interaction is possible	Hollander & Thomas, 2009; Mancuso et al., 2010; Pojanapunya & Jaroenkitboworn, 2011	√	√	√
asynchronous interaction is possible	Dickey, 2003; Dickey, 2005a	√	√	√
		+/communication with other platforms is possible	√	√
		+/ signboard-like message objects are available	√	√
			It is possible to block or mute unwanted users	√
LITERATURE REVIEW & HEURISTIC INVESTIGATION		INTERNAL EXPERT REVIEW	EXTERNAL EXPERT REVIEW	IMPLEMENTATION OF THE QUESTIONNAIRE
EDUCATIONAL SPECIFICATIONS 1. Teaching/learning activities	Reference	EDUCATIONAL SPECIFICATIONS 1. Teaching/learning activities	EDUCATIONAL SPECIFICATIONS 1. Teaching/learning activities	EDUCATIONAL SPECIFICATIONS 1. Teaching/learning activities
demonstrations and presentations can be made	Kay & Fitzgerald (2008)	√	√	√
role-playing activities can be conducted	Duncan, Miller & Jiang (2012); Huang, Rauch, & Liaw, 2010; Kay & Fitzgerald (2008); Warburton, 2009	√	√	√
simulation-based activities can be conducted	Duncan, Miller & Jiang (2012); Kay & Fitzgerald (2008)	√	√	√
activities that are otherwise challenging and expensive in real life can be performed	Dalgarno & Lee (2010)	√	√	√
cultural activities can be conducted	Kay & Fitzgerald (2008); Warburton, 2009;	√	√	√
users can participate in activities	Duncan, Miller & Jiang (2012)	√	Excluded	
users can make research via the platform	Duncan, Miller & Jiang (2012)	√	Excluded	
		+/ educational environments pertaining to virtually every topic can be organized	√	√
		+/ rewards/points can be given	√	√
			+/ fun elements exist	√

√: Accepted+/item added x/item modified

Razrada popisa kriterija za odabir 3D virtualnih svjetova i izradu obrazovnog okruženja

Sažetak

Svrha ovog istraživanja bila je razrada popisa kriterija koje treba uzeti u obzir prilikom odabira 3D virtualnih platformi u obrazovne svrhe. U tom su procesu znanstvenici najprije sastavili nacrt kriterija na osnovi proučene literature i heurističkog istraživanja. Dva naša i četiri vanjska stručnjaka pregledala su i napisala osvrt na nacrt kriterija koji se zatim koristio u obliku upitnika. Završni popis kriterija podijeljen je u sljedeće tri kategorije: 50 tehničkih kriterija (osobine sustava / programa, iskoristivost, softverski alati, multimedijski alati, sigurnost, cijena), 21 kriterij vezan uz interakciju (avatari, aktivnosti, komunikacijski alati) i 8 obrazovnih kriterija (aktivnosti poučavanja / učenja). Na kraju će razrađeni popis kriterija pomoći u utvrđivanju i uklanjanju nedostataka i ograničenja virtualnih svjetova koji se koriste u obrazovne svrhe.

Ključne riječi: *3D virtualni svjetovi; izrada obrazovnog okruženja; razrada popisa kriterija; virtualno obrazovno okruženje.*

Uvod

Danas su mnoga istraživanja usmjerena na traženje novih platformi u virtualnom svijetu budući da je Second Life ukinuo popust na obrazovnu djelatnost. Nameće se pitanje u koji bi se virtualni svijet trebalo preseliti. Razvijaju se i reklamiraju različite virtualne platforme koje korisnicima omogućuju izradu 3D okruženja. Trenutno postoji gotovo 90 virtualnih platformi (Kzero, 2011). Iako su osobitosti virtualnih platformi poput 3D okruženja vjernih stvarnom životu, korištenje avatara i komunikacija s drugim korisnicama uobičajena pojava u 3D virtualnom svijetu (Dickey, 2003), platforme se mogu razlikovati s obzirom na svoju namjenu. Te razlike mogu se odnositi na svojstva poput dodavanja animacija, izradu novih predmeta, korištenje gotovih predmeta i drugih mogućnosti prilagodbe. Prijedlozi za odabir platforme ovise o kontekstu, no prije kupnje virtualne platforme znanstvenici bi trebali uzeti u obzir nekoliko kriterija kako ne bi došlo do promjene platforme usred provedbe projekta.

3D virtualni svjetovi ističu se kao tehnologija koja učenicima omogućuje izgradnju i razmjenjivanje vlastitog znanja, a ponekad i učenje stvaranjem vlastitog virtualnog okruženja (Girvan, 2008; Huang i dr., 2010; Shih i Yang, 2008). U tim su okruženjima učenicima dane mogućnosti izrade predmeta i materijala, učenja pojmova, primjene naučenog u različitim stvarnim zadacima, svladavanja i rješavanja postojećih problema i doživljavanja virtualnih iskustava. Osim toga, te se platforme mogu izraditi tako da budu komunikacijski, simulacijski, istraživački, virtualni sveučilišni kompleks (Alarifi, 2008;Hew i Cheung, 2010; Prasolova-Førland, 2008).

Posljednjih godina virtualni svjetovi u 3D grafici s vremenski usklađenim i neusklađenim mogućnostima interakcije postaju, u znatnoj mjeri, predmet istraživanja (Girvan i Savage, 2010; Huang i dr., 2010). To je zbog činjenice da 3D virtualni svjetovi ne ovise o vremenu i prostoru (Dickey, 2005a), mogu se prilagoditi samostalnom učenju i omogućiti cjeloživotno učenje (Heid i Kretschmer, 2009), kao i unaprijediti suradničke vještine (Harris i Rea, 2009). Također, omogućuju lakši pristup izvorima informacija, daju priliku učenicima da pokažu svoje znanje i sposobnosti (Dickey, 2005b) te promiču interakciju posredstvom predmeta, modela i alata (Dickey, 2005b). Zbog njihova obrazovnog potencijala neki znanstvenici smatraju 3D virtualne svjetove obrazovnim okruženjem budućnosti (Clarke i Dede, 2005; Salmon, 2009). To je potaknulo akademsku raspravu o potencijalu virtualnih svjetova kao obrazovnog medija (Choi i Baek, 2011; Girvan i Savage, 2010). Stručnjaci za obrazovanje provode istraživanja kako bi proučili primjenu principa poučavanja u 3D virtualnim svjetovima (Lok i dr., 2006) i olakšali učenje korištenjem tih principa (Girvan i Savage, 2010; Shih i Yang, 2008).

U posljednje vrijeme praktičnost 3D virtualnih svjetova u obrazovnoj praksi, aktivnostima i primjenama postala je popularnom temom istraživanja. Međutim, pregled literature povezane s tom temom otkriva da postoji samo malen broj istraživanja koja precizno određuju koje se vrste obrazovnih aktivnosti mogu uspješno provesti, koje teme, teorije učenja i aktivnosti učenika u 3D virtualnom okruženju (Duncan i dr., 2012; Messinger i dr., 2008). Iako sva ta istraživanja određuju obilježja virtualnih platformi koje su već osmišljene u obrazovne svrhe, ona ne obuhvaćaju platforme koje se koriste za stvaranje obrazovnog okruženja.

U klasifikacijskim istraživanjima 3D virtualnih svjetova istraživali su se kriteriji (Bell, 2008; Warburton, 2009), programska podrška i obrazovni alati (Dickey, 2005a, 2005b), provedene aktivnosti učenja/poučavanja (Richter, 2010; Kay i FitzGerald, 2008) zajedno s povezanim materijalima (Richter i dr., 2007), sredstva namijenjena obrazovanju (Dalgarno i Lee, 2010; Warburton, 2009). Općenito, istaknutije mjesto imaju istraživanja u kojima se uspoređuju dvije popularne virtualne platforme ili ona u kojima se virtualne platforme uspoređuju s primjenom u stvarnom svijetu (Dickey, 2005a). Unatoč opsegu tih istraživanja u relevantnoj literaturi nema istraživanja koja bi obuhvatila mogućnosti korištenja virtualnih platformi kao obrazovnog medija i koja bi ponudila temeljitu klasifikaciju za ocjenjivanje svih kriterija virtualnih platformi

koje se koriste u obrazovnom kontekstu. Također, ne objašnjavaju značenja koja se odnose na obrazovne politike i praksu s obzirom na to da su usmjerena na različita područja kao što je poslovno okruženje, trgovina itd. (Messinger i dr., 2008). Važno je istaknuti da su se obrazovna istraživanja na temu 3D virtualnih svjetova tek nedavno počela pojavljivati u literaturi.

Richter i dr. (2007) navode da nastavnicima nedostaju učinkovite metode procjene novih tehnologija te da je to prepreka u procesu prilagodbe virtualnih svjetova. S obzirom na novije zanimanje za upotrebu virtualnih svjetova u obrazovne svrhe i nedostatak odgovarajućih akademskih analiza bilo bi korisno razraditi kriterije koji će pomoći nastavnicima pri izboru virtualne platforme koja može zadovoljiti obrazovne potrebe i pomoći im da utvrde nedostatke postojećih platformi. Tergan (1998) se također slaže s idejom prikladnosti kriterija za procjenu bilo koje vrste programske podrške. Budući da virtualni svjetovi mogu preuzeti ulogu obrazovnog okruženja, važno je uzeti u obzir stajališta instrukcijskih dizajnera. Prema tome, cilj ovog istraživanja bio je razraditi popis kriterija koji mogu pomoći instrukcijskim dizajnerima, programerima i nastavnicima izvršiti procjenu svih virtualnih platformi u obrazovne svrhe.

Razrada popisa kriterija

Popis kriterija definira se kao popis elemenata koji su strukturirani intuitivno prema određenim kategorijama (Tergan, 1998). U ovom je istraživanju popis kriterija korišten na način da otkriva prednosti i nedostatke virtualnih platformi te istražuje njihov potencijal za praktičnu primjenu. Proces razrade popisa kriterija uključivao je fazu proučavanja literature i heurističkog istraživanja, prikupljanja mišljenja stručnjaka nakon čega je uslijedio pregled, ispravak i provedba upitnika. Sažetak procesa prikazan je u Tablici 1. Navedene faze opširnije su opisane u idućim odlomcima.

Slika 1.

Proučavanje literature i heurističko istraživanje

U ovom istraživanju znanstvenici su se također koristili literaturom o virtualnim svjetovima da bi odredili kategorije za popis kriterija. Nadalje, primijenjeno je heurističko istraživanje budući da se ta metoda čini korisnim i učinkovitim načinom provjere u odnosu na prirodu novih tehnologija i teorija povezanih s njima (Tergan, 1998). Koristeći se heurističkim pristupom, znanstvenici s 3 godine iskustva u području 3D virtualnih svjetova i doktoratom iz instrukcijske tehnologije sastavili su popis elemenata i provjeravali kategorije kriterija na osnovi svojih iskustava i proučavanja virtualnih svjetova. Heurističko istraživanje i proučavanje literature poslužilo je za sastavljanje nacrta kriterija. Osmišljeni elementi rezultat su proučavanja literature i heurističkog istraživanja, a prikazani su u Dodatku 2. Prema Dodatku 2 svi elementi navedeni pod iskoristivost, neki elementi navedeni pod primjena / aktivnosti, značajke sustava / programa, alati za programiranje, softverski alati, avatari i komunikacijski alati izdvojeni su nakon provedenog heurističkog istraživanja, a drugi su izdvojeni

tijekom proučavanja literature.

Osvrt naših stručnjaka

Osvrt na popis kriterija u ovom su istraživanju najprije napisala 2 člana fakultetskog vijeća koji su stručnjaci na području instrukcijske tehnologije i imaju trogodišnje iskustvo u radu s virtualnim svjetovima (OPENSIM i Second Life). Nakon rasprave licem u lice s tim stručnjacima, napravljen je ispravak vezan uz korištenu terminologiju. Modernizirani su elementi koji se odnose na kategorije iskoristivosti, sigurnosti, troškova, multimedijskih alata, softverskih alata, komunikacijskih alata, avatara i aktivnosti poučavanja / učenja (vidi Dodatak 2). Odlučeno je da se svaki element ocijeni ocjenama od 1 do 5. Stručnjaci za virtualni svijet izuzeli su, promijenili, odobrili ili dodali nove elemente s obzirom na heurističko istraživanje i proučenu literaturu. Elementi završnog popisa kriterija prikazani su u Tablici 1.

Osvrt vanjskih stručnjaka

Ispravljeni popis kriterija poslan je četirima različitim stručnjacima te je zatraženo njihovo mišljenje. Dva od njih imala su iskustva s virtualnim svijetom Second Life, a dva s virtualnim svijetom ActiveWorlds. Zatraženo je da 70 elemenata s popisa ocijene ocjenama od 1 do 5 prema njihovoj važnosti za popis. Također je zatraženo da izraze svoje mišljenje, ako ga imaju. Na taj su način izmijenjene glavne grupe kategorija i neki elementi unutar njih, a drugi su elementi unaprijeđeni u smislu korištene terminologije (vidi Dodatak 2). Mišljenja stručnjaka pomogla su znanstvenicima u tome da preurede glavne grupe kategorija. Elementi završnog popisa kriterija prikazani su u Tablici 1.

Primjena popisa kriterija u obliku upitnika

U procesu procjene korisnici popisa mogu dati važne povratne informacije i empirijske podatke (Tergan, 1998). Ispravljeni popis kriterija pretvoren je u mrežni format i poslan na adrese 103 studenta preddiplomskog studija informatike i instrukcijske tehnologije: 46 studentica i 57 studenata. Od tih studenata 34 ih je bilo na drugoj godini studija, 32 na prvoj, a 36 na završnoj. Svrha upitnika bila je procjena važnosti elemenata na popisu kriterija sa stajališta početnika u instrukcijskom dizajnu. Svi studenti uključeni u istraživanje radili su na dizajnu 3D virtualnog svijeta (Second Life i OPENSIM) oko godinu dana. Studenti su trebali ocijeniti elemente na popisu kriterija prema razini važnosti za koju su mislili da je prikladna tim elementima. Svaki je element ocijenjen s 'da', 'djelomično' i 'ne'. Studente se također poticalo na to da izraze svoje mišljenje vezano uz popis kriterija. Srednje vrijednosti za svaku glavnu grupu i kategoriju na popisu kriterija prikazane su u Tablici 2.

Tablica 2.

Odgovori studenata pokazuju da su gotovo svi elementi važni početnicima u instrukcijskom dizajnu. U skladu s odgovorima studenata na popis kriterija u grupu

tehničkih kriterija dodano je 7 novih elemenata (vidi Dodatak 2). Završni popis kriterija prikazan je u Dodatku 1.

Analiza pouzdanosti završnog popisa kriterija

Koristeći se završnim popisom kriterija, platformu Second Life, jedan od najpopularnijih virtualnih svjetova, procijenila su četiri stručnjaka. Jedan stručnjak i tri stručnjakinje prethodno su imali barem dvije godine iskustva u dizajniranju platforme Second Life. Za izračun pouzdanosti ocjenjivača koristio se koeficijent korelacije koji pokazuje stupanj usklađenosti među ocjenjivačima (Ozcelik i dr., 2009). Intraklasni korelacijski koeficijent pokazao je stupanj usklađenosti četiriju ocjenjivača u vrijednosti od .89.

Glavne skupine i kategorije popisa kriterija

U ovom dijelu znanstvenog rada glavna kategorija završnog popisa kriterija opisana je u detalje. Ukupan popis kriterija nalazi se u Dodatku 1.

Tehnički kriteriji

U 3D virtualnom svijetu dizajniranje bi trebalo biti tehnički jednostavno, a greške koje mogu nastati tijekom dizajniranja trebale bi biti lako rješive. Broj tehničkih problema utječe na motivaciju dizajnera. Zbog toga se tehničkim kriterijima bavimo u prvoj skupini popisa kriterija. U tu smo kategoriju također uključili značajke sustava, iskoristivost, multimedijske alate, softverske alate, sigurnost i troškove.

Značajke sustava

Na osnovi značajki njihova sustava / programa 3D virtualne platforme omogućuju korištenje gotovim predmetima i personaliziranim sadržajima te podržavaju korištenje različitih vrsta datoteka poput videozapisa, glazbe i slika (Messinger i dr., 2009). Da bi sustav bio učinkovit, potrebno je instalirati programske dodatke. To su važne značajke s obzirom na to da mogu utjecati na hardver, koji je potreban za 3D virtualne aplikacije, kao i za interakcije i aplikacije koje se mogu pokrenuti na platformi. Zbog toga smo značajke sustava uvrstili kao zasebnu kategoriju na popis kriterija.

Iskoristivost

Iskoristivost podrazumijeva sve vezano uz pristup, shemu, traženje smjera i estetiku (Yildirim i dr., 2004). Kad se 3D virtualne platforme provjeravaju s obzirom na iskoristivost, prozor za razgovor ili upotrebu virtualnog okruženja, tom se prilikom ističu izbornici koji nude promjenu predmeta, značajki avatara i upotrebu integriranih mrežnih skenera (Dickey, 2003). Ti medijski dijelovi trebali bi biti dizajnirani na način da pospješuju komunikaciju i interakciju. Kao posljedicu toga kategoriju iskoristivosti uvrstili smo na popis kriterija. U toj kategoriji navedeni su elementi s obzirom na sljedeće karakteristike: jednostavna instalacija programa, pristup

virtualnom okruženju, prijelaz s jednog na drugo okruženje, mogućnost rada bez mrežne veze i jednostavno učitavanje poslužitelja, jednostavno sučelje i njegova upotreba, dostupne opcije za pomoć, odgovarajući sadržaji za različite jezike, pomoć u realnom vremenu, ažuriranje platforme, jednostavno premještanje avatara, sprečavanje miješanja predmeta s avatarima.

Multimedijski alati

Dok korisnici pretražuju virtualne svjetove u ulozi avatara, sustav / program istodobno im pruža audiovizualne povratne informacije (Jones i dr., 2005). Da bi stvorili iskustva što sličnija stvarnom životu, dizajneri imaju mogućnost 3D virtualnim okruženjima dodati zvučne zapise, videozapise, animacije i simulacije, prikazati mrežne stranice i izrađivati prezentacije te integrirati 3D predmete iz različitih izvora u virtualno okruženje (Boulos i dr., 2007; Dickey, 2005b; Jung i Kang, 2010; Warburton, 2009). Iz perspektive obrazovanja te karakteristike učenicima omogućuju interakciju, iskustvo i vježbu u 3D virtualnim okruženjima. Podrška multimedijskih alata stoga je važan dio virtualnih svjetova. Elementi u ovoj kategoriji odnose se na sljedeće značajke: mogućnost dodavanja zvučnih zapisa, videozapisa i animacija, podržavanje različitih vrsta datoteka (xml, raw, mpeg, avi, mp4, ppt, jpeg itd.), dodavanje slajdova / izrada prezentacija, dodavanje 3D i 2D predmeta, prikaz mrežne stranice, izrada simulacija, dijeljenje i umnožavanje novododanih predmeta.

Softverski alati

3D virtualne platforme omogućuju dizajnerima jednostavan pristup izvorima informacija, gotovim predmetima ili avatarima, alatima za prikupljanje informacija ovisno o softverskim alatima koje posjeduju (Jonassen, 1999). Dizajneri i programeri mogu oblikovati virtualno okruženje koje je odraz njihove mašte, a ovisno o bazama avatara i predmeta koje nude 3D virtualne aplikacije. Dizajneri i programeri također mogu dodavati, kopirati, brisati, okretati i pomicati dane predmete te mogu pripremiti interaktivnije i zanimljivije aktivnosti dodavanjem teksta predmetima i avatarima (Dickey, 2005b). Budući da te značajke pomažu učenicima da razmisle o onome što su naučili (Winn, 2002), kategoriju softverskih alata također je trebalo uvrstiti na popis kriterija. U tu su kategoriju uvršteni elementi koji se odnose na sljedeće značajke: upotreba gotovih predmeta, mogućnost izmjene gotovih predmeta, dostupnost baze predmeta, dostupnost baze avatara, interakcija među predmetima u virtualnom okruženju, jednostavno postavljanje / instalacija predmeta, interakcija korisnika s predmetima, prikaz autora predmeta, opcija poništavanja, praćenje ponašanja učenika, vođenje evidencije poruka korisnika, interakcija između korisnika i predmeta, pisanje / dodavanje teksta i napredno programiranje.

Sigurnost

U 3D virtualnom svijetu korisnici mogu oblikovati vlastite identitete i profile koristeći se svojim korisničkim imenom i lozinkom. Također, mogu onemogućiti

ostalim korisnicima pristup osobnim podacima i upravljanje njihovom platformom (Dickey, 2003). Osim toga, korisnik može ograničiti pristup 3D platformama koje oblikuju drugi korisnici te mogu provjeravati druge na taj način da uklone mogućnost izmjene ili brisanja predmeta koje su izradili (Dickey, 2005b). Sigurnost virtualnih aplikacija koje se koriste u obrazovne svrhe stoga je važna i treba je pažljivo provjeravati da bi se suzbilo moguće neetično ponašanje korisnika. S obzirom na te značajke virtualnih svjetova kategorija sigurnosti uvrštena je na popis kriterija. U tu su kategoriju elementi uvršteni na osnovi sljedećih značajki: otvaranje profila putem korisničkog imena i lozinke, autorizacija korisnika, provjera značajki platforme i objekata (izmjene, brisanja, zaključavanje, ograničavanje), zaštita platforme od vanjskih utjecaja, nadzor problema poput zloporabe, poniženja, uvreda itd., provjera pogrešaka korisnika, automatski ispravak pogrešaka korisnika.

Troškovi

Važno je napomenuti da virtualne svjetove u mnogim slučajevima ne kupuju pojedinci, već institucije. Čak ni tada institucije često ne dopuštaju znanstvenicima kupnju virtualnih otoka. Prema tome, 3D virtualne platforme za obrazovne svrhe ne bi trebale predstavljati veliki financijski trošak institucijama i nastavnicima. Za određene aplikacije u 3D virtualnim svjetovima potrebno je platiti članarinu, a za druge nije. Na nekim je platformama članstvo besplatno, ali se plaćaju predmeti koji se dodaju na platformu, izrada obrazovnog okruženja, unošenje teksta (Warburton, 2009) i ažuriranje. Osim toga, platforme koje nude održavanje poslužitelja naplaćuju prilično veliku naknadu da bi mogle uslužiti velik broj korisnika. Popis kriterija stoga obuhvaća i kategoriju troškova. Elementi uvršteni u tu kategoriju nalaze se u Dodatku 1.

Interakcijski kriteriji

Važan razlog zbog kojeg se 3D virtualni svjetovi koriste u obrazovanju mogućnost je izrade obrazovnog okruženja koje izgleda poput stvarnog života. Međutim, da bi omogućili iskustvo učenja koje je slično učenju u stvarnom životu, moraju pružiti osjećaj stvarnosti, zadovoljavajuću interakciju predmeta i drugih sastavnih dijelova platforme sa sastavnim dijelovima koji pripadaju stvarnom životu. Glavna skupina kategorija vezanih uz interakciju stoga je uvrštena na popis kriterija. Tu smo istraživali kategorije avatara, aktivnosti i komunikacijskih alata.

Avatari

Korisnici mogu izabrati avatare iz 3D virtualnih baza avatara. Avatari prikazuju korisnike u virtualnom okruženju; oni mogu komunicirati s drugim avatarima (Boulos i dr., 2007; De Noyelles, 2011; Dickey, 2005a; Kohlera i dr., 2009), mogu hodati, kretati se u svim smjerovima, letjeti, trčati i podići ruke (Dickey, 2005b). Uz to, da bi se na platformi omogućilo promatranje iz većeg broja gledišta, korisnici mogu, primjerice, mijenjati kut gledanja avatara i imati pogled na stražnju stranu glave avatara ili znatno

povećati prikaz slike (De Noyelles, 2011). Nadalje, mogu međusobno komunicirati koristeći se neverbalnom komunikacijom poput kontakta očima, gesta i položaja tijela (Pojanapunya i Jaroenkitboworn, 2011). Zbog tih obilježja avatare smatramo važnim dijelom virtualnih platformi. Kategoriju avatara stoga smo uvrstili na popis kriterija. U toj su kategoriji sljedeće značajke preoblikovane u elemente: promjena obilježja avatara, uređivanje profila avatara, dodavanje animacija za pokrete avatara, korištenje gesti avatara, kontrola pokreta (let, hodanje, sjedenje itd.) i kontakt očima posredstvom avatara.

Aktivnosti

Obrazovna okruženja u 3D virtualnim svjetovima omogućuju upoznavanje i druženje korisnika, kupovinu, obilazak i izgradnju različitih mjesta, uključivanje u tjelesne aktivnosti, sudjelovanje u institucionalnim, akademskim i društvenim aktivnostima (Partala, 2011; Rymaszewski i dr., 2006). S obrazovnog stajališta te su vrste aktivnosti ključne za unaprjeđenje iskustva, razumijevanje i primjenu vještina učenika. Broj i kvaliteta aktivnosti koje platforma nudi važni su jer omogućuju bogatije obrazovno iskustvo. Zbog toga je bilo potrebno kategoriju aktivnosti uključiti na popis kriterija. Unutar te kategorije značajke iz kojih su izvedeni elementi uključuju: izgradnju (građevina, planina, cesta, stabala, vodopada itd.), postavljanje umjetničkih galerija / izložbi, držanje / praćenje predavanja, provođenje društvenih aktivnosti (ples, pjevanje, slušanje glazbe, organizacija / gledanje koncerata, sportske aktivnosti), ponudu predmeta / materijala svojstvenih nekoj kulturi i igranje igara.

Komunikacijski alati

U današnje vrijeme 3D virtualni svjetovi omogućuju korisnicima komunikaciju u realnom vremenu, tekstualnu komunikaciju s vremenskim kašnjenjem i glasovnu komunikaciju (Pojanapunya i Jaroenkitboworn, 2011). U procesu komunikacije korisnička imena uglavnom se pojavljuju na glavama avatara kako bi korisnici prepoznali i upamtili jedan drugog (Dickey, 2003). Korisnici mogu izraditi kontakt liste ili slati poruke drugim korisnicima u različitim 3D virtualnim okruženjima (Dickey, 2005b). Platforma bi trebala omogućiti jednostavno korištenje tih alata i njihovu privlačnost budući da se korisnici većinom služe standardnim opcijama unutar platforme. Komunikacija među korisnicima važna je s obzirom na to da rade zajedno i razmjenjuju ideje u obrazovnim aktivnostima. To je razlog zbog kojeg smo kategoriju komunikacijskih alata uvrstili na popis kriterija. U toj kategoriji elementi su popisani prema sljedećim karakteristikama: pisana komunikacija, glasovna komunikacija, interakcija u realnom vremenu, interakcija s vremenskim kašnjenjem, komunikacija s drugim platformama, poruke u obliku javnih natpisa, mogućnost isključivanja zvuka i blokiranja neželjenih korisnika.

Obrazovni kriteriji

Obrazovni kriteriji, u kojima su sadržane brojne obrazovne metode i alati, posljednja su glavna grupa na popisu kriterija. Unutar te kategorije nalazi se kategorija obrazovnog okruženja i aktivnosti učenja / poučavanja. U 3D virtualnim svjetovima pojedinci mogu doživjeti 3D umjetnost, izvesti 3D prikaz, prikazati više slika i tekstova, povezivati se s muzejima i knjižnicama (Boulos i dr., 2007; Jung i Kang, 2010). Prema Kayu i Fitzgeraldu (2008), u 3D virtualnim svjetovima korisnici se mogu služiti prikazom i prezentacijama, 3D prezentacijama, simulacijama i igranjem uloga, slikovnim prikazom i simulacijom podataka, mogućnošću pronalaska skrivenih predmeta, 3D arheologijom, rekonstrukcijom prošlosti, jezičnim i kulturnim aktivnostima. Uz to, 3D virtualni svjetovi promiču obrazovna okruženja u kojima je naglasak na socijalizaciji, kreativnom mišljenju, istraživanju i konstruktivističkom učenju (Burgess i dr., 2010.). Aktivnosti koje se provode u 3D virtualnim okruženjima razvijaju kritičko mišljenje, aktivno učenje i vještine rješavanja problema (Dickey, 2005a; Iqbala i dr., 2010; Wrzesien i Raya, 2010). Iako obrazovne aktivnosti ovise o zahtjevima projekta, izabrana platforma trebala bi imati mogućnost prilagodbe kako bi osigurala tražene aktivnosti i više.

Zaključak

U ovom istraživanju dizajnerima predlažemo popis kriterija koje mogu upotrebljavati prilikom procjene i odabira 3D virtualnih svjetova. Međutim, pouzdanost ovog istraživanja ograničena je aplikacijama koje su trenutno u ponudi i brzim napretkom u svijetu 3D virtualnih aplikacija. U procesu razrade popisa kriterija slijedili smo određene faze. One uključuju proučavanje literature vezane uz temu, korištenje heurističkog pristupa, prikupljanje mišljenja stručnjaka i primjenu popisa u obliku upitnika za studente Odsjeka za informatiku i instrukcijsku tehnologiju.

Popis kriterija pomaže pružateljima usluga i korisnicima usporedbu prikladnosti i učinkovitosti različitih programa i tehnologija koje su dostupne na tržištu u aktivnostima učenja i poučavanja (Tergan, 1998). S obzirom na izabrane značajke ili tehnološke dijelove na popisu kriterija može se naići na različite vrijednosti za različite značajke kao što su tehnički kriteriji, obrazovna svrha, aktivnosti ili ciljani korisnici (Bronstein, 2007). Zbog toga je za povezanu tehnologiju vrlo važno razviti standardiziran popis koji je lako dostupan i štedi vrijeme (Bangert-Drowns i Kozma, 1989). U ovom istraživanju popis kriterija razrađen za 3D virtualne svjetove smatra se učinkovitim pri izboru najprikladnije virtualne platforme u obrazovne svrhe. Također je koristan za usporedbu i procjenu virtualnih platformi s obzirom na značajke sustava, iskoristivost, multimedijske alate, softverske alate, sigurnost, troškove, avatare, aktivnosti, komunikacijske alate, obrazovna okruženja i aktivnosti učenja / poučavanja. Nadalje, pouzdan je i ekonomičan instrument za prikupljanje podataka za procjenu 3D virtualnih platformi s obrazovnog aspekta.

Trenutno se razvija velik broj virtualnih platformi (Kzero, 2011), a njihov broj raste iz dana u dan (Dieterle i Clarke, 2009). Specifikacije postojećih virtualnih platformi također se svaki dan nadograđuju. S obzirom na to važno je pokušati otkriti prednosti

i nedostatke 3D virtualnih platformi budući da imaju važnu ulogu u razvoju platformi i njihovoj upotrebi u obrazovnom kontekstu (Warburton, 2009). Vjerujemo da će popis kriterija razrađen u ovom istraživanju pomoći u otkrivanju i otklanjanju nedostataka i ograničenja ovih kategorija: značajke sustava, iskoristivost, multimedijski i softverski alati, sigurnost, troškovi koji su sastavni dio tehničke dimenzije 3D virtualnih platformi. Također, očekujemo da će popis kriterija dati smjernice za razvoj 3D virtualnih platformi za nastavnike i instrukcijske dizajnere.

Nastavnici nemaju učinkovite metode procjene brojnih novih tehnologija, što predstavlja prepreku u procesu prilagodbe virtualnih svjetova (Richter i dr., 2007). Smatramo da će razrađeni popis kriterija sa svojim glavnim dimenzijama i detaljno opisanim kategorijama ponuditi drugačiji pogled na istraživanje virtualnih svjetova ograničenih na tradicionalne nastavne aktivnosti. Također, vjerujemo da će nastavnicima i dizajnerima dati smjernice za korištenje 3D virtualnih svjetova otkrivajući njihove obrazovne prednosti te predstaviti obrazovno stajalište budućim istraživanjima 3D virtualnih svjetova.

„Zadaci", „sredstva" i „vrijeme" ključni su u integraciji nadolazećih tehnologija u učinkovitu obrazovnu praksu nastavnika (Soloway i dr., 2000). Pojam „zadatak" odnosi se na projekte i aktivnosti koje učenici provode tijekom procesa učenja. U skladu s tim elementi koji se odnose na aktivnosti učenja i poučavanja na popisu kriterija razrađenom za 3D virtualne svjetove koristit će se u usporedbi različitih platformi s obrazovnog stajališta. Uz to, upotreba popisa kriterija za određivanje obrazovnih okruženja na 3D virtualnim platformama pridonijet će procjeni iskoristivosti i funkcionalnosti tih platformi u procesu učenja i poučavanja (Bangert-Drowns i Kozma, 1989; Tergan, 1998).

Ukratko, ovo se istraživanje razlikuje od sličnih istraživanja 3D virtualnih svjetova s obzirom na dimenzije, kategorije, elemente i ciljanu publiku. Očekujemo da će ovo istraživanje sa svojim dimenzijama stvoriti nove ideje i znanstvenicima, praktičarima i instrukcijskim dizajnerima ponuditi širu perspektivu s obzirom na obrazovna okruženja koja se mogu izraditi u virtualnim svjetovima.

Zahvala

Ovo istraživanje provedeno je u okviru projekta „Effect of Virtual and Multimedia Environment on Interest and AwarenessTowards Winter Sports" financiranog od *Vijeća za znanstvena i tehnološka istraživanja Republike Turske* pod brojem „111K516".