

# ENABLING THE DIFFERENTLY - ABLED

By

SONALI PAL

*Assistant Professor, Pearl Academy of Fashion, New Delhi.*

## ABSTRACT

*It is perhaps unfortunate that enabling technologies do not come with an 'ability warning', as they generally require the user to already have acquired a certain level of IT skills, in a similar way that online courses require users to have a certain level of prior IT knowledge. Accessing a computer and making the most of e-learning materials requires support at both the curriculum and technological levels, and some students find it easier to work with computers than others. Dyslexic students are no different, and often have the added cognitive load of having to use enabling technologies to access these materials, examples being text to speech facilities, magnification, changes in desktop settings and various methods to help with the input of text. These added technologies can be liberating, but only if they have been chosen with the specific requirements of that particular student in mind, and the student has gained adequate skills to make the most of the technologies' attributes.*

*Disabled learners must not be disadvantaged in education and it is important to ensure that learners are not unfairly treated in assessment situations. Colleges have an obligation to anticipate the needs of learners and to make reasonable adjustments to ensure that disabled learners can demonstrate their skills and abilities equally with their non-disabled peers. This obligation extends to online, distance and blended learning. Disabled learners can encounter barriers when undertaking online learning and when using Information Learning Technology.*

*The focus of this paper is how to make learning materials and electronic learning environments easy and made accessible. In many cases, assessments can be undertaken using technology to assist learners. However, the needs of disabled learners also should be considered when the assessment is technology based, for example, multiple choice quizzes in a Virtual Learning Environment (VLE). This paper covers the four main areas of accessibility: presentation, content, structure and navigation.*

*Importance should be stressed on anticipating the needs of disabled learners in any given learning situation. This means that colleges and curriculum managers should not wait until a disabled learner has enrolled on the course before thinking about which adjustments may be necessary in the classroom or the delivery method. An anticipatory duty means that colleges should include consideration of the needs of disabled learners during the period of curriculum design, planning and review. It is important to remember that access to the curriculum cannot be Provided solely by means of technology; what is needed is a pedagogical solution, where the learner is included through an equivalent accessible learning experience.*

*Key words: Dyslexia, Online Learning, Pedagogical Solutions, Help Software, Constructive Learning.*

## INTRODUCTION

Learning refers to the highest and most complex cognitive function of the brain and it should be of no surprise that many children (as many as 5 -10% worldwide) have problems acquiring the basics of reading, writing, and mathematics<sup>1</sup>, though the number of students has been steadily increasing over the last few years, many of which

are not even registered and some of them get treated within a short span of time. Not many people at India were even aware about this disorder, but thanks to "Taare Zameen Par" (Stars upon the Ground), a Hindi movie released towards the end of 2007, was a big box-office hit. The script was written by Amole Gupta and Deepa Bhatia

<sup>1</sup>Chakravarty A. "Taare Zameen Par" and dyslexic savants. *Ann Indian Acad Neurol* 2009;12:99-103

and the film was directed by the noted actor Amir Khan. The film portrays the life of a young boy, Ishan Awasthi (enacted by 8-year-old Darsheel Safary), who is dyslexic and cannot read or write; he leads a tormented life until he meets with his art teacher, Ramashankar Nikumbh (enacted by Amir Khan), who discovers his artistic talents. Neurological illnesses had been portrayed earlier in various movies, but none of them touched one's heart as strongly as this one. *"Although awareness and support for dyslexic students has increased dramatically in the past decade"<sup>2</sup>, there is need for the awareness of accessibility issues for electronic mediums for dyslexic students to be increased.*

Designing e-learning environments for quality professional education is a challenge for educationists, as simply moving courses online can be surprisingly disabling. Students enjoy using computer-based assessments, appreciate the open access, perceive it as fair, and find the feedback helpful.

But that doesn't mean *"You can just throw information up there, and clutter up cyberspace. Anybody who makes a web site should make the effort to organize the information."*<sup>3</sup> Within the education sector, be it schools or higher education, the use of electronic media for access to materials is increasing, with lecture notes and study materials being put online to allow the student to access the materials anywhere, anytime. Virtual Learning Environments (VLEs) and Intranets are being increasingly used as a means of delivery and storage of learning materials.

Current Web Accessibility Initiatives (WAI) and other accessibility guidelines mainly focus on the research affecting people with visual impairments and the Blind. There is, however, little research available that specifically deals with the issues surrounding accessibility for people with dyslexia and other Specific Learning Difficulties (SLDs), hence the production of this paper.

The accessibility of electronic material is affected by a whole range of issues, not just the 'readability of the text',

but also some of the common difficulties that face readers of the printed page. These issues could be as simple as recognizing characters on keyboard Vis – a - Vis on screen, be able to enter correct characters in given bars such as passwords for email id. Other issues cover such diverse aspects as readability, user control over presentation and information architecture.

This paper attempts to draw some conclusions (and make suppositions) about the needs of dyslexic students with known dyslexic difficulties and their implications when using electronic material. Most of the advice contained within this paper can be applied to HTML web pages, word processing documents and Postscript files though some aspects as specific to particular formats.

### 1. Explaining Dyslexia

Dyslexia is a learning disorder that manifests itself primarily as a difficulty with reading and spelling. It is separate and distinct from reading difficulties resulting from other causes, such as a non-neurological deficiency with vision or hearing, or from poor or inadequate reading instruction<sup>4</sup>.

Thus students with dyslexia often have problems with:

- Visual processing (inc. scotopic sensitivity),

Scotopic Sensitivity Syndrome is sometimes called Irlen Syndrome after Helen Irlen, who in the early 1980's discovered that some people with poor reading showed a marked and immediate improvement by simply overlaying the pages with colored plastic (e.g. acetate sheets).

It is believed that this condition affects, to varying degrees, approximately 12% of the population and that the condition is somehow caused by the brain and/or eye incorrectly processing/interpreting what the eye is seeing (i.e. it is neurological). These people will have increased difficulty in reading and studying. Unfortunately standard sight tests and most educational assessments do not detect this condition<sup>5</sup>.

- Phonological decoding, analysis and processing,
- Reading and comprehension,

<sup>2</sup>D. E. Gilroy, T. R. Miles "Dyslexia at College" Routledge, New York, 1996

<sup>3</sup>Robert . W. Proctor, Kim Phuong L Vu, Lawrence Erlbaum Associates, 2005  
"Handbook of human factors in web design"

<sup>4</sup><http://en.wikipedia.org/wiki/Dyslexia#History>

<sup>5</sup><http://www.hale.ndo.co.uk/scotopic/definition.htm>

- Auditory processing,
- Memory recall,
- Structure and sequencing,
- Planning and organization.

These problems have an impact on the user's ability to read, write, navigate, comprehend and recall relevant information on normal printed papers and with a greater difficulty from electronic materials e.g. web sites. *"In addition, within the dyslexic population as a whole a number of underlying processing difficulties present themselves as various sub-types of dyslexia"<sup>6</sup>*. Combining this with the many different learning styles and study strategies leads to a wide spectrum of not only skills but also difficulties.

In academic situations these difficulties can have more widely ranging effects than simply difficulties with reading. Dyslexic students can have difficulties with visual processing, leading to slow visual object recognition and problems with visual concentration and/or over-sensitivity to light. This means that dyslexic students can be affected by both the aesthetic qualities of a Graphical User Interface (GUI) and the visual readability of the content. This should be highly considered by tutors all over the world as in the name of better technology, most of them are moving all of their study content online, more so summative assessments.

Dyslexic students commonly have problems with short term and working memory, structure and sequencing. This can have a huge impact on the accessibility of information, and more broadly the accessibility of information architecture. For example remembering passwords, navigation through websites, connections between hyperlinks etc. The effect of short-term memory problems and sequencing can mean an increase in the likelihood of a dyslexic student becoming lost in a hypertext structure. More specifically one could suggest that since the recall of information in a reversed sequence is problematic, it suggests that they will have more problems in backward navigation (returning to a higher level within a hyper text structure).

<sup>6</sup>Cesare Cornoldi, Jane Oakhill, "Reading Comprehension Difficulties: processes and Intervention", Lawrence Erlbaum Associates, 1996

## 2. Demand of Today, Technology of Tomorrow

Academies, communities, business and government leaders are calling upon our institutions of learning, to graduate a different kind of student, than a generation ago. Among the skills called for, are critical thinking, problem solving, written communication and ability to work collaboratively. No more one can adopt short cuts for their teachings. The students need to be allotted with enough time for cohesive learning.

Education is being transformed by the many and varied uses of technology to support student learning. While this impact is being felt across the educational sectors, the demands of higher education (HE) for bespoke high-quality learning and teaching materials to be delivered online have resulted in the creation of a new role - that of the learning technologist.

Learning technologists have a unique role to play in bringing together the technology and education to underpin and drive the development of e-learning in higher education. The definition of who a learning technologist is, and what role they play is still developing, but there is no doubt that this role has become as embedded in the business of higher education as that of lecturer or librarian. Learning technologists are at the leading edge of e-learning developments, and higher education institutions are reliant upon their expertise and continued development to meet the cultural and strategic challenges that the advent of E-learning has made to the education community.

In the recent past, use of Information Technology (IT) innovations into the educational process was a major undertaking technically and economically; this was primarily due to hardware setup and maintenance and the need for software environments specific to the individual educational tools. Presently, there have been many impressive achievements in the application of IT to education. Teaching and learning are no longer confined to the classroom. There are many technologies that can offer a great deal of flexibility in when, where, and how education is distributed.

As the demand for more economical and effective

learning packages increases, researchers are experimenting with non-traditional approaches in the facilitation of student learning. These approaches include incorporating gaming through multimedia, simulation, virtual reality packages and visualization techniques.

*"We learn through different sense modalities, and the more one modality reinforces another, the more effective the learning. The more the TLA's, the better the learning"*. As given in Table 1.

There is no dearth of types of online collaborations for blended classroom learning. Below are mentioned a few with details of collaboration.

**Multimedia:** Multimedia can be defined as a combination of media types on a single document, including: text, graphics, animation, audio and video. Multimedia can be broadly divided into two categories which are linear and non-linear multimedia. Linear multimedia (e.g. video tape) starts and continues till the end without any navigation control for the use.

Whereas, non-linear multimedia (e.g. CD- ROM) offers interactivity to the end use. As multimedia is a system that conveys information in various formats, it enhances user experience and makes it easier and faster to grasp information.

There are basically two different types of multimedia that cover most educational needs. The first package is a CD-ROM version which is most suitable for stand-alone use in a personal computer or for a classical presentation in a classroom. The second product is a World Wide Web site containing most of the information included in the CD-ROM, but with enriched functionality utilizing the communication capabilities provided by the Internet.

**Simulation- Virtual reality** – The use of simulated activities

Most People Learn:	
10%	Of what they read
20%	Of what they hear
30%	Of what they see
50%	Of what they hear & see
70%	Of what they talk over with others
80%	Of what they use & do in real life
95%	Of what they teach someone else

**Table 1. Learning Through Different Sense Modalities**

<sup>7</sup>Biggs, 2003, 'Teaching for quality learning at university', Open University Press

in education is widely becoming recognized as an important tool in schools. They are "real" or virtually real. They simulate some activity so well that real learning takes place. In fact, the term "virtual reality" is now a widely recognized term and one whose implications are important to education. Educators are not known for having access to state of the art educational technology, but the principles of virtual reality, applied appropriately, are within the grasp of most educators who are serious about the work they do. They are so versatile that the students are participators and not just listeners, they are motivators and they are age appropriate. The use of simulations puts the teacher into a new role -- a role that is the inevitable result of the evolution of the role of the teacher in education. Most teachers recognize that their role is no longer that of a presenter of information and that students are no longer sponges for facts.

**E- mail - Electronic mail** (abbreviated "e-mail") is a store and forward method of composing, sending, storing, and receiving messages over electronic communication systems. Many distant learning organizations are using emails to send and receive assignments, projects, portfolios, and photos etc as a part of their learning programmes.

**Interactive white boards** - There are two very different kinds of interactive white boards.

The first type of interactive whiteboard is a 'virtual' electronic version of a dry wipe board on a computer that enables learners in a virtual classroom to view what an instructor, presenter or fellow learner writes or draws. It is also called an electronic whiteboard and can be found in conferencing and data-sharing systems such as Microsoft NetMeeting.

The second type of interactive whiteboards are used in lecture or classroom environments and the technology allows you to write or draw on the surface, print off the image, save it to computer or distribute it over a network.

**Chat rooms – blogs** - A chat room or chat room is a term used primarily by mass media to describe any form of synchronous conferencing, occasionally even

<sup>8</sup>[http://en.wikipedia.org/wiki/Chat\\_room](http://en.wikipedia.org/wiki/Chat_room)

asynchronous conferencing.<sup>8</sup>

**Internet, Web-based learning multimedia** - The World Wide Web (commonly shortened to the Web) is a system of interlinked hypertext documents accessed via the Internet. With a Web browser, one can view Web pages that may contain text, images, videos, and other multimedia and navigate between them using hyperlinks.

**Mind mapping** - Mind Mapping, a visual tool developed by Tony Buzan to enhance note-taking, to improve memory and problem-solving, to promote creativity, to organize thinking, and to develop ideas and concepts. Model mapping, is also a visual tool similar to Mind Mapping. In both forms of visual mapping, a central focus or graphic representation of a problem or issue is placed in the centre of the page, and key words, connected to the radial image with lines, are used to represent hierarchies or categories of ideas.

### 3. Accessibility of a Web Site's Graphical presentation

*Usability is like oxygen — you never notice it until it is missing... Anonymous*

The internet or any of the above mentioned online tools are such a fantastic resource, containing information on every subject one can imagine (and probably more on subjects you can't) and while the veracity and worthiness of much of the content is debatable, there is no reason the information should only be accessed by "normal", average people. A significant number of people have some sort of disability, and this *must not* preclude them from using the web. Thus the accessibility covers many issues such as:

- Color and contrast issues
- Text alignment
- Slide transition time span
- Page design issues
- Printable content
- Font type
- Animation
- Underlining

#### **Color and contrast issues**

*'The main focus of evaluation should be on identifying*

*problems rather than proving that something works.'*<sup>9</sup>

- The choice of colour for images, text and background is important, and it is advisable to provide sufficient contrast between elements of a page.
- Colour should not be used as the only means of distinguishing different sections of content (e.g. red text for important text).
- The most important contrast should be between the text and background. The background should be in a single, solid colour. Where possible, avoid bold textures, patterns or images. However, do not rely on the background as the sole means of contrast as some users' browsers may not display the chosen colour or form. When choosing colours, use a dark text on a pale background, for example dark blue on pale yellow. Using 'web safe' colours (256 colours that are available on the majority of browsers) should help to ensure inter-operability.
- Red and green should not be used on top of one another or side-by-side where confusion can occur for colour-blind users. Red on black and vice-versa is another issue for colour blindness.
- Some people with dyslexia suffer from scotopic sensitivity that means they find high contrasts difficult to read, such as black on white. This can cause visual effects such as rivers of white space (Figure 1).
- Ensure that sequential presentation allows enough time for a slow reader (who may have to decode each word separately) to keep up. It is always better to keep no slide transition animation but the simple click and roll.
- Always allow the user to go back and re-read information.

Figure 1. [www.mercurytide.co.uk/media/resources/2006](http://www.mercurytide.co.uk/media/resources/2006)

<sup>9</sup>Paul Ramsden, 1994, 'Learning to teach in Higher Education', Routledge, London and New York

It is important to remember that colour is very much an individual choice; what works for one person may not work for another.

## Page design issues

*'One need to be clear about the kind of learning that we want from students, so that the assessment tasks can encourage them.'* (Moon, 2002)

To reduce the cognitive burden, layout designs should be simpler. The designer's focus should be on information with function rather than funkiness. Thus simple designs leading to simple thoughts.

*"Designers should reduce overall information density to less than 50 percent of the screen area"*<sup>10</sup>

- It is helpful to provide sufficient 'white space' to guide the reader from one point to another and allow time for the material to be absorbed.

*"When a page comes up, users focus their attention on the centre of the window, where they read the body text before they bother looking over header bars, or other navigational elements"*<sup>11</sup>

- This implies that visual presentation of navigational mechanisms should clearly stand out from the body of the text. This can be achieved by using a combination of grouped layout, color, size and underlining of hyperlinks.

- Use graphics, images, and pictures to break up text, whilst remembering that graphics should be relevant to the material and not distract from the content. Bear in mind that graphics and tables may take a long time to download.

*As Jerome Bruner says 'Interest in the material to be learned is the best stimulus to learning. Motivation and interest levels for students are related to class room activities and the tutor's ability'.*<sup>12</sup>

## Consider the width of columns

- The width of the 'reading line' can have a large impact upon readability, for both comprehension and the user's

<sup>10</sup>Michael J. Albers, Beth Mazur, 2003, "Content & Complexity: Information Design in Technical Communication" Lawrence Erlbaum Associates

<sup>11</sup>Journal article, Sasha A. Barab, Michael F. Young, Jianjuan Wang; International Journal of Instructional Media, Vol. 26, 1999, "The Effects of Navigational and Generative Activities in Hypertext Learning on Problem Solving and Comprehension"

<sup>12</sup>Biggs, 2003, 'Teaching for quality learning at university', Open University Press

comfort.

- Horizontal scrolling should be strictly avoided.

## Visual accessibility of the text

Fonts should be

- Easy to read,
- Have clear definable letter shapes,
- Have clear spacing between letter combinations.

Bear in mind that fonts with unusually shaped letters, script fonts and novelty fonts can be difficult to read. The following four fonts have been designed for on-screen reading or may be easier than others to read from the screen.

- Use sans serif fonts such as Arial (Helvetica) or Comic Sans. Other suggestions include Verdana, Georgia, Tahoma and Trebuchet MS (Figure 2).

- For printed documents should use a minimum of text size 12pt or 14pt.

However, it's well known that Comic Sans is not regarded as a professional font, nor it is cross-platform compatible – but experienced dyslexia support practitioners have found that dyslexic students find this as a very readable font. Further information on font readability: <http://www.mcu.org.uk/articles/accessibletext.html>

## 4. Why is printing important?

Web pages should ideally be themselves, or provide printer-friendly documents. Users with dyslexia may have a slow reading speed and so take longer than normal to read through large amounts of text. By providing a printable alternative to the webpage, the user can read the page offline in their own time. Students may often find the printed page easier to revise from, due to the kinesthetic learning effect of having the pages at hand. It is often noticed that it is easier to read through printed text rather than onscreen text, as on screen tends to be

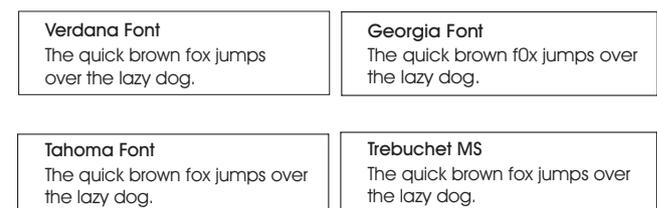


Figure 2. Visual Accessibility of the Text

digressive, unfocused, chattier, and less concise.

Since monitors are luminous and paper is reflective, paper copies might be easier to read from for some users with scotopic sensitivity. This will also allow them to keep a copy for later reference as well as encouraging annotations and even graphical note taking.

### ***Avoid underlining except for hyperlinks***

Don't underline large blocks of text as it makes reading harder. Underlining usually indicates hyperlinked text; it can be confusing for users if it is used where no link exists. Conversely, always underline hyperlinks as users expect to be able to recognise hyperlinked text or images.

### ***Do not use blinking text or moving text***

Ensure that online webpage does not use blinking text tags or marquee (scrolling) text as this is very hard to read and can distract the user from the important content. Moving text creates problems for people with visual difficulties. It also creates a difficulty for text-reading software.

### ***Avoid the use of capital texts***

Text in all-capitals is much harder to read than normal-case continuous text. One or two words set in capitals should not create too many reading problems. Because they are bigger, capital letters are easier to see than lower-case letters, so may be suitable for labels. Do not capitalize whole sentences, as this can be visually distracting and annoying to the reader.

### ***Keep to left aligned, un-justified text***

Justified text causes uneven inter-word spacing, which can create 'rivers of white space' for some dyslexics. (Figure 1).

- In word processing documents limit lines to 60–70 characters and in web pages consider the average column or table width. Lines that are too long or short can put strain on eyes due to increased physical movement.
- Use line spacing between paragraphs to break up text.
- Use headings and wide side margins.
- Use boxes for emphasis or to highlight important text.
- Avoid dense blocks of text by using short paragraphs.

- If appropriate use bullets or numbers rather than continuous prose.

- Don't hyphenate words that are not usually split in order to fill up line ends, e.g. "continuation".

- The space between lines is important. Research suggests a leading (space) of 1.5 to 2 times the space.<sup>13</sup>

### ***User control over presentation***

Some dyslexic students customized their PCs in some basic ways, commonly:

- Changing background colors,
- Changing text colors,
- Enlarging text (within a browser and in the operating system).

Further information can be found at: <http://www.techdis.ac.uk/seven/wizards/>

## **5. Accessibility of a web site's content**

### ***Consider how accessible the actual content is to the user***

*'Great deal of skill and judgment is required to ensure that what you're testing bears any relationship to your real learning objectives. Therefore, online testing is used selectively, often alongside other assessment methods, both online and offline'.*<sup>14</sup>

Research shows that readers access text at a 25% slower rate on a computer.<sup>15</sup> This should be taken into account when putting information on the web.

One should always put instructions, key information and tasks to perform on top of the page.

### ***Making content readable for those with dyslexia***

People with dyslexia and other Learning Disorders may not have the ability to scan through documents as a means of speed reading, but they might be able to use their reading time more effectively if they are able to identify the sections they are in or the topic that the text is covering.

Authors should try to write in a clear, consistent and

<sup>13</sup>Adapted from the X04Frendly, BDA, 2000.

<sup>14</sup>Gregory J. Shepherd, Eric W. Rothenbuhler; 2001, "Communication and Community", Lawrence Erlbaum Associates

concise manner. Material should be written at an academic level suitable for the intended audience. *'Understanding' is a word of many values: we express one meaning; we assess another, lower level meaning. In making our objectives clear it is essential that we unpack and make explicit the meaning we want our students to address.*<sup>16</sup>

### **Ensure screens are not crowded and provide enough white space**

A limited amount of information should be presented on a page so that scrolling is. The way in which text is written can have an impact on the reader. Long and complicated sentences can be difficult for the reader to navigate and comprehend.

- Use short simple sentences with clear instructions.
- Use concise paragraphs with clear topic headings.
- Be conscious of where sentences begin on the page. Starting a new sentence at the end of a line makes it harder to follow.
- Give instructions clearly. Avoid long sentences of explanation.
- Use bullet points or numbering for lists.
- Where appropriate, use graphics that explain any complex text.
- Use the ABBR and ACRONYM mark-up to explain abbreviations and acronyms.

### **Use highlighting to emphasize keywords and concepts**

Use bold tool or highlight, in order to emphasize keywords and concepts. A different colour could be used to visually distinguish.

Highlighting (the background) is a very good way of drawing the *attention* of a reader to the main points of the text. **Adding colour** can **increase** the likelihood that the information will enter the *long term memory*.

### **6. Use alternative content**

Everyone has different learning styles. It is important to consider this when presenting ideas and concepts. The

<sup>15</sup> Julie A. Jacko, Andrew Sears; 2003 , "The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications" Lawrence Erlbaum Associates

<sup>16</sup>Biggs, 2003, *'Teaching for quality learning at university'* pg 53, Open University Press

following learning styles as described below are commonly used to explore a dyslexic's skills and difficulties. Consider the following learning styles from Bandler & Grinder (1982)

### **Visual Learners**

Learning is through seeing. Learners in this category prefer to see pictures or diagrams. They like demonstrations, reading or watching video. Visual learners are usually stronger, faster readers and would rather read, than be read to. Some people might find it easier to access a long and wordy explanation whilst others may prefer an alternative style. The visual learner likes to have information presented through images, diagrams, visual representations of relationships etc.

### **Auditory**

Learning is through hearing. Learners in this category like to listen to audio tapes, or to learn through lectures, debates, discussions and verbal instructions. Auditory learners are easily distracted by noise and tend to need to say a thing to remember it. They find writing more difficult and prefer oral communication. Even material which uses a number of multi-media clips, video and/or audio elements, is going to make a lot of demands on visual skills.

### **Kinesthetic**

Learning is through doing. These learners like to be hands-on, manipulating objects and experiencing learning directly. They have trouble in remembering abstract ideas and rely on reinforcement exercises to really be able to conceptualize and remember ideas.

From understanding these styles one should consider using:

- A contents page at the beginning and an index at the end of long documents.
- Flow charts for explaining procedures.
- Diagrams to help explain spatial concepts.
- Pictograms and graphics which help to locate information by attracting the eye and stimulate the visual memory.
- Lists of do's and don'ts, which are more useful than

continuous text to highlight aspects of good practice.

- A glossary of abbreviations and jargon. (If possible use the abbr element in HTML).
- Audio files of text passages.
- Videos to demonstrate visual concepts.
- Use keyword captioning on videos to aid comprehension and memory recall.

*"Words and pictures can be a powerful combination, but they must work together".<sup>17</sup>*

Images can be used to mark a difference between pages and can also be used to identify sections of a site. Images should only be used to supplement the text, in that they provide an alternative presentation of information, which is especially useful when describing a visual concept.

## 7. The serialist versus the holist

Often dyslexics describe themselves as thinking differently from others. It is believed that they think holistically, and that they see others as thinking linearly.

Gordon Pask (2001) developed an overall systems approach to learning which is highly abstract and difficult, although rewarding: it is reflected in the "conversational" models of learning of Laurillard (2002)<sup>18</sup> and Thomas and Harri-Augstein. Pask conceived two different kinds of learning strategy: "serialist" and "holist".

*"When confronted with an unfamiliar area, serialists tackle the subject step by step, building from the known to the unknown with the simplest possible connections between the items of knowledge. Holists, on the other hand, seek an overall framework and then explore areas within it in a more or less haphazard way, until they have filled in the whole" (Atherton, 2002).*

### **Avoid multi-sensory overload or bias**

Do not provide video or audio content unless on the user's demand, i.e. do not start an audio file automatically when a page loads; instead allow the user to control playback of the audio file.

<sup>17</sup>Robert W. Proctor, Kim-Phuong L. Vu; 2005, "Handbook of Human Factors in Web Design", Lawrence Erlbaum Associates

<sup>18</sup>Paul Ramsden, 1994, 'Learning to teach in Higher Education', Routledge, London and New York

Ensure that equal content is provided by text and multimedia. Do not rely on multimedia to provide content.

### ***Making text usable when read-aloud by text-to-speech software***

As explained earlier some learners find hearing text read aloud helps learning. Assistive technologies such as a 'text-to-speech program' or a full-fledged 'screen reader' can be used to produce synthesised speech of the text being read aloud. There are a number of points to bear in mind when preparing information for use with text-to-speech programs.

- Use semi-colons, commas, or full stops after bullet points in order to separate each point.
- Number menu items to aid navigation.
- Don't write words purely in capital letters, as they may be read as single letters.
- Avoid the use of ASCII text and unnecessary symbols (e.g. # - :-> ) as these will be read aloud by a text-to-speech program.
- When using text documents always punctuate abbreviations, e.g. BDA should be B.D.A.
- Use alt attributes for images especially where they have functional uses e.g. "link to homepage".<sup>19</sup>

## 8. Accessibility of a web site's information architecture

### ***Navigation mechanisms***

Navigation should be easy! Finding items and moving around a site should be obvious and intuitive to the user, not just the designer. As the designer has created the online page, the content is already stored in his memory and is readable even if the contrast colors of background and text are clashing, which might not be readable to the audience.

The provision of a site map is essential, as it aids the user in the construction of a conceptual or cognitive map of the sites structure.

- Try to make any page no more than 3 links away from the homepage or sub-section index page. Navigating back could be a big problem for Dyslexic students.
- Do not use random images that require a mouse

<sup>19</sup>Adapted from the X04Friendly. BDA, 2000

rollover to see the destination of the link for navigation elements.

- Use a visited style to make a visited link visually distinct from an unvisited one. Visited links are often given in a purple color.
- In the body of text always underline hyperlinks as users expect to be able to recognize hyperlinked text or images.
- Use color to divide pages into various navigational or content sections, though use colors safe for color-blind users or provide text alternatives.
- Use text and symbolism for navigational elements that are truly representational or a well known concept e.g. a house for home.
- Ensure consistency between all pages throughout the site with an indication of where the user is at any one time be it for font size or font type.<sup>20</sup>

Consider the use of a breadcrumb trail to give the user a perspective of their location within the site's structure. (E.g. Home page > section > sub-section). These should use active hyperlinks so they can be used as a navigational mechanism.

**Breadcrumbs** typically appear horizontally across the top of a web page, usually below title bars or headers. They provide links back to each previous page the user navigated through to get to the current page or—in hierarchical site structures—the parent pages of the current one. Breadcrumbs provide a trail for the user to follow back to the starting or entry point. Generally, a greater than (>) serves as hierarchy separator, although designers use other glyphs as well.<sup>21</sup>

Provide clear intuitive categories for menus and links and ensure they are grouped accordingly. Do not provide alphabetical links lists for menus as the user is then required to guess the link titles in order to know where to look within the alphabetized column listing (Bernard, 1999). *It has been found that search time is significantly faster when links are grouped in columns rather than rows (Nygren, 1996)*

Use front-loaded hyperlinked sentences to allow for easy

<sup>20</sup>Adapted from the X04Frendly. BDA, 2000

scan reading.e.g. Hyperlink title, further details about the link.

### **Use bullet pointed lists to present a list of hyperlinks**

Using hyperlinks in a bulleted list decreases the likelihood of a user making a navigational error. Bullet hyperlinks provide more space between links and increase the readability of the individual link titles. The Edge Hill study suggests using full line spacing between links to make them easier to read.

### **The hypertext page problem (Mark Hurst, 1999)**

*"The hypertext page problem states that on any given Web page, users have a particular goal in mind, and this goal drives their use. Either they click on a link that they think will take them toward the goal, or (seeing no appropriate forward clicks) they click the Back button to take another path."*

Users often become lost within a web site's structure. They may find they don't know where they are, where they are going or where they have been. It is important to provide contextual navigation clues to enable a user to determine their location within the overall structure of the site.

*58% of users will make two or more navigational errors while searching for information.*

*66.8% of users have stated that one of the greatest problems about the Web is "not being able to find the information that I am looking for".<sup>22</sup>*

### **Issues of the site's overall structure**

A common problem for a user when navigating a site is the sense of getting lost. This can be exacerbated when the user takes digressive links that there is no obvious route to back track through. Therefore consider carefully the use of digressive hyperlinks embedded within text.

Generally, it has been found that people make fewer navigational mistakes if the hierarchical structure of the site is broader rather than 'deeper'. *The reasoning is that "the deeper the level, the more a user has to rely on short-term memory" (Bernard, 2002).* This means for people with short-term memory difficulties 'deep' complex

<sup>21</sup>[http://en.wikipedia.org/wiki/Breadcrumb\\_\(navigation\)](http://en.wikipedia.org/wiki/Breadcrumb_(navigation))

<sup>22</sup>GVU's 10<sup>th</sup> WWW user survey

structures can be confusing as they have further to go (more links to follow) back or forward.

Also, with 'deeper' structures, the hyperlink titles are often vaguer at the higher levels; at each deeper level the titles become more specific. With deeper structures users might find it difficult to figure out which way to navigate and remember the path they took.

When sites must use 'deeper' structures, user browsing for specific information will find this information faster if the structure is concave (breadth of 8 x 2 x 2 x 8). Stated in a more simplistic manner, sites structures should be broad (providing links to many pages) at the top and lowest levels, while the interior of the structure should be narrow (with fewer hyperlinks to pages) (Figure 3).

The idea is that the broad level at the top will provide enough information to enable the user to take the correct path, whilst the broad level at the base will allow the user to select the specific information. The use of a narrow interior reduces the chance of the user getting lost as they have fewer links to choose from and hopefully less chance of becoming disoriented.

#### 9. Provide common documentation/information pages

**Homepage** – The default page the user always hyperlinks back to, containing links to the navigation paths.

**Contacts page** – A page containing the organization's name, address and email.

**Site Map** – This page provides directional links for the content of the entire web site.

**References or Links Pages** – A page which is useful on educational sites to provide a separate resource page for referencing other sources of expertise, further information and links to other sites.

**Copyright or Disclaimer pages** – A page or pages in which details of legal copyright and disclaimer

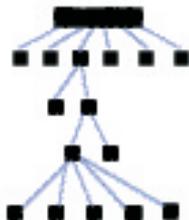


Figure 3. A concave site structure, breadth of 6 x 2 x 2 x 5.

information can be provided.

**Accessibility statement** – A page could be provided to assist a user in using the site effectively with different accessibility needs.

#### 10. Site-design issues

##### *Provide help for the user*

Provide context-based help and suggestions; try to anticipate possible common problems. One useful method to assist the user is to provide a series of 'Frequently Asked Questions' (FAQs), where one can try to anticipate possible common problems on their site. This also gives the author a platform from which to answer issues that arise. A feedback or comments form can also provide the basis from which to build a FAQs web page.

##### *Deal effectively with invalid search or form field entries*

When a form field is used for users to input information they must be given sufficient guidance to know which fields are mandatory (must be filled out) and those which must contain a particular format of data entry.

- For example: If a user tries to search with a blank or empty input field, then the user should be told that they have not entered anything into the 'search field'.
- Also an option should be provided where one can see the letters of password inserted rather than (\*), an error might be repeated umpteen times due to letter recognition disorder.
- If a series of fields are used to request the user's address and the post code field is required before the user can proceed, the text should explain that directly rather than through the use of a red letter label or asterisk (\*) by the label.
- If a date is required, then within the text the user must be told to enter the text in a certain format e.g. dd/mm/yy.

##### *Provide an easy-to-use, intelligent search facility*

Try to provide a search engine for your site as it may help users locate particular information quickly. If possible when using search engines:

- Always put the search box in a clear obvious position, usually at the top of the page.
- Try to limit the search or provide 'search within results'

so that the user is not over-burdened with too many results.

- Make the links to 'next page' (sometimes numerals) clear and obvious.
- Provide the title of each search result page and its URL.
- Offer a search engine that is forgiving of spelling errors.
- Inform users when they have entered nothing in the search or query box.

## 11. What is the future?

In the 1960's the main approach to teaching was to support the acquisition of knowledge. More recently since the 1980's, the approach to teaching has been to foster knowledge construction *Students should be taught how to learn; how to seek new information; how to utilize it and evaluate its importance; how to solve novel, non textbook, professional problems. They need high level Meta cognitive skills and an abstract body of theory on which to deploy them so that they can judge how successfully they are coping. Action learning for life.*<sup>23</sup>

Changes in the way that people think about student learning have necessarily caused people to think about how their teaching supports that learning. In some cases this has led to radical redesign of entire subject areas, such as the move to Problem-based Learning (PBL). Online assessments or information dissemination may not be able to assess all forms of knowledge adequately, but they can make a major contribution. These days, many of the skills we need are cognitive - they do not involve any manual activity on behalf of the performer. And cognitive skills are important skills like problem solving, decision-making, analysis, synthesis and evaluation. Not all cognitive skills can be thoroughly or even adequately tested using tests delivered by computer, but enough to make the method useful. But it's not necessary that these cognitive skills come easily to every one. Thus keeping in mind the differently abled, it is our duty as tutors to provide support in an enabling manner, even if it's online. Thus online Learning could be the medium to impart learning and will become an aid to retrench what we have imparted.

<sup>23</sup>Biggs, 2003, 'Teaching for quality learning at university' pg 93, Open University Press

## 12. Ideas to work upon...

### Color issues

- The text and the background colors should be in stark contrasts, never tone on tone but also not clashing neon colors. The whole look should be aesthetically appealing and calm.
- The background should not have bold or busy patterns or textures.
- Red and green color combinations should be avoided for kind consideration for color blind people.

### Page design Issues

- Each page should not open as a new window, the user may lose track.
- Always allow the user to go back and forward to re-read information.

### Text and content issues

- Each page should have less density of text or content on it.
- The main body of the text should be at the center of the page, maybe outlined by a border to keep the focus of the user. Other navigational tools and images should stay clear and away from the main body text.
- Do not justify the text, always keep it left indented.
- Use simple fonts, not too fancy.
- Page size should be A4, avoid horizontal scrolling.
- Paragraphs should be separated with double spacing, do not underline text for laying emphasis.

### Customization

- Avoid animation for turning to next page, should be in accordance to the readers speed of reading thus a mouse click works best here.
- The user should be able to change color settings, font sizes and backgrounds according to his preference.
- The content could be changed to auditory mode for easy comprehension.
- Help page or FAQs should be available to help them steer on the correct path.
- Do not ask for cryptic codes and passwords again and again.

Overall keep in mind the site is being designed for users and not for designers to appreciate...keep it simple.

## Conclusion

Hopefully this paper will highlight the issues surrounding the accessibility and usability of electronic documents for students with dyslexia.

- A dyslexic student's difficulty with visual processing can mean that the accessibility of a web site's graphical presentation can have a large impact upon the readability of a site's content. One of the most important factors is that of the visual readability of the text (both the choice of font and the contrast of the text and background colors).
- The way in which the information is presented and structured can have a considerable influence on a dyslexic student's recall and comprehension of the documents content. Documents should be well structured, breaking text down into manageable and sensible chunks. Avoiding large paragraphs that are too intense to read and long pages where it is too easy to lose track.
- The common dyslexic problem with short term and working memory means that the clarity and usability of navigation mechanisms remains critical. Documents and web sites should be intuitively structured with clear headings and subsections.

One of the main conclusions drawn from this paper is the need for tutors and developers to be aware of the diversity of perceptions of content, learning styles, cognitive limitations and learning strategies. They need to build in alternatives for both the visual presentation and in the mode and medium of the learning material.

## Useful resources

### Papers

- (1) *An evaluation of the use of participatory methods in exploring disabled learners' experiences of e-learning*:LEXDIS Methodology Report to JISC, <http://eprints.soton.ac.uk/63199/>
- (2) Chakravarty A. "Taare Zameen Par" and dyslexic savants. *Ann Indian Acad Neurol* 2009; 12:99-103

(3) *Exploring disabled learners' experiences of e-learning*, LEXDIS Project Report ; Jane Seale<sup>1</sup> , E.A Draffan<sup>2</sup>, Mike Wald<sup>2</sup> , December 2008; School of Education, University of Southampton; School of Electronics and Computer Science, University of Southampton

(4) "Access All Areas": *disability, technology and learning* Edited by Lawrie Phipps, Allan Sutherland and Jane Seale , © JISC TechDis Service and ALT

(5) Journal article , Sasha A. Barab, Michael F. Young, Jianjuan Wang; *International Journal of Instructional Media*, Vol. 26, 1999, "The Effects of Navigational and Generative Activities in Hypertext Learning on Problem Solving and Comprehension".

### Books

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[16]. Julie A. Jacko, Andrew Sears; 2003 , "The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications", Lawrence Erlbaum Associates

#### Web sites

<http://www.annalsofian.org/text.asp?2009/12/2/99/53077>

- <http://www.beeth.com/categories/world/>
- <http://en.wikipedia.org/wiki/Dyslexia#History>
- [http://en.wikipedia.org/wiki/Chat\\_room](http://en.wikipedia.org/wiki/Chat_room)
- <http://www.hale.ndo.co.uk/scotopic/definition.htm>

- <http://www.hdsg.20m.com/dyslexia.html>
- <http://www.dyslexia.com/info/webdesign.htm>
- [http://en.wikipedia.org/wiki/Breadcrumb\\_\(navigation\)](http://en.wikipedia.org/wiki/Breadcrumb_(navigation))
- GVU's 10<sup>th</sup> WWW user survey
- Clive Shepherd, 'Checking Out', available at:<http://www.fastrak-consulting.co.uk/tactix/features/checkingout.htm>
- M. K. Hamza, 'Technology and education: between chaos and order', available at: [http://www.firstmonday.dk/issues/issue4\\_3/hamza/index.html](http://www.firstmonday.dk/issues/issue4_3/hamza/index.html)
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#### ABOUT THE AUTHOR

Ms. Sonali Soni Pal is an Assistant Professor in the premium design institute, Pearl Academy of Fashion at New Delhi, in the Textile Design Department. She has a teaching experience of over 5 years and is in constant touch with the industry. She Post Graduated in Knitwear Design & Technology from NIFT, New Delhi in 2000 and graduated in Sociology Honors from Delhi University in 1998. She has also done her Post Graduate Certificate in Higher Education from NTU, at Pearl Academy of Fashion and is an E-learning mentor for phase II and III of PGCHE at Pearl Academy of Fashion. She has over 10 Years of experience in Designing, in areas of apparels and textiles in knits and woven. Several articles and papers of her have got published in leading national textile Journals and news papers. She can be reached at [soni@pearlacademy.com](mailto:soni@pearlacademy.com) or [sonisonali@yahoo.com](mailto:sonisonali@yahoo.com).

