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Innovative Intelligent Technology and Information Systems for Visually Impaired

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ABSTRACT

The paper presents an IT network program developed specifically for visually impaired students. Innovative in its conception, this program contains all the learning required equipment, such as classroom (virtual), accessible learning materials, laboratory, and teachers trained to teach visually impaired students (Arditi et al. 1996). Additional teaching aids, like iNetSim, a universally accessible network simulator, created to allow vision-impaired and sighted students to complete Cisco Certified Network, and Microsoft HoloLens 2 (a new vision for computing, is used to transform abstract concepts into 3D experiences in the virtual classroom), which enables students to research and explore more deeply, see more clearly, and learn by doing (Huang, Jonathan 2017). This article aims to allow visually impaired students, as well as sighted students, to perform with similar results.

Keywords: Teaching, Visual impairments, Classroom

INTRODUCTION

For 30 years, a great number of educational institutions, which offer e-learning programs that have been developed considerably. Although, forthcoming the digital era, often has not become the reality for most students with visual impairments (Harper, S. et al. 2001) "Visually impaired", also known as vision impairment or vision loss, is a decreased ability to see to a degree that causes problems not fixable by usual means, such as glasses. This scientific work was established in 2018 for students visually impaired. Scientific and technological contents are rapidly changing in the education system, and the Internet and web became essential media to access information and learning materials. The new learning methods, based on Internet and Web extent use, provide extraordinary opportunities in design. However, visually impaired students are a group deeply affected by this change and find serious problems to deal with it, which goes from simple work, as typing a letter or draw with the use of computers. The objective of this scientific work is to explore an e-learning course challenged by students with visually impaired and sight students. This is reached equally by tracking the best practice eLearning program. On the year of 2017, we started using Windows Mixed Reality. The new project (2018) contains available materials, a laboratory,

and a network for the design and the testing and Microsoft HoloLens 2 for all students). Two teachers trained for the visually impaired students and teachers that instruct sighted students. This new project (2018) with the Cisco Certified Network Associate (CCNA) course with the iNetSim application (Cisco Systems, 2004), offers a visually impaired certification in IT networks and could also be offered a design course. In this last year of 2018, we also started using the iNetSim, which is perceptible by vision-impaired users. It is based on Mac OS X Tiger, a system software with an incorporated screen reader called Voice Over and Microsoft HoloLens, that transforms abstract concepts into 3D experiences in the classroom, permitting students to investigate more deeply, see more clearly, and learn by doing. The project contains available learning tools, an online learning environment, and a remote virtual network for testing of a computer network. It was selected specific colors for text and backgrounds of web and e-learning tools because it could reinforce the readability of on-screen text. The program was also supported by the Web Accessibility Initiative (WAI) and Section 508 for creating web pages usable by students with visual impairments and recommends several online tools to select appropriate page background and text colors. The Cisco Network Academy Program (CNAP) computer networking, a certification course, giving the users with vision impairment relevant qualifications.

Students with Vision Impairment

Vision impairment presents a significant variety of forms, from congenitally blind, without vision from birth or very early age to those who lost their vision in variable levels for various reasons, clinical or other. Temporary blind students and partially sighted students are two very different groups that present specific study patterns and difficulties. Each group has expectations of their own and require special staff support. Scientific and technologic fields such as IT, engineering, or design are strongly rooted in visual supports making visual abilities crucial and affecting negatively impaired students who face serious problems in comprehending essential parts of the program.

Learning Barriers

Low vision students challenge different kinds of obstacles: to fully access the matters, in fact, the first category needs to depend on screen readers, while the second category, lean on optical supports and/or to precise customization selections, may approach a larger variety of software functions, involving, frequently, those with graphic interface. Among the problems faced by students with vision impairments, one is related to the fear of damage to the equipment, usually expensive and sensitive. They feel they cannot fulfill their need to 'play' with the equipment and computer design programs even if this is essential to the educational course (Cisco Systems, 2004). A useful application is offered, as an essential element of the educational course method. Limited vision depends on sequential learning using tactile, proprioceptive, and acoustic perceptions to create spatial associations. Those

students require alternative means of developing and understanding the third dimension. The Cisco Network Academy Program (CNAP) has been altered to integrate innovative visualization approaches to assistance the conceptualization, as specific Barriers, with deficiency of accessible e-learning education and nature of vision incapacities, require advanced instruction, and preparing establishments should convert a significant multimodal (using several modes or methods) operator interface to a design e-learning tools more accessible to all users.

Accessible Learning Management System

It's important to consider in creating an accessible e-learning environments': technological and methodological subjects. The accessible learning management system presented, is to offer the students with visual impairment the accessibility of iNetSim and the use of Microsoft HoloLens. (Bigelow A.E.1996) Cisco Certified Network Associate level two (CCNA 2) is a teaching e-learning program for students with visual impairments. The Cisco curriculum is well known as an international program. This project investigates the efficacy of the available systems and adds the most active methods into an understandable education course. The students with vision impairment, that benefited from this course, they could get results within 5% of the sighted students. Education Institutes offer computer networking career education through certificate, associate degree, or bachelor's degree programs. The purpose of this course was to contribute to students with vision impairments, that could get access to computer networking career education, and they will have a chance to start a curriculum and be able to get a work. A computer networking skill could be important for people with visual impairment for some purposes. Principally, for collaboration with computer networking and computer workstations at the actions stage through text interface (Eckert, Martin, et al. 2018). Text interface uses text input and output, and text is simply transformed in audio output by screen reading software. A screen reader is an essential piece of software for the visually impaired person. Simply put, a screen reader transmits whatever text is displayed on the computer screen into a form that a visually impaired user can process (usually tactile, auditory, or a combination of both). Most basic screen readers with additional features can give people with visual impairment much more independence. While the physical network, (When installing and optimizing networks, most people overlook the physical components, which can have a great impact on performance) may include wiring (electronic sketchbook and hardware electronics for developing ideas. It is a context for learning fundamentals of computer programming). IT Network Solutions, (offers a comprehensive set of voice and data solutions developed by a team of engineers) is reasonably shaped and is implement rationally through a workspace. Finally, the students with vision impairments and sighted students, that use computers, internet, and HoloLens, as a support, this practice is indispensable not only to support a computer network, but also to allow them to repair the computer systems. To accomplish the purpose of the course, it was required to establish a course, accessible to users with vision problems.

The E-Learning Project

The E-Learning Project was accomplished over a semester in 2017 at IADE-Creative University, Lisbon and the course was established, and the program year was improved (2018) Universidade Europeia, Lisbon. This plan included about 5 students with vision impairment in India and 5 visually impaired students in Portugal (all with about <10% visual insight), recommended by APA, (Association for Blind). The Cisco Systems Inc. establish the essential network tools for the teachers to improve and instruct the students conveniently. In the live teaching operation phase, where the matters were separated into two sets, sighted students and visually impaired students exposed for purposes of comparison. Cisco Learning Network Space (a digital learning platform built to offer instant user access to training information, course materials, and exam preparation resources. It's designated, as a practical tool operated by visually impaired permitted them to access no more than 20% of the regular Cisco e-learning tools. The result supported a requirement showing the supplies for alternate procedures. The project conclusions were positive. In all Cisco examinations, PassMark Software is 75%. Students with Visual impairment verified 90% in the first test series. The result was identical to sighted students, who also reached 90%. The normal differences in results for the two groups were also very alike.

Creating a Program for Students with Vision Impairment

It was created a curriculum, especially to contain the requirements of students with vision impairments, the following topics were established: 1. A teaching environment accessible for resident learners; 2. A test center for computer network and research; 3. An offered program inclosing a group of electronic tools for design programs; 4. The use of HoloLens's; 5. Distribution by trained instructors to teach students with vision impairment and regular instructors. These learners were aided with the necessary supplies and offered with the effective instructional strategies.

Basic Classroom

The basic classroom comprises a physical environment (teachers should design the environment by organizing its spaces, furnishings, and materials to maximize the learning opportunities and the engagement of every student) for students and instructors and a virtual classroom (used by far away (Indian students). The virtual environment (an online learning environment that allows for live interaction between the tutor and the learners as they are participating in learning activities. The most common tools in a virtual classroom are Videoconferencing, TV on-line, and call management application (is the process of designing and implementing inbound telephone call parameters, which govern the routing of these calls through a network), that certifies instructors to broadcast network (is a group of radio stations, television stations, or other electronic media outlets, that form an agreement to air, or broadcast, content from a centralized source) to classes local and distant education. VoIP (software that integrates most frequently used communications applications and services from a single, multimedia interface on

PC or Mac). VoIP call management systems were Cisco Call Manager and Ventrilo; offer adequate assistance. It was important, that sighted teaching assistant, achieve the broadcast network, by radio buttons on a visual display by screen reading software, Students were listed into the online learning environment to attend classes, to assist classroom exercises. The online space (where the learners and the tutor work together simultaneously), provides advanced tools for students to communicate with other users and interact with instructors, comparable to a regular environment classroom. All classes were reported and published in audio file format along with other instruction tools for simple learning by all students. Long-Distant communications appeared through VoIP, where mainly students were using freeware (software) functions, like Skype for communication.

The physical environment comprised workrooms equipped with operational technology (OT) (a category of hardware and software that monitors and controls how physical devices perform). Operational technology (OT) (in e shape of screen readers and screen magnifier, specific colors, and contrasts for the computers' screens for the visually impaired), router bundles, and network equipment for the remote laboratory (is the use of telecommunications to remotely conduct real experiments, at the physical location of the operating technology from a separate geographical location), network simulation tool (a system of computers that are connected so that they can share resources and communicate internally and even globally), and learning management system (LMS) to support teaching and learning processes. Additionally, haptic technology, (is any technology that can create an experience of touch by applying forces, vibrations, or motions to the user). Besides this tool, it adds a touch helpful technology that was validated. All students could manage the studying context through the Internet and could approach similar tools and equipment, as those students in the physical environment (the overall design and layout of a given classroom and its learning centers).

Supplementary Test Center

The Supplementary Test Center was designed to allow both local and faraway students to check their system developments. This center consisted of some system groups and three servers (are a computer program or a device that provides functionality for other programs or devices). Operating VMWare to provide virtual networks (is a software product that provides operations management across physical, virtual, and cloud environments), where students could set up the system to meet requirements of the proposals, they established using the system recreation device and check them in the test room. This expertise provided the learners a chance to test different systems proposals and understand how the modifications they introduced in their works, that would be important for the success of their plans in a physical environment. The distant center also allows students positioned far-away to have similar aids, as the students joining the physical environment.

Cisco Course

During 2017, the course was in a long-lasting development, with the upgrading of the supplies and instruments with changes to each new edition of education systems emitted using the Cisco Learning Network. The Cisco course was created to be operating two years, where the users should acquire expertise: Organize, set up; manage systems; Resolution of network subjects; Settle different types of operating systems. The program gives requirements for all students, such as these tools: substitute keyboard navigation is important for users with visual impairments, that couldn't depend on pointing gadgets, such as a mouse; the basic accessibility features provided by operating techniques, plus preservation of highlights which are important for low vision users, as extending fonts, convert color design, adjusting color brightness and contrast, improving the contrast between text and background; complete assistance for screen reading tools, that is essential for graphic components and written texts, that benefits not only to permit a major understanding of screen subjects, but also to make viable the written interaction between the software application and a user who, may insist on a speech synthesizer; images, cartoons: they should not be the only way to submit material, as they characterize a difficult for the visually impaired; features which may confuse vision and/or reading, such as high – frequency flickering elements (is a frequency at which an intermittent light stimulus appears to be completely steady to the average human observer), should be avoided; the position of the focus point (the point where waves of light or sound that are moving towards each other meet), should be clearly visible by human eye and by assistive technology (assistive, adaptive, and rehabilitative devices for people with disabilities); documentation and other tools sustaining the use of software functions should be accessible in digital format, so that they can be entirely read by any type of users, including those with visual impairments. In this program, the screen reading applications of the computer can convert the text to audio, as the holoLents and the students with vision impairments could have the capabilities to study for further university education and get a job in the networking area.

Technology Support

One of the difficulties established during the experimental project of 2017, it was about hiring regular teachers, instead of trained professors. Because of the regular instructors, they were not entirely sensible of the requirements of visually impaired user's association with evidence of concepts and supplies. In this 2018 e-learning program were hired two teachers trained for the visually impaired students. They were capable to provide the 2018 e-learning program sources and they offer more methods of showing knowledge sources. The audio Notetaker, (the note-taking app and software for student) was saved into the administration device to following leaner contact. During the distribution of the class, far away students could do interrogations. Tests were accomplished frequently to see the evaluation of the work enclosed and regulate the efficacy of the education methods. Students with vision impairments

operated together with the teaching team to shape a successful communication system. All the students adopted equivalent tools and test centers; the lessons planned at change hours in the day, because of the noise produced by the sighted students, this could be hard for users with vision impairment catch audio production from screen reader applications. Screen readers are software applications that try to deliver what users with normal vision see on exposure to their users through non-visual ways, like text-to-speech or sound icons. The students completing each program number of the 2017 program: 5 visually impaired and 5 sighted. Regular teachers organized the classes for sighted students and trained teachers for visually impaired students. iNetSim, available system simulation, designed to permit visually impaired and sighted learners to finished Cisco Certified Network Associate level two (CCNA 2) test center phases. On the 2018 project, the iNetSim, was developed for this new program for student's complete network performs and operated particularly in a teaching router outline, network management, routing protocol configuration, and programming access records to manage approach routers. It approved the arrangement of virtual network tools involving routers, switches, hubs, Macs, and PCs. Control and feedback above the virtual reality were supplied by a command-line interface to tools. The interface operated in a related system to the functioning procedure for that gadget sort, for example, a basic DOS similar method for Macs PCs and Cisco IOS for routers. (Meddaugh, J.J. 2011) iNetSim was created to functioned uniquely with the keyboard, easing the eye and hand matters confronted by users with visual impairment. A GUI (graphical user interface) (is interactive components such as icons and other graphical objects that help a user interact with computer software, such as an operating system), was also available. It was provided also to the screen readers, which are software applications that are installed on the computer to provide the translation of the information on the computer screen to an audio output format. The translation is passed to the speech synthesizer and the words are spoken out loud. Currently, fully functional screen readers are only available for Linux in console mode. Linux supports develops an important position of the programs, and a voice synthesizer tool for Linux was advanced precisely intent (comprising both hardware and software).

Results

The students with vision impairment reached comparable results regarding sighted students, then it required them extra time to embrace tools in provision for these evaluation procedures. (Gregory, R.1998) To prepare for the final examination in each course, the visually impaired worked 4-5 times more hours than the other learners. The system tests have a pass mark of 75%, and learners need re-sit exams until they accomplish at least 75% correct answers. The sighted estimated to increase results than visually impaired users in tests; still, the two groups performed with no significant difference concerning average scores and in the number of examination attempts. At the first evaluation, the visually impaired and sighted students achieved a normal 92%. At the second assessment, the visually impaired students gained

87/% compared to 84% for the sighted group in identical evaluations. The grades were closer in the last valuation, the students with visual impairment achieving 88% equaled 87% for the sighted students. Advanced results could be clarified by the devotion of users with visual disabilities as a result of a course precisely planned to increase their abilities. These users used expressively extra time interpretation and concluding performs out of class time than the sighted students. Finally, the program for visually impaired users provides a complete questionnaire concerning matters, with the accessibility of remodeled plan, the competence of tools suggested in the test center, the efficacy of operative equipment utilized (screen reading and text enlargement applications), and the supply of materials by instructors. The users adopted to attend the voice synthesizer tool. One more essential reflection was the length of time the users with visual disabilities were required to embrace the program tools. As a result, a few students with visual disabilities argued that they wish to continue to postgraduate studies. Finishing this program allowed the visually impaired students to feel confident in their capacity to successfully complete their courses.

The Use of HoloLents

This work can improve the quality for learning and benefit with environmental orientation and interaction. Visually impaired students confront various challenges when relating with different materials. Principally in unfamiliar environments, this could be hard with unpredictable and indefinite experiences, as the misplacement of an object. Within this program, an example to discover and identify matters in digital images and it was develop adopting intense learning technologies. The work includes a HoloLens system for all students and can be managed to identify items and described them through voice output. Microsoft HoloLens offers not only a mobile mixed reality solution (mixed reality solution, the augmented reality enhanced wearable hybrid simulation IV trainer (AR-RLS), replicates real-world clinical skills training), that covers image catching, microphone and 3D audio playback functionalities. It also offers a spatial model, which can be used for distance calculation between an item in the spatial model and the HoloLens. The latest technology improvements in profound studying and windows mixed reality PC, hardware permit quicker progress of accessible tools. The recommended program proposes various options to increase the learning of the visually impaired and can be utilized without any preceding instruction on the tool. The last version of the HoloLens with help a lot the inclusive education. Seeing that the computing power of the new version is potent enough, an item recognition could be achieved precisely on the HoloLens. The three-dimensional understanding of the HoloLens would make it viable to inform the user if is standing in front of a barrier at a certain distance. The solution of profundity data can be development utilizing an external depth sensor (With optical elements separated the same distance as human eyes, both Structure Sensor and Structure Core bring human-scale depth perception to a multitude of applications). Garon, M. et al., 2016) Other applications already identify signs or bank notes (Sudol et al., 2010), applying diverse Optical Character Recognition (OCR) structures.

Future Training Supports

Therefore, designing a model specifically for people with special needs requires a precise definition of the target group, which helps to determine the criteria for selecting the appropriate content for them. Teachers in inclusive education may face challenges in evaluating the effectiveness of e-learning program content design for several reasons: The best solution for this problem may be to design flexible programs that can be shaped to each situation. Especially, when the project could permit a precise method, concerning to different assembly of different categories of leaners, one visually impaired and the other sighted. (Hope J.2006) The course could gain from wider study in the forthcoming on the best applicable processes of providing the knowledge supplies to various sorts of people disregarding of their sight capacities.

CONCLUSION

Students with disabilities can be included equally in classroom learning activities, and they could cooperate with and compete with other regular students without any barriers. It is clear, that technology is a powerful collaborative learning tool because it enhances communication skills, which can help the students to maximize the benefits they gain from the learning setting. Furthermore, it is an efficient tool to help students who have special needs to join their peers in the same classroom and focus on the same content. This project provides a safe, therapeutic setting that is unlimited in scope; the size of an e-learning course can far exceed the physical confines of the learning setting and, through employing the power of the internet, can involve participation from all corners of the globe. This e-learning project included extremely good tools to require the stage of availability needed and offer the students with vision impairments support in their capacity to acquire and accomplish the equal education results as the regular students (Knoblauch, K.et al 1991). The excellence of the education supplies appears to have improved during the stage of the investigation (Lazar, J.2004). Concluding, it seems that was no differentiation in the results between the sighted students and the students with vision impairment using this course. It signifies such contribution with a proper background and comprehensible program resources, people with visual disability could be able to reach equal results as the sighted students.

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