CHAPTER 7
CONCLUSION

Education is undergoing a dramatic transformation. Technology plays a powerful role in the life of today’s students and institutions can no longer meet their needs through classroom-based instruction alone. E-learning is used as a means to deliver quality training and education for organizations with limited resources and budgets. It is not the same as learning face-to-face and it is not always a substitute for traditional classroom instruction. They can complement each other very well. The creation of high quality e-Learning systems includes building knowledge portals to share information and developing standard digital contents and management strategies. E-learning isn’t just ‘page turners’ any more. It is immersive instruction designed to keep the learner engaged through sound instructional methodologies. The technology boom is driving the necessity to teach and learn in new ways- and e-learning is changing too. It not just about delivering a course over the web anymore; it’s about using technology to enable the learning process.

Due to the great impact of advanced technology in the field of education, a virtual learning environment as a powerful virtual world for teaching and learning has been applied with e-learning applications. When comparing learning an identical course in a traditional framework to a virtual learning environment, students have expressed higher satisfaction from the virtual learning environment, and rated the learning as more effective than in the traditional framework. In other studies, too, it was argued that computer mediated or online learning is more effective and interactive.

E-learning also includes advantages which are not found in traditional learning, such as: time for digesting the information and responding, enhanced communication among the learners, both as regards quality and as regards urgency, knowledge being acquired and transferred among the learners themselves, the ability to conduct an open discussion, where each learner gets more of an equal standing than in a face-to-face discussion, access to information and to discussion ability, responses may be made around the clock with no restrictions, a higher motivation and involvement in the process on the part of the learners. The very use of technology for learning has been found to have a positive effect on the student’s commitment to the learning process. Also, use of technology creates a greater commitment on the
students’ part to learning. VR is both an artistic and a scientific language that can be used during creation, presentation and checking processes. Also, it can be used as a tool to offer real prospect for learner participation in educational activities.

Our research is important in part because information technology is developing powerful capabilities for creating virtual environments. Within the next decade, via the videogame industry, devices capable of multisensory immersion will be ubiquitous in rich and poor homes, urban and rural areas. To compete with the captivating, but mindless types of entertainment that will draw on this power, educators will need beautiful, fantastic, intriguing environments for learning. While providing adequate, sophisticated school-based instructional technologies is extremely important, it is vital to leverage this investment via simultaneous utilization of entertainment and information-services devices in family and community settings.

In the current research objects are identified by their geometry and have specific physical and behavioral attributes. The current research was carried out with Cosmo Player as the browser plug-in for three-dimensional rendering and VRML coding was done in a text editor. A great deal of scripting was performed to make the behaviors of the objects in the world complex, dynamic, and interactive. The heavy use of PROTO nodes and ROUTEs in the current research also distinguishes it from straightforward VRML environments. The methodology presented in here, followed by an application example, illustrated how desktop VR technology can address the challenges to experiment with scenes in real visualized projects. More efficient user control and management of scene parameters is desirable for the future. In such a system students could locally modify values of variables in real time. There is a possibility to change 3d model appearance and behavior on demand, or study the dynamic alteration of the whole scene over time. It is also possible for learners/designers to dynamically retrieve the geometry and texture of planting from a database.

Generally, one of the most important findings of research efforts directed at identifying features that enhance student learning is that students learn more effectively and permanently when they can actively participate in the learning process [212]. It is thus important to provide possibilities for the students to actively use and explore the new concepts as they learn them. VR is used to create illusion of real environments, and by virtual simulations allow students to do things in environments
they might not otherwise have access to. They add components of attractively, tighter interaction with virtual world and added fun to learning.

- Active exploration of the virtual world
- Challenge to progress through
- Fun during learning

7.1 Findings

The role of conventional laboratories for training and understanding educational problems is presently being challenged. The advances made by virtual environments have led to some learning processes being replicated to varying degrees in the form of distance courses available through the Internet. Virtual Reality provides a friendly representation of the provided information, interaction with the system, which does not require advanced knowledge of the computers technology and reduced cost compared to other technologies. In this research work, the ability of using virtual reality as a new technology to facilitate the distance application is demonstrated. This is achieved by developing three types of learning systems in the domains of education, industry and information retrieval. The first one focuses on 3D graphics concepts learning which can facilitate the gained information of such subject in desktop virtual environmental systems. The very use of technology for learning has been found to have a positive effect on the student’s commitment to the learning process. Also, use of technology creates a greater commitment on the students’ part to learning.

Most students respond to a visual style of learning which virtual reality is more than able to provide. The graphical nature of this technology combined with an explorative approach, physical interaction and an intuitive interface makes it an ideal vehicle for delivering information to a mixed ability classroom. The VRML document can be created as a simple document for only visualization and navigation or as a complex point-and-click, dynamics, animation enabled document. In the first case only the functionality of the VR browser, i.e. fly-over, walk-through, examine, pan, zoom, can be utilized that is applicable for queries where no further information is necessary. The second type of VRML documents extends almost unlimitedly the ability of both queries and interactions with the model. VRML is capable of describing dynamic interactions among objects and time related changes.
Bearing in mind the syntax of VRML, established rendering principles and the dynamic status of VRML documents in the presented approach, the following visualization requirements of the database can be drawn:

- Supplement of geometry, appropriate for visualizing in the VR browser, i.e. faces, coordinates and orientation of faces and parameters to describe predefined primitives in case of line and point objects.
- Provision of sufficient information for coloring faces, i.e. diffuse, emissive and ambient color.
- Storage of image files for texturing with appropriate visualization of image co-ordinates, for texture mapping and parameters for image draping.
- Fast retrieval of information.
- Real-time creation of LOD to speed up navigation.
- Information about the behavior of virtual objects to facilitate the organization of scripts and thus ensure efficient GUI for the query, the dynamic creation of documents and the exploration of the results.

The second domain of research focuses on industry applications which give many visual and audio aids besides the full manipulation ability for scene. VR is used in engineering design and construction disciplines to develop and visualize project designs. Students and the trainees learn important construction planning concepts more quickly and are engaged in their learning experience. The VR model designed and explained in chapter 4 gives an excellent representation of VRML’s ability to produce VR models of manufacturing processes. Interactivity of the model is an inherent part of VRML that was created for this project. The aim of this research was to make a contribution to the manufacturing industry by laying a foundation for remote access of manufacturing processes and by identifying the ability to control and visualize manufacturing processes remotely, interactively and in a 3D format.

The third domain focuses on server based information visualization. VRML and Java give the possibility to visualize and handle the system components dynamically, whether they are the modeled entities or the manipulation tools. A big advantage of this system is being web enabled, representing a new breed of on-line, request-based applications that users can access whenever needed. The novelty aspects of the system can be observed in many characteristics. Besides being an on-line modeling system, the technologies that are used enable to push the limits of VR
by integrating visualization, interaction, data management options into a virtual environment, modeling options that have been previously considered as inappropriate for VR due to resource constraints or the rather static nature of the VR content systems such as VRML.

Research clearly demonstrates that students and teachers do better when they have variety, flexibility, and comfort in their environment—the very qualities that classrooms lack. We have found that student understanding (and enjoyment) of technical topics is greatest when they must apply conceptual techniques first-hand to produce working demonstration programs.

All findings from the examinations of the effects of virtual learning environments on education are significant to the latest emerging virtual learning environments and they can provide a useful direction as well as instructions for education on virtual learning environments. The purpose of training on developing skills for participants is to become more effective and efficient in their work as they have to update themselves to survive in this competitive world.

The conclusion that the language is appropriate for 3D modeling is drawn. Furthermore, the syntax of VRML requires the provision of specific information for the successful creation of the document, i.e. vertices, orientation of faces, color, texture, descriptors for behavior and dynamic, lights, views. Most of such data has to be available at the database level. The suite of VRML and HTML documents is capable of either selecting predefined queries or composing new ones. The resulting dynamically created new VRML documents may be as complex as the starting one and, hence, used for further queries in two directions: to the server and to the local model on the client site.

The design and development of the various VR models indicates the process could benefit significantly from the advantages namely:

- parameterization
- reusability
- increased complexity
- decreased development time
- componentization
7.2 Benefits

The three-dimensional representation has some benefits over the two-dimensional representation. The obvious one is the possibility to use the third dimension and to be able to display more information in one screen. High interactive worlds can be created. Using 3D and virtual reality environments as part of training methodology allows students or workforce to experience an entirely new side of training. This type of technology breathes life back into traditional computer based learning and re-awakens the enthusiasm in users who are used to this technology in other circles outside of training. There’s no substitute for the real hands-on training but VR representation goes a long way towards giving learners the knowledge and preparing them for a real life situation.

Complicated pieces of equipment, processes or systems can be recreated using VR techniques. This form of e-learning allows users to learn about mechanisms and processes that would be physically or logistically difficult to do so in other conditions. VR worlds can provide a giant laboratory for educators to experiment and play and explore new possibilities and alternative configurations. Objects in a VR-based learning environment can be modeled with varying degrees of accuracy to explain and visualize the certainty, believability and veracity of the information related to that object. The use of database technology has the ability to recreate a natural environment for the user in which information can be retrieved more intuitively. The visualization of a 3D space should be either quite simple or be close to a real world environment depending on the kind of representation needed for the database.

Interaction in VR can be seen as the mutual exchange of actions between users, objects and the environment that have an effect upon one another in the three dimensional space. The VR interface is characterized by transparency, which means that conscious thinking about how to act is not required by the users. Moreover, the way to interact with the virtual environment is characterized by the feeling of presence and comes naturally to the users without spending time and energy to take formal instructions. Navigation for users means participation and understanding of the virtual scene. Summarized benefits of what the VR functionality in education is:

- Engage learners to be involved into problem solving (Problem Based Learning);
• Enhance spatial thinking, reasoning and content understanding through the use of 3d models and simulations of concept plans;
• Learners can easily extend, manipulate and manage the knowledge base (learning modules);
• Allow educators to differentiate their instruction;
• Allow learners to follow their own personal learning style (Individualized learning);
• Offer a uniform way for learners to meet learning goals;
• Has a positive effect on time students usually spend in educational activities;
• Offer all of the above without any geographical or time restricts (e-learning functionality).

7.3 Problems encountered

Problems that were encountered in the project were mostly of a practical nature. Although VRML has been standardized, it is still an evolving standard with additions being made to it. Many browsers do not fully comply with the standard or may interpret the standard in different ways making it difficult for content creators to design content that will be the same in different browsers and platforms. This is especially evident for event ordering and handling. VR applications do not support multiple users or do not provide any type of interaction between their users. Current e-Learning programs on offer are severely limited in scope simply because they continue to operate within classroom-based educational paradigms.

As anticipated, e-learning differs from classroom-based training in many ways. Therefore, converting a traditional course to e-learning may represent a complex endeavor, and as such it requires accurate planning, monitoring and control, to make the conversion effective and economical. In the first place, unless the advantages of e-learning outnumber the disadvantages for both the educational institution and the learners, converting to e-learning may not represent an efficient solution.

VRML is not a complete object-oriented language. VRML provides encapsulation of fields, and uses ROUTES to provide circuit-like access to fields. However, its implementation is not “traditional” or complete encapsulation. Additionally, there is no “inheritance” in VRML in an object-oriented sense. These factors and others make it difficult to achieve object-oriented design goals within
VRML. PROTOs, ROUTEs, and scripts alone are not enough to satisfy object-oriented design goals, because there are few restrictions on their structure and function.

There is no good three-dimensional editing tool that allows one to “program” VRML using three-dimensional graphics, although tools are available that export VRML and some VRML-specific geometry tools do exist. There is no editor to write a PROTO node and then use it through a three-dimensional editing tool. It remains to be developed. Also, there are no good debugging tools for VRML, as browser error messages can be cryptic. This has the effect of lengthening the design-debug cycle.

Lack of education or experience with the computer and language may cause some of individuals to experience anxiety that negative impacts their ability to learn. GartnerGroup acknowledges the current barriers that prevent more widespread use of e-learning, including high cost, complex and time-consuming implementation, and a shortage of high-quality course content [199].

7.4 Future work

- Generating the mapping information between a database and the library of VRML prototypes. This information could then be included directly in the database for easier recovery and management.
- VRML is intended for read-only (visualize-only) single user applications: Although VRML includes some features to add interaction to 3D models, these features are severely restricted and intended primarily for animation effects.
- VRML is not intended for real 3D editing; it does not support mechanisms to report changes in the scene back to the server; each time the scene is reloaded, it is displayed again in its original starting state.
- VRML lacks the scalability needed for very large models: it lacks library mechanisms to locally manage reusable 3D components and to avoid constant reloading/pre-processing. It is however not possible to spatially organize large scenes; VRML browsers are not able to decide which parts of a large model should be loaded and which are currently not within the view frustum anyway.
- New components and improvements over existing ones will remain an open opportunity for VRML developers as long as VRML has an audience.
- Automatic adaptation of the student’s profile: currently the profile parameters are just received from the e-learning platform, but it could be probably very interesting if the student’s actions could be evaluated and an automatic feedback with the server updated the stored profile.

- Porting to X3D: decoupling the multimedia information from the geometric description of the models, as well as the external management of the adaptation process, imply that a migration of the system to support scenes described in X3D should just require a modification of the interfaces.

- It is important to consider the impact of E-Learning on communities of learners who experience special access difficulties. The prime example is the visually impaired community there are a number of ways E-Learning environments can be made maximally accessible including designing for access and the use of assistive technologies.
  - Designing for accessibility - Web Accessibility Initiative (WAI) standards
  - Assistive technology - voice input, VXML, screen reading software

- With the advent of new elements in the VRML/X3D language, this system could be extended to take advantage of new interaction modalities, of new standard geometry types and of new levels of interconnection possibilities that make the handling of dynamic content easier.

  Learning should be an exciting, fascinating and challenging experience which will involve the learner moving out of their comfort zone but in a controlled way. VR technologies increase training effectiveness. Around the world, a number of educational organizations are already beginning to utilize "slick" computer-generated visuals to replace oral/text-based learning materials and depend on their audience adapting a visual learning style. Whether one likes it or not, in the future, 3D, interactive, multi-user, collaborative virtual environments (based on computer games technology) are going to be increasingly used to generate online educational experiences around the world. It is imperative that researchers and practitioners start to examine the implications of this technology, evaluate its potential advantages and disadvantages and assess its impact on learners. However, it should be noted that
there is potentially significant development costs in the use of this technology, which may involve the assistance of additional staff or technology vendors and consultants.

The era of programming by writing code in a code editor is long gone. Demands on programmers are pushing them towards rapid code development. Shorter life cycle development and easier maintenance of developed systems can be achieved through different approaches ranging from computer-aided development to rapid prototyping and model development.

Demands from captivated users are driving virtual reality modelers to explore the modeling environments that can support high quality modeling and that poses integrated tool for achieving interactions in Virtual Reality worlds. Choosing a working environment is not an easy task. The chosen software tool may shorten the production period but, at worst, may considerably prolong it. If the modeling environment is too complex, the programmer will require training and practice time before becoming productive - time that we simply do not have.