

Accessibility considerations for e-learning in Ghana

by

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Abstract

This paper reports on a study that explored the best ways to design e-learning in order to provide better access for adult learners with disabilities. Two districts from the Central Region of Ghana were selected and two major research questions guided the study. The five-point Likert scale was employed between May and August of 2014. The two questions asked were: The kind of issues that should be taken into account in the design and management of accessible e-learning? And what problems need be resolved to have accessibility solutions for e-learning by the diverse adult learner population in the region? The results confirm existing insights about accessibility considerations in Ghana, other African countries and the world at large for the disabled, showing that Ghana and other African countries are not unique in terms of accessibility requirements in designing e-learning in order to provide better access for adult learners with disabilities.

Keywords: accessibility, disabled learners, communication handling, learning attainment, web interface accessibility

Introduction

This study was motivated by some questions pertaining to management interfaces of modern e-learning system and environment {well designed interfaces like good educators and instructional materials should build a teacher-student relationship that guides users to learn and enjoy what they do (Shojar, Barzegar, Aeini, & Rashidi; 2015)} and how to comply with accessibility guidelines {accessibility guidelines explain how to make user agents accessible to people with disabilities, particularly to increase accessibility to web content.

User agents include Web browsers, media players and assistive technologies which are software that some people with disabilities use in interacting with computers (UAAG, 2005)}, and whether the application of such guidelines primarily aligns with the student, or content-user interface to the system in an attempt by the School of Continuing and Distance Education of the University of Ghana to respond effectively to the needs of adult learners in the use of instructional design technology for developing essential knowledge, skills, and attitudes for lifelong learning. The current study asked the following two questions: What are the kind of issues that should be taken into account in the design and management of accessible e-learning in the Central Region of Ghana? What problems need be resolved to have accessiibility solutions for e-learning by the diverse adult learner population in the region?

According to the UNESCO Institute for Statistics, (2007) cited by Asunka, (2008) in sub-Saharan Africa, it is estimated that only 1 in 250 people have access to the Internet as against the global average of 1 in 15 Furthermore, Asunka, (2008) citing Saint, (1999)

show that online learning in higher education in sub-Saharan Africa poses a great challenge as this mode of instruction delivery relies solely on the available information and communication technology infrastructure and the fact that most institutions within the sub-region are currently in a state of crises – having to cope with collapsing infrastructure, brain drain, and dwindling financial resources, whilst under increasing pressure to cater for larger student populations.

Despite these constraints, online learning is still being touted as the only and best possible solution to the problem of access to quality higher education in Sub-Saharan Africa (Asunka, 2008). Although, online learning has been seen to benefit everyone, students with disabilities still experience web barriers that prevent them from benefiting from online learning (Ndeya-Nderera, 2012). Such students according to Ndeya-Nderera, often struggle with some aspects of learning because most online courses are not accessible to students with disabilities. According to Burgstahler, Corrigan & McCarter, 2004: 234), courses that are designed to be accessible to all potential students, including those with disabilities, offer opportunities to level the playing fields for people with disabilities. Furthermore, CANnect, (2011); observe that engaging in accessible course design has been proven to be a proactive approach in which online courses are created, taking into consideration the needs of diverse learners (in age, gender, backgrounds, learning styles, abilities and disabilities).

Bugler (2013) revealed that crucial assistive technology in education ranges from low-tech options such as reading stands to high-cost computer technology such as Braille display. She further showed that although text-to-speech software has vastly improved opportunities for those with disabilities to engage with ICTs, the real deal comes in the

shape of hardware complete with loudspeakers, a Braille keyboard and screen-reader software which converts all text on a screen to audio output. She noted that, all these assistive technologies come at a great cost and wondered how African educational Institutions could make accessibility in online learning a reality for the disabled.

Literature Review

Cooper, Colwell & Jelfs (2007), makes it clear that, if e-learning research and development projects are to be successfully adopted in the real-world teaching and learning contexts, they must effectively address accessibility and usability issues.

Defining accessibility

The Lincolnshire County Council, (2010), defined accessibility as the process that aims to promote social inclusion by helping people from disadvantaged groups or areas access jobs and essential services. Accessibility focuses on making things usable by people with disabilities, including temporary disabilities. Designing for functional limitations overlaps with designing for situational limitations (Suwannawut, 2011).

Accessibility has also been defined as the ability of the learning environment to adjust to the needs of all learners (IMS Global Learning Consortium, 2002). “Accessibility” is thus determined by the flexibility of the e-learning system or learning resource to meet the needs and preferences of all users. These needs and preferences may arise from their environment (e.g. working in a noisy environment), the tools they use (e.g. assistive technologies such as screen-readers, voice-recognition tools or alternative keyboards, etc.) or a disability in the conventional sense (Cooper et al, 2007).

Distinction between Accessibility and Usability

Shneiderman (2000) observe that people with disabilities encounter all the same problems that people without disabilities do. According to Sloan et al., (2002), accessibility and usability are intrinsically linked. The lower the level of accessibility of a resource for an individual, the less usable it will be for them. In the worst case they will not be able to use it at all. Conversely, improved accessibility for disabled users promotes usability for all. Usability should play an important role in accessibility testing, since a resource presenting usability difficulties will generally present significant accessibility problems for disabled users. Even sites with a high level of accessibility can nevertheless have usability problems that may prevent people with disabilities from using them efficiently (Cooper et al, 2007).

Views on accessibility

Sloan et al., (2006) adopted the inclusive view and promoted the concept of user-centered design through personalization. In this concept there was no single universal solution that could appropriately address the needs of all of user groups. Cooper, (2006) introduced the concept of accessible e-learning as referring to design qualities that endeavor to make online learning available to anyone irrespective of their disability, and to ensure that the way it is implemented does not create unnecessary barriers to the one interacting with a computer or connecting device. Parry, (2010), argue that there still are broad evidence of the inaccessibility of e-learning experiences.

Students Expectations and Experience

Asunka, (2008) show that, a cross-section of Ghanaian students studied in a private tertiary school did not respond favorably to online constructivist teaching approaches such as asynchronous discussions and ill-structured project-based learning activities, and perceived collaborative online learning within their context as a complex, more demanding and time-consuming experience. Many other studies have reported unfavourable students experiences with online learning stemming largely from improper planning and poor implementation and evaluation of e-learning approaches.

Accessibility models

In this study, questions asked reflected ideals expressed by some accessibility models. So it was found worthwhile to review the literature on accessibility models, particularly the web accessibility integration model (WAIM), the composite practice model (CPM), the holistic model (WM) accessible e-learning practice in higher education model (AELPHEM), the universal design model (UDM) and the learning content management system model (LCMSM).

The web accessibility integration model

Lazar, Dudley-Sponaugle, & Greenidge, (2004) adopted an approach of web accessibility, arguing that an accessible website must be sufficiently flexible to be used by assistive technologies. This model tried to assess whether online curriculum content and delivery software applications conform to the principles of standard and legislative compliance or meet accessibility requirements prescribed in the guidelines. It relied on advancing technology, i.e. accessible web sites, to solve e-learning problems and enhance learning for students with disabilities. It requires skills to interpret and translate these principles and their implications for the learning technology community.

The Composite Practice Model

The composite practice model focused on linking experts and utilizing their knowledge in order to support students (Leung, Owens, Lamb, Smith, Shaw, & Hauff, 1999). The philosophy behind this model is grounded in “best practice” and that the ultimate responsibility lies with the governing body of the institution. This model suffers from the weakness that it lacks in universality because of the wide scope of inspection for each agent. The constant technological change and the many contextual variables make it impractical to endorse a single model for service delivery.

The holistic model

The holistic model placed learners at the center of the development process and focused on the context in which accessible e-learning developed (Kelly, Phipps, & Howell, 2005). It provided resources, which are tailored for the students’ particular needs, and welcomed diversity. This model also has a shortcoming in that, it can become tiresome for students to have to continually discuss their disability with various members of staff as they go through their degree program in order for their needs to be met.

Accessible e-learning practice in higher education model

Seale, (2006) introduced the contextualized model of accessible e-learning. He viewed the development of accessible e-learning as a practice or activity that can and will be mediated. He distinguished three components as follows:

1. all the stakeholders of accessibility within a higher education institution
2. the context in which these stakeholders have to operate: drivers and mediators

3. how the relationship between the stakeholders and the context influences the responses they make and the accessible e-learning practices that develop.

The model encompassed two theoretical frameworks for practicing, communities of practice and activity theory and the time needed to build strong network to establish strong tie of community.

Universal Design

A new paradigm emerged that sought to design products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design (Center for Universal Design, 2008).

It was based on the philosophy of "barrier-free" or "accessible design"

The seven core principles addressing the key concepts of universal design: Equitable Use, Flexibility in Use, Simple and Intuitive Design, Perceptible Information, Tolerance for Error, Low Physical Effort, and Size and Space Appropriate for Approach and Use.

Learning content management systems

According to Thomas, (2007) and Brown & Merri, (2013), learning content management systems (LCMS) environments have become progressively more complex as instructors and students demand more features and more capability from their learning environments. Thomas argues that, in terms of the interface elements, such as logging in, logging out, navigating to courses and content and communicating with instructors and

other students, modern LCMS environments typically have multi-layered structures across which users must be able to navigate.

Whilst the LCMS core environment has its fixed interface elements, instructors have the ability to add further navigation issues in the form of multi-layered content folders, hyperlinks, html content, all of which can typically be mixed together in any number of ways. Whilst this creates flexibility for instructors and course designers, it can leave users of assistive technologies learning not just how to interact with the core LCMS features but with the individual courses as built by the instructors. The issues of accessibility are addressed by the websites for Blackboard and Moodle LCMS tools, with the Moodle site offering authors a basic accessibility overview and some do's and don'ts in terms of course design and content format, whilst Blackboard offers comprehensive instructions to students in terms of using the system with assistive technologies (Blackboard, 2013, Brown & Merri, 2013).

Accessibility standards for learner profiling

The accessibility for Learner Information Package Final Specification (ACCLIP) was approved by the IMS Technical Advisory Board in July 2003 (IMS Global Learning Consortium, 2003). ACCLIP enables the description of user preferences (in terms of visual, aural or device) that can be exploited in order to customize learning contents (e.g. preferred/required input/output devices or preferred content alternatives).

In other words, this profile provides a means to describe how learners interact with an e-learning environment, by focusing on accessibility requirements. Learners can declare multiple preference sets according to different contexts of use of the e-learning environment. For each context, accessibility preferences can be grouped into the following sections; display information, control information and content information (Brown & Merri, 2013).

Content and assessment accessibility in e-learning

In order to improve the accessibility of e-learning content, another IMS standard was defined: the AccessForAll Meta-Data (ACCMD) specification to describe learning content by identifying which types of resources are available in a learning object, that can be used to present the same content to a given learner, but by means of different media (IMS Global Learning Consortium, 2004).

For instance, metadata that can be exploited to describe that textual alternatives that are available for images, audio descriptions for videos, transcripts or captioning for audio tracks, visual alternatives for text, and a variety of other potential alternative formats. Thus, ACCMD thus makes possible to identify those resources which match user's stated preferences or needs. The idea is that if the ACCMD specification is implemented in an e-learning environment, smart strategies can be devised to select those (alternative) media resources, composing a Learning Object, which can be fully enjoyed by a given user (IMO Global Learning Consortium, 2009).

Methodology

This was an exploratory survey carried out to investigate accessibility issues and needs that confronts the diverse learner population in the Central Region (CR) of Ghana. This research was part of a bigger research carried out in the Central Region from May to August, 2014. The entire survey investigated six research questions as follows:

The questions asked are:

1. What major challenges/opportunities do learners face in pursuing e- learning in CR?
2. What accessibility/usability issues are significant in e-learning in CR?
3. What are the needs of working/ and non-working adults to pursue e-learning in CR?
4. What are the needs of disabled learners to pursue e-learning in CR?
5. What issues are discussed among system developers to provide accessible e-learning
6. How to become cost effective in e-learning taking into consideration issues about access to resources, accessibility and usability

In this paper only 2 of the 6 questions are addressed. Survey instruments for the current study addressed the research questions 2 and 4. The survey instruments probed respondents about what accessibility issues are important in e-learning for disabled learners. Specific issues considered in the survey instruments included; forms learning content takes, how assessments happen, how communication are handled, the design of e-learning systems, the functioning of the e-learning system interface, web interface accessibility, inclusive education options for the disabled, learning attainment and respondents' physical location. A second question considered by the survey instrument

was the needs disabled learners' have effective e-learning in Ghana. Under this question, specific issues investigated by the survey instruments included; training needs of disabled learners for e-learning support for text browsers on the world-wide web, alternate methods for online forms, information layouts that are consistent and easy to understand, simplified and consistent design and presentation, obtaining e-test versions of books, screen enlargements, appropriate text colors and highlights, provision of visual and aural presentation of materials and provision of organizational areas such as calendar task list address book

The survey questions were measured using a five-point Likert scale. It probed the extent to which adult learners in the Central Region agreed or disagreed with concerns and statements expressed about accessibility in e-learning. The survey covered two districts in the Central Region namely, the Cape Coast Metropolitan Assembly and the Abura-Asebu-Kwamankese District.

Population and sample sizes of the study

Population for the study comprised adult learners within the two Districts considered for the study in the Central Region. The study population was estimated to approximate between 500 to 600 adult learners in the two districts. The sample size was 150. Two hundred questionnaire were distributed to respondents. One hundred and fifty were returned. Out of this number, 50 indicated to have some form of disability and 100 said they have no disability but know learners with disability. Only respondents who claimed to have experienced e-learning at a point in their life were included in the study.

Questionnaire development

The questionnaire employed Likert scale with five levels ranging from strongly agree (5 points), agree (4 points), uncertain (3 points) disagree (2 points) and strongly disagree (1point) was used.

Validation of instruments

The instruments for the study was assessed for content and construct validity. Each item of the instrument was carefully analyzed and checked to ensure that it conveyed the necessary message.

Data entry and analysis

Quantitative data resulting from the survey was entered into the Statistical Package for Social Sciences (SPSS). Data entered was analyzed and mean responses were examined. Descriptive Statistics (means, charts and standard deviations) were used to present results.

Results

Figure 1, shows respondents assessment on the various accessibility issues important in E-learning system in the Central Region of Ghana.

Table 1. Accessibility issues important in e-learning for learners in Ghana

Accessibility issues	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
Learning Attainment	2(1.3%)	20(13.3%)	14(9.3%)	65(43.3%)	49(32.7%)
Communication Handling	2(1.3%)	2(1.3%)	9(6%)	83(55.3%)	54(36%)
Web interface accessibility	2(1.3%)	10(6.7%)	10(6.7%)	64(42.7%)	64(42.7%)
Forms Learning content takes	1(0.7%)	4(2.7%)	17(11.3)	89(59.3%)	39(26%)
How assessment take place	3(2%)	4(2.7%)	12(8%)	92(61.3)	39(26%)
E-learning systems are designed	7(4.7%)	14(9.3%)	15(10%)	49(32.7%)	65(43.3%)
E-learning systems interface function	2(1.3%)	7(4.7%)	11(7.3%)	88(58.7%)	42(28%)
Inclusive education options for disabled	1(0.7%)	6(4%)	9(8%)	85(56.7%)	49(32.7%)
Physical location	1(0.7%)	12(8%)	13(8.7%)	79(52.7%)	45(30%)

Of all the accessibility issues, respondents indicated that accessibility issues in terms of learning attainment (mean = 4.3) was of major importance. Reporting in a frequency table the number of responses to each question and scale in (%) are shown in Table 1. It was perceived by the study respondents that communication handling (mean = 4.2), web interface accessibility (mean = 4.2) and all other accessibility issues (inclusive education options for the disabled, mean = 4.2; forms learning content takes, mean = 4.1; how assessments take place, mean = 4.1; E-learning system interface functioning, mean = 4.1; physical location, mean = 4.0) showed in the figure above were all important in E-Learning system. The means of these responses clearly indicated their assessment.

On assessing needs of disabled learners for e-learning, respondents made it clear that providing them alternate methods for online forms (mean = 4.3) was the major priority. Respondents indicate provision of both visual and aural presentation of material (mean= 4.2). Reporting in a frequency table the number of responses to each question and scale in (%) are shown in Table 2. A simplified and consistent design and presentation

of the e-learning platform (mean= 4.2) and also providing them e-test versions of books (mean= 4.2) for the disabled. Respondents perceived other needs mentioned are listed in the table 2. They include: Support for text browsers on the world-wide-web, (mean = 4.1); providing information layouts that are consistent and easy to understand (mean = 4.1); Screen enlargements (mean = 4.1); providing appropriate text colors and highlights (mean = 4.1) and providing areas for better organization such as calendar, task list and address book (mean = 3.9).

Table 2. Needs of disabled learners for e-learning in Ghana

Needs of disabled learners	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
Training needs of disabled learners for e-learning; support for text browsers on the world-wide-web	1(0.7%)	6(4%)	17(11.3%)	82(54.7%)	44(29.3%)
Alternate methods for online forms	1(0.7%)	5(3.3%)	17(11.3%)	48(32%)	79(52.7%)
Information layouts that are consistent and easy to understand	0	9(6%)	14(9.3%)	82(54.7%)	45(30%)
Simplified and consistent design and presentation	7(4.7%)	5(3.3%)	7(4.7%)	63(42.0%)	68(45.3%)
Obtain e-test versions of books	4(2.7%)	6(4.0%)	8(5.3%)	71(47.3%)	61(40.7%)
Screen enlargement	1(0.7%)	10(6.7%)	12(8.0%)	70(46.7%)	57(38.0%)
Appropriate text colors and highlight	2(1.3%)	11(7.3%)	18(12.0%)	53(35.3%)	66(44.0%)
Provision of both visual and aural presentation of material	4(2.7%)	4(2.7%)	17(11.3%)	58(38.7%)	67(44.7%)
Provision of organizational areas such as calendar task list, address book etc.	2(1.3%)	25(16.7%)	13(8.7%)	49(32.7%)	61(40.7%)

Discussion

Learning attainment

This study has identified the major needs and accessibility issues that are of importance to learners in the Central Region of Ghana. Specifically respondents have agreed in their responses that learning attainment (the propensity for disabled learners to reach, or succeed in getting to the content, interacting with the content and learning appreciably from the e-learning experience) was an important issue to them. VITA (undated), identifies three things that instructional designers must do to design accessible e-learning course that meets accessibility standards and that appreciably improves learning attainment for all learners.

It was suggested that designers should ensure that all learners are able to access the content required to master the course objectives and that, all learners must be able to complete the assessments and the course should include provision for learner interaction to assist all learners in achieving mastery of instructional materials. Interestingly, interactivity has been cited as one of the principal elements in instructional design, as it enhances the learning experience and aids in the retention of information (Brannan & Michigan State University., 2002; VITA, undated).

Designing for effective interactivity, cautious use of analogies, examples and scenarios to engage learners in such a way that they can interact with the content being displayed and learn from the experience. Avoiding the use of

analogies, examples and scenarios that are exclusive to non-disabled learners have been found to be helpful. For example, using examples like ‘riding a bicycle’ might not be perceived well by learners who are unable to ride bicycle because of their disability.

This might not help them to be engage appreciably so as to be able to learn meaningfully from the online learning experience. Similarly, the use of examples that depict ‘seeing things’ or ‘hearing tunes or notes played from a musical instrument’ might not effectively engage learners whose disabilities prevent them from being able to see or hear. Avoiding use of such examples, scenarios and analogies and using the kind that all learners (both disabled and non-disabled ones) can relate to, helps in enhancing learning attainment.

The other pathways to better learning attainment in e-learning course, are through assessment. According to the report by VITA (undated), assessments or activities carried out within a lesson or topic may be the ultimate way in which to create that level of interactivity learners need to experience learning. It has been suggested, choosing formats in which all learners can demonstrate their level of mastery has been found to be helpful. The use of complex tests and activities that are difficult to understand or follow do not enhance learning attainment. Similarly, sticking to tests that use complex response mechanisms or require the use of manual dexterity may exclude learners whose disability put them in disadvantaged positions to engage effectively and learn in the process.

Communication handling

Respondents in this study have agreed that, the way communication tools are used in the design of the web-based course are important in enhancing the accessibility of e-learning courses. This agreement, conforms to what the literature on accessibility upholds. VITA, (undated) points out that, it is the responsibility of developers to ensure that all non-text elements have alternate text and that text descriptions should convey same information that is communicated by the corresponding images, movies, sounds and applets should also have Alt tags.

It is further argued that, while the use of charts, often is a very efficient way of presenting information because of the advantage of combining textual information with vision, its use should be limited where the goal is to enhance accessibility, unless there is an equivalent alternative in place to present the essential information. The use of the alternative means to present the essential information may likely have cost implications and so should be the responsibility of the designer in charge to make judgment about feasibility on embarking on such actions.

Using the appropriate color and the right contrast has been found to affect accessibility. It has been estimated that about 12% of men in are color blind (VITA, undated). Avoiding the use of wrong colors (green and red) and using the right colors with the right contrast matters in ensuring accessibility in e-learning. Moreover, to enhance accessibility, it has been suggested that any information conveyed through audio, multimedia format is also

available in a text format via captioning or transcription (VITA, undated). When multimedia is used as a method of delivery, it is important to ensure that the content provided is suitable and accessibility standards are adhered to.

Conclusion

The paper explored the accessibility issues that were of significance to potential adult e-learners from the Central Region of Ghana. Among other interesting findings, the study has shown that, learning attainment (the propensity for disabled learners to reach, or succeed in getting to the content, interacting with the content and learning appreciably from the e-learning experience) and communication handling (the way communication tools are employed in the design of the web-based course) are important to assure accessibility.

Basically all means fell between 4.0 and 4.2. Looking at the frequency tables in Table 1 and Table 2 majority of respondents agreed that the issues raised are important to support e-learning for the disabled learners. Asunka's (2008) study in Ghana showed that, a cross-section of Ghanaian students studied in a private tertiary school did not respond favorably to online constructivist teaching approaches such as asynchronous discussions and ill-structured project-based learning activities, and perceived collaborative online learning within their context as a complex, more demanding and time-consuming experience. The present study is confirming his findings that ill-structured project-based learning activities and perceived collaborative online learning within the learner context must have failed to address all or some of the above accessibility issues adult learners in

Ghana consider important for effective e-learning. Findings from the study also tie in with Ndeya-Nderera's (2012) beliefs that, implementation of learner-centred approaches that enhance learning are critical to ensure student success, particularly disabled learners. Based on the finding from the study and issues emerging from the discussion, it can be concluded that, increasing effectiveness in accessibility design could be achieved by providing among others, support for text browsing as well as providing simplified and consistent design presentation. Also

providing screen enlargements, organizational areas, such as calendar, task list, address book and providing e-test versions of books will enhance accessibility.

Other tools to use to increase effectiveness in accessibility design will include, on-line help, and using alternative text for images, using appropriate color and contrast and employing accessible and consistent navigation technology. Designers should employ interactive elements that can effectively be integrated with assistive technologies. Vita (undated) report that the use of tool tips, mind maps and closed captioning for audio and video materials have used successfully to enhance effectiveness in accessibility design.

References

- Asunka, S. (2008). Online Learning in Higher Education in Sub-Saharan Africa: Ghanaian University students' experiences and perceptions. *The International Review of Research in Open and Distance Learning*, 9(3). Retrieved from <http://www.irrodl.org/index.php/irrodl/article/view/586>
- Blackboard.com (2013). How to Use Blackboard
<http://www.blackboard.com/Platforms/Learn/Resources/Accessibility/Accessibility-Resources.aspx> Retrieved, December 20, 2014.
- Brannan, T. A., & Michigan State University. (2002). *Learner interactivity in higher education: Comparing face-to-face, hybrid and online instruction*. Retrieved December 19, 2014 from http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqdiss&rft_dat=xri:pqdiss:307497
- Brown J & Mirri, S. (2013). E-learning accessibility: Research and Development Working Group. Retrieved December 20, 2014
- Bugler, P. (2013). Empowering the disabled through e-learning Retrieved on 27th March, 2015 from: www.elearning-africa.com/eLA_Newsportal/empoweing-the-disabled-through-e-learning/

Burgstahler, S., Corrigan, B., & McCarter, J. (2004). Making distance learning courses accessible to students and instructors with disabilities: A case study.

Internet and Higher Education, &: 233-246

CANnect (2011). How online education content benefits from universal design. Web

accessibility for online learning. 1 page. Retrieved on 27th March 2015 from:

<http://projectone.Cannect.org/universal-design/benefits.php>.

Center for Applied Special Technology (CAST, 2013): Universal Design for

Learning, <http://www.cast.org/udl/index.html>; Retrieved December 19, 2014.

Clow, D. (2013). MOOCs and the funnel of participation (p. 185). ACM Press.

doi:10.1145/2460296.2460332

Center for Applied Special Technology (CAST, 2013): Universal Design for

Learning, <http://www.cast.org/udl/index.html>; Retrieved December 19, 2014.

Cooper, M., Colwell, C., & Jelfs, A. (2007). Embedding accessibility and usability:

Considerations for e-learning research and development projects. ALT-J,

Research in Learning Technology. Vol. 15, No. 3, pp 231 - 245, Routledge.

Cooper, M. (2006). Making online learning accessible to disabled students: an

institutional case study. *ALT-J, Research in Learning Technology*, 14(1), 103-115.

IMS Global Learning Consortium (2002). Guidelines for developing accessible learning applications. Retrieved December 20, 2014 from:

http://www.imsglobal.org/accessibility/accv1p0/imsacc_guidev1p0.html

IMS Global Learning Consortium (2003). IMS Learning Information Package

Accessibility for LIP. Retrieved, December 20, 2014

<http://www.imsglobal.org/accessibility/index.html#acclip>

IMS Global Learning Consortium (2009). IMS Access For All Personal Needs and Preferences Description for Digital Delivery

http://www.imsglobal.org/accessibility/accnpv2p0/spec/ISO_ACCPNPinfoMode1v2p0.html Retrieved December 20, 2014

IMS Global Learning Consortium (2004). IMS AccessForAll Meta-data Specification . Retrieved December, 20, 2014

http://www.imsglobal.org/accessibility/accmdv1p0/imsaccmd_oviewv1p0.html

Kelly, B., Phipps, L., & Howell, C. (2005), Implementing a holistic approach to e-

learning accessibility. In C. Cook & D. Whitelock (Eds.), *Exploring the Frontiers of E-learning: Borders, Outposts and Migration*, ALT-C 2005 12th

International Conference Research Proceedings, ALT, Oxford. Retrieved December 21, 2014, from:

<http://www.ukoln.ac.uk/web-focus/papers/alt-c-2005/>

Lazar, J., Dudley-Sponaule, A., & Greenidge, K-D. (2004). Improving web

accessibility: A study of webmaster perceptions. *Computers in Human Behavior*, 20, 269-288.

Leung, P., Owens, J., Lamb, G., Smith, K., Shaw, J. & Hauff, R. (1999). *Assistive*

education. Retrieved December 21, 2014, from http://www.dest.gov.au/archive/highered/eippubs/eip99-6/eip99_6.pdf

Liang, H.-N.; Parsons, P.; Wu, H.-C.; Sedig, K. (2010). An exploratory study of

interactivity in visualization tools: 'Flow' of interaction, *Journal of Interactive Learning Research* 21 (1): 5–45. Retrieved December 19, 2014.

Lincolnshire County Council. (2010). *Definition of accessibility*. Retrieved

December 21, 2014, from <http://www.lincolnshire.gov.uk/residents/environment-and-planning/environment/accessibility/definition-of-accessibility/56334.article>

Ndeya-Nderera, C (2012). Research in progress presentation. Supporting online learning for all distance students especially students with disabilities. Retrieved on 27 th March, 2015 from: ODL-064-2012_Final_Ndeya-NdereraC.pdf (page 1-4).

Parry, M. (2010). *Colleges lock out blind students online*, Chronicle of higher education. Retrieved December 21, 2014, from http://chronicle.com/article/BlindStudents-Demand-Access/125695/?sid=pm&utm_source=pm&utm_medium=en

Parsons, P.; Sedig, K. (2014). Adjustable properties of visual representations: Improving the quality of human-information interaction". *Journal of the American Society of Information Science and Technology* **65** (3): 455–482

Seale, J. (2006). The rainbow bridge metaphor as a tool for developing accessible e-learning practices in higher education. *Canadian Journal of*

Learning and Technology, 32(2). Retrieved December 21, 2014 from
<http://www.cjlt.ca/index.php/cjlt/article/viewArticle/56/53>

Sedig, K.; Parsons, P.; Babanski, A. (2012). Towards a characterization of
interactivity in visual analytics. *Journal of Multimedia Processing and
Technologies, Special Issue on Theory and Application of Visual
Analytics* 3 (1): 12–28. Retrieved December 19, 2014.

Shneiderman, B. (2000). Universal usability. *Communications of the ACM*, 43(5),
85- 91. Sloan, D., Dickinson, A., McIlroy, N., & Gibson, L. (2006).
Evaluating the usability of online accessibility information. Retrieved
December 21, 2014, from
<http://www.computing.dundee.ac.uk/staff/dsloan/usableaccessibilityadvice.htm>

Shojafar, M., Barzegar, S., Aeni, F., & Rashidi, H., (2015). The practical guidelines for
designing user interface in virtual learning environment. Int'l Conf. e-learning, e-
Bus, EIS. Retrieved on 27th March, 2015 from:

https://www.academia.edu/793207/The_Practical_Guidelines_for_Designing_User_Interface_in_Virtual_Learning_Environment?login=jboat2009@gmail.com&email_was_taken=true

Sloan, D., Gregor, P., Booth, P., & Gibson, L., (2002). Auditing accessibility of

UK higher education websites, interacting with computers, 14 (4), 313-325.

Suwannawut, N. (November, 2011). Integrating accessibility into the design of

online learning management systems: Theories and practice; 14th Annual

Accessing Higher Ground. School of Library and Information Science,

Indiana University, Bloomington.

Thomas, D. (2007). Accessibility and e-learning. E.learning Age, pp 12-14.

UAAG (2005). User Agent accessibility Guidelines (UAAG)- Overview for browsers,

media players and other user agents. W3C web accessibility initiative. Retrieved

on 27th March, 2017 from : <https://W3.org/WAI/intro/uaag.php>:

<https://www.w3.org/WAI/intro/uaag.php>

VITA (undated). Developing accessible E-learning. Virginia Information

Technology Agency (VITA) IT accessibility Toolkit. Retrieved December

18, 2014 from:

[http://vita.virginia.gov/uploadedfiles/VITA_Main_Public/unmanaged/library/acce](http://vita.virginia.gov/uploadedfiles/VITA_Main_Public/unmanaged/library/accessibility/DevelopingAccessibleE-Learning.pdf)

[ssibility/DevelopingAccessibleE-Learning.pdf](http://vita.virginia.gov/uploadedfiles/VITA_Main_Public/unmanaged/library/accessibility/DevelopingAccessibleE-Learning.pdf)

Witt, N., & Sloan, D. (2004). Access as the norm, not as an add-on. *Times Higher Education Supplement*, (1638), 14–15.

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