

Guidelines

for the Development of

e-Content

for Children with Disabilities



Developed
by
Sub-Committee of Experts
Constituted by the Ministry of Education
Government of India
March 2021

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ABBREVIATIONS

AAC	Augmentative and Alternative Communication
ADC	Accessible Digital Content
ADM	Accessible Digital Material
ADT	Accessible Digital Textbooks
ARIA	Accessible Rich Internet Applications
ASD	Autism Spectrum Disorders
AT	Assistive technology
BibFrame	Bibliographic Framework
CAST	Center for Applied Special Technology
CBSE	Central Board of Secondary Education
C-DAC	Center for Development of Advanced Computing
CIET	Central Institute of Educational Technology
CPRD	Convention of Rights of Persons with Disabilities
CwD	Children with Disabilities (<i>Divyangstudents</i>)
CwSN	Children with Special Needs
CWID	Children with Intellectual Disabilities
DAIL	Department of Adult Independent Living
DAISY	Digital Accessible Information System consortium
DHHS	Deaf and Hard of Hearing Students
DIKSHA	Digital Infrastructure for Knowledge Sharing - One nation, One Digital Platform
DTISL	Diploma in Teaching Indian Sign Language
e-Content	Electronic content
EPUB/ePub	Electronic Publication

e-Saadhya	<i>SaralAnukulaney Adhyayan</i>
FACP	Functional Assessment Checklist for Programming
Gboard	Google keyboard-a virtual app developed by Google for Android and iOS devices
GIGW	Guidelines for Indian Government Websites
GLAD	Grade Level Assessment Device
HI	Hearing Impaired
HoD	Head of the Department
ICT	Information and Communication Technology
IDD	Intellectual and Developmental Disabilities
IDPF	International Digital Publishing Forum
ISAA	Indian Scale for Assessment of Autism
ISCED	International Standard Classification of Education
ISL	Indian Sign Language
ISLPT	Indian Sign Language Proficiency Test
KVs	<i>Kendriya Vidyalayas</i>
MARC 21	MAchine-ReadableCataloging
MD	Multiple Disabilities
MoE	Ministry of Education
MoM	Minutes of Meeting
MOOCs	Massive Open Online Courses
NCERT	National Council of Educational Research and Training
NEP-2020	National Education Policy-2020
NIEPID	National Institute for the Empowerment of Persons with Intellectual Disabilities
NIEPMD	National Institute for Empowerment of Persons with Multiple Disabilities

NIOS	National Institute of Open Schooling
NISE	National Institute of Special Education, Republic of Korea
ONIX	Online Information EXchange
OPD	Organizations of Persons with Disabilities
OWL	Web Ontology Language
PwD	Persons with Disabilities
RCI	Rehabilitation Council of India
QR Code	Quick Response Code
RDF	Resource Description Framework
RPwD	Right of Persons with Disability Act 2016
SLD	Specific Learning Disabilities
SSA	<i>Sarva Shiksha Abhiyan</i>
SWAYAM	Study Webs of Active-Learning for Young Aspiring Minds
SWAYAM PRABHA	A group of 34 DTH channels devoted to telecasting educational programmes.
SwDHH	Students with Deafness and Hard of Hearing
UDL	Universal Design of Learning
UNCRPD	United Nations Convention of Rights of Persons with Disabilities
UNICEF	United Nations Children's Fund
VI	Visually Impaired
W3C	World Wide Web Consortium
WCAG	Web Content Accessibility Guidelines
WHO	World Health Organisation
WIPO	World Intellectual Property Organization

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ACKNOWLEDGEMENTS

Extensive use of digital technology to provide accessible e-content to *Divyang* students has been provided further impetus in the new National Education Policy (NEP-2020). In pursuance of this vision, Department of School Education and Literacy, Ministry of Education (MoE) constituted a Working Group under the chairmanship of Mr. Manoj Ahuja, Chairperson, CBSE for the development of e-content for Children with Special Needs (CwSN).

At the outset, I would like to express my sincere thanks to the Director, NCERT for nominating me as inclusive education expert in the 'Working Group'.

The Working Group strongly felt the need to evolve guidelines for developing e-content, which can be uniformly used by all content developers. I am thankful to Mr. Manoj Ahuja, Chairperson of Working Group for reposing faith in me to chair a sub-committee for the development of these guidelines.

I would also like to put on record my thanks to Mr. Rajnish Kumar, Director (Digital Education), Department of School Education and Literacy, MoE for providing constant guidance and inspiration to the sub-committee.

I deeply appreciate the contributions of all sub-committee members nominated by MoE and additional experts co-opted for finalizing these guidelines. They worked relentlessly, bringing together an array of rich experiences to this path-breaking task.

Finally yet importantly, academic and managerial inputs of Mr. Ashu J, Senior Research Associate and Ms. Trisha Hari, Junior Project Fellow at International Relation Division of NCERT are also deeply appreciated.



Professor Anupam Ahuja
Professor, DEGN & Head IRD, NCERT and
Chairperson of the Sub-committee

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EXECUTIVE SUMMARY

A comprehensive initiative, PM eVIDYA was launched on 17th May 2020, with the aim to unify all efforts related to digital/online/on-air education. The programme envisages development of special e-content for visually and hearing impaired students, along with extensive use of radio, community radio and podcasts and the uploading of QR coded energized digital textbooks. In pursuance of this vision for providing accessible e-content to *Divyang* students, Department of School Education and Literacy of Ministry of Education (MoE) constituted a Working Group with the specific goal of developing teaching-learning e-content for Children with Special Needs. The Working group in its meeting held on August 20, 2020 constituted three sub-committees. The recommendations given in this document have emerged after detailed deliberations amongst members of the sub-committee for the development of guidelines for developing e-content for Children with Special Needs, and need based additional members co-opted during the course of study. The committee has restricted its recommendations for developing e-content for Children with Disabilities as specified under the Rights of Persons with Disability (RPwD) Act 2016. **The suggestions of the committee to provide further impetus to accessibility are presented at the end of each section in blue bold fonts.**

Section-1: Introduction discusses the vision as laid out in the National Education Policy (NEP), 2020 for inclusion of *Divyang* Students in regular schools. It lays special emphasis on digital education and *Divyang* students. The government has launched many laudable initiatives for promoting digital education, such as DIKSHA, SWAYAM, ePathshala and NISHTHA, among others. Furthermore, Hon'ble Minister of Education launched *VidyaDaan* program on 22nd April 2020 for inviting e-learning contributions. In view of the large number of digital initiatives and PM *VidyaDaan* programme, the MoE has released guidelines for digital education, including PRAGYATA, Guidelines for the Development of e-content for School & Teacher Education (version 3.0) and UGC Guidelines for e-content development. The existing guidelines recommended by the sub-committee for development of e-content based on global research findings recommend Universal Design of Learning (UDL) approach for content design. During interactions with parents and other organisation, it emerged that there is a need to also develop e-content for meeting the specific needs of certain disabilities. These guidelines address this need.

Section-2: Disability Census and Rights of Persons with Disabilities deals with two critical aspects- (a) census data on disabilities, and (b) legal rights available to Persons with Disabilities.

It also details recommendations to ensure that legal rights as provided to persons with disabilities are implemented effectively. The section discusses that it is estimated that more than one billion people around the world have some form of disability– with over four in five persons living in developing countries – and 93 million of them are children under the age of 14 living with a ‘moderate or severe disability’. There is a lack of accurate data showing the true scale of discrimination worldwide and on the national level. As per the 2011 census, there were 26.8 million persons with disability in India, which corresponded to 2.21 % of the total population of 1.2 billion. Further, it covers that the rights of persons with disabilities are enshrined in international conventions and national acts, such as United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), National Policy on Universal Electronic Accessibility 2013, and Rights of Persons with Disabilities Act 2016.

Section-3: Accessible E-content: Essential Components and Technical Standards aims at helping all the stakeholders in the chain be on the same wavelength regarding producing accessible websites and content. The Government version 2.0 of GIGW Guidelines is meant for making all Government websites and smartphones accessible to everyone. However, it has been observed that while technologists, content developers and publishers have knowledge of these standards, a large number of academicians who write the content, teachers who teach the content and children who use the content are not fully aware of the technical standards and guidelines. The section discusses the essential components of e-content, which include: content is appropriately adapted to meet the needs of students with disabilities, content complies with Accessibility Technical Standards, distribution and reading platforms comply with the Accessibility Technical Standards and pedagogical adaption. Technical standards such as Web Content Accessibility Guidelines (WCAG) and GIGW Guidelines provide comprehensive standards for making Web content accessible to persons with disabilities.

Section-4: Recommended Technical Standards, Guidelines and Policy Measures presents the specific standards and guidelines to be **mandatorily complied** for ensuring accessibility across all websites and content under administrative control of MoE. The section includes: (a) recommended updates in the existing document [“Guidelines for Development of e-content for School and Teacher Education” Version 3.0](#) to address the accessibility needs, (b) recommendations on the policy and process framework to ensure that standards recommended

above meet the end result, and (c) review of the GIGW standards itself and see whether the same meet the latest international standards.

Section-5: Guidelines for Adaption of Printed Textbooks into Accessible Digital Textbooks for ‘All’ Children based on UDL Principles details out the experience of UNICEF and NCERT in developing prototypes/exemplar materials based on UDL principles. Based on research, it has been established across the globe that one of the major barriers for sustaining inclusion of children with disabilities in the schooling process is the lack of accessible curriculum content. The digital revolution during the last few years has made it possible to develop affordable Accessible Digital Textbook (ADTs) or accessible e-content, which meet the learning needs of ALL students, including children with disabilities. Accordingly, it is strongly recommended by the sub-committee to adapt all printed textbooks into accessible digital formats based on UDL principles. Based on the principles of UDL and Inclusion, the Department of Education of Groups with Special Needs (DEGSN) at NCERT developed *Barkhaa: A Reading Series for ‘All’*, consisting of 40 story books.

Section-6: Guidelines for E-content for Students with Intellectual Disabilities, Autism Spectrum Disorder, Multiple Disabilities, Mental Illness Disorders and Blood Disorders, Section-7: Guidelines for E-content for Children with Specific Learning Disabilities, Section-8: Guidelines for E-content for Students with Blindness and Low Vision and Section-9: Guidelines for E-content Development for Deaf and Hard of Hearing Students delineate the form of e-content, standards and guidelines to be followed for developing disability specific contents. The sub-committee also recommends development of e-content for meeting the needs of students with specific disabilities, which can also be suitably hyperlinked to ADTs. **The specific guidelines in these sections have been highlighted in blue bold fonts.**

Section-10: Summary of Recommendations recommends the summary of Standards and Guidelines to be widely shared with content writers, designers, publishers and e-distributors already involved or likely to be engaged for the development of e-content. ***Section-11: Suggestions to Improve Compliance to Accessibility and Implementation Roadmap*** gives a summary of suggestions to ensure and incentivise accessibility along with an implementation Gantt chart, for perusal of MoE.

Appendices at the end of the document include: (a) *Appendix-1*, which provides guidelines as recommended by the sub-group for the production of sign language videos, and (b) *Appendix-2* that details out technical and pedagogical guidelines for developing content based on UDL principles.

SECTION-1

INTRODUCTION

Professor Anupam Ahuja

SECTION 1: INTRODUCTION

1.1 Background

Realizing the importance of digital education and its ability to ensure continuity of school education even in extraordinary situations like the COVID 19 Pandemic, a programme for multi-mode access to digital/online education was launched on 17th May, 2020 under the PM eVidya Program. As a comprehensive initiative, PM eVIDYA envisions to unify all efforts related to digital/online/on-air education, benefitting nearly 25 crore school going children across the country. The programme envisages development of special e-content for visually and hearing impaired students, along with extensive use of radio, community radio and podcasts and the uploading of QR coded energized digital textbooks for grades 1 to 12 on DIKSHA portal.

In pursuance of this vision for providing accessible e-content to *Divyang* students, Department of School Education and Literacy of Ministry of Education (MoE) constituted a Working Group with the specific goal of developing teaching-learning e-content for children with Special Needs. The Working group in its meeting held on August 20, 2020 constituted three sub-committees) Sub-committee for the development of guidelines for developing-content for Children with Special Needs ii) Sub-committee for the collation of existing resources and uploading on DIKSHA and iii) Sub-committee for creating an inventory of colleges and organizations that are already working in the field of e-content development. The recommendations given in this document have emerged after detailed deliberations amongst members of the first sub-committee nominated by MoE and need based additional members co-opted during the course of study.

1.2 NEP 2020: Focus on Digital Technology and *Divyang* students

While NEP-2020 focuses on multiple aspects, including revamping of the current schooling structure and radical reforms in the curriculum. **The inherent thread that runs throughout the Policy is an extensive use of digital technology to provide accessible content to *Divyang* students.** Some relevant extracts from a few paragraphs, which establish this thread, are given below:

- *Extensive use of technology in teaching and learning, removing language barriers, increasing access for Divyang student (Introduction to NEP)*
- *Software will be available in all major Indian languages and will be accessible to a wide range of users including students in remote areas and Divyang students.(23.6)*
- *Teaching-learning e-content will continue to be developed by all States in all regional languages, as well as by the NCERT, CIET, CBSE, NIOS, and other bodies/institutions, and will be uploaded onto the DIKSHA platform (23.6).*
- *DIKSHA/SWAYAM, will be better integrated across school and higher education, and will include ratings/reviews by users, so as to enable content developers create user friendly and qualitative content.(23.6)*

- Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPARBHA will also be leveraged for creating virtual labs.(24.4 f)
- Standards of content, technology, and pedagogy will be laid to formulate guidelines for e-learning by States, Boards, schools and school complexes, HEIs, etc. (24.4 j)
- Schools will develop smart classrooms for using digital pedagogy (4.46)
- Teachers will undergo rigorous training in learner-centric pedagogy and on how to become high-quality online content creators themselves using online teaching platforms and tools.(24.4 g)

1.3 Digital Education-Major Government Initiatives

1.3.1 [DIKSHA](#)

DIKSHA, a national platform for school education, was launched in September 2017. It has been adopted by 35 states/UT's across India. The platform offers teachers, students and parents engaging learning material relevant to the prescribed school curriculum. Teachers have access to learning aids like lesson plans, worksheets and activities, to create enjoyable classroom experiences. Students are able to understand concepts, revise lessons and do practice exercises. Parents can follow classroom activities and clear doubts outside school hours. It currently supports 18+ languages. In the current context of COVID-19 Pandemic related disruption of schooling, the portal has been widely used by students to access digital textbooks and other material from home. The QR codes placed in textbooks provide a ready gateway for any new/modified content to be uploaded on DIKSHA. e-Content tagged to 1900 QR coded Energized Textbooks of 27 states/UTs are on DIKSHA.



1.3.2 [SWAYAM](#)

Under the Digital India Initiative of Government of India, NIOS has been identified as one of the partners for the National MOOC (Massive Open Online Courses) initiatives for “Study Webs of Active Learning for Young Aspiring Minds (SWAYAM)”. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. The MOOCs are developed using the four-quadrant approach – text in PDF, a teaching video, self-assessment exercises; and discussion forum. NCERT has launched 34 online courses for students (Classes XI-XII) and teachers on the SWAYAM portal.



1.3.3 [SWAYAM PRABHA](#)

The SWAYAM PRABHA is a group of 34 DTH channels devoted to telecasting of educational programmes on 24X7 basis. Every day, new content is broadcasted for at least four hours, which is repeated five times a day thereafter, allowing the students to choose the time of their convenience. The contents are provided by NPTEL, IITs, UGC, CEC,



IGNOU, NCERT and NIOS. NCERT is the National Coordinator for DTH TV channel #31 i.e. “Kishore Manch”.

1.3.4 [E-Pathshala](#)

The ePathshala portal and Mobile apps are a storehouse of audios, videos, ebooks, flipbooks etc. Resources can be accessed through laptop, desktop, tablets and smart phones etc. Resources are available in Hindi, English and Urdu.



1.3.5 [NISHTHA : National Initiative for School Heads' and Teachers' Holistic Advancement](#)

NISHTHA is a capacity building programme for improving the quality of school education through Integrated Teacher Training. It aims to build competencies among all teachers and school principals at the elementary stage. Recently, in light of the COVID-19 Pandemic situation, teacher training modules have been adapted for online dissemination and other stages of education.



1.3.6 [OLabs](#)

The OLabs are based on the idea that lab experiments can be taught using the Internet, more efficiently with fewer expenses. The labs can also be made available to students with no access to physical labs or where equipment is not available owing to being scarce or costly. The content is aligned to NCERT/CBSE and State Board syllabus in Physics, Chemistry, and Biology from Class 9 to Class 12 and English and Maths lessons for Class 9 and 10.



1.3.7 [Virtual Labs](#)

Virtual Labs provide remote-access to Labs in various disciplines of Science and Engineering at the undergraduate level and post graduate level. To provide a complete Learning Management System around the Virtual Labs, the students can avail the various tools for learning, including additional web-resources, video-lectures, animated demonstrations and self evaluation



1.3.8 [National Digital Online Library](#)

National Digital Library of India (NDLI) is a virtual repository of learning resources and provides a host of services for the learner



community. It is sponsored and mentored by the Ministry of Education, Government of India, through its National Mission on Education through Information and Communication Technology (NMEICT). It has more than 50 million resources.

1.3.9 National Repository of Open Educational Resource

NROER is a collaborative platform, which brings together everyone interested in school and teacher education. The project is managed by the CIET, NCERT under the aegis of Department of School Education and Literacy, Ministry of Education,



1.3.10 Special e-content for Visually and Hearing Impaired

NIOS offers content for students with disabilities such as content in Indian sign language for hearing impaired learners and ePub and DAISY enabled ‘talking books’ for visually impaired learners. It is reported that NIOS has developed more than 270 videos in sign language across 7 subjects to provide educational access to learners at secondary level and on Yoga courses.

1.3.11 Mukta Vidya Vani (MVV),

NIOS organizes live interactive web streaming of Personal Contact Programmes (PCPs) for various subjects of Secondary, Senior Secondary and Vocational courses. These are organised for its learners through *Mukta Vidya Vani* (MVV), an open Education Radio facility for providing informational and educational content.

1.3.12 CBSE Podcasts: Shiksha Vaani

Shiksha Vaani is an audio-based learning initiative of CBSE and is available via Android App store. The podcasts cover various subjects at the secondary and senior secondary levels and are available both in English and Hindi.

1.4 PM VidyaDaan Programme

Realizing the scale and potential of DIKSHA, multiple institutions, organizations and individuals over the years have expressed their interest in contributing digital resources on DIKSHA. The use of crowd sourcing¹ tools to obtain high quality content under the programme from experts, teachers, individuals and organizations have been focussed. Accordingly, Hon’ble Minister of Education launched *VidyaDaan* program on 22nd April 2020 for inviting e-learning contributions.

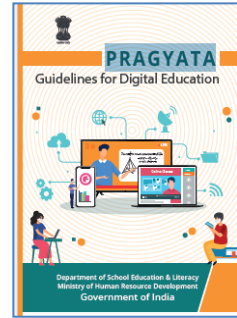
1.5 MHRD/MoE’s existing Guidelines for Digital Education and e-content Development

In view of the large number of digital initiatives and PM *VidyaDaan* programme, Ministry of Education has released the following guidelines for digital education.

¹Sourcing content from a large number of people, either paid or unpaid

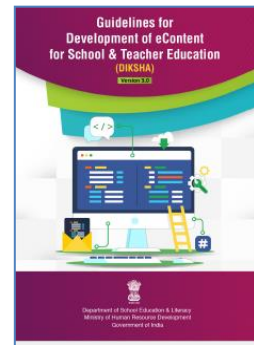
1.5.1 PRAGYATA

In July 2020, MoE released guidelines titled “PRAGYATA” to assist school heads, teachers, parents and students in e-learning. These guidelines prepared by NCERT are only advisory in nature and state governments can formulate their own rules, based on local needs. The guidelines include eight steps of online/digital learning i.e. i) Plan, ii) Review, iii) Arrange, iv) Guide, v) **Yak** (talk), vi) **Assign**, vii) **Track** and viii) **Appreciate**, in short **PRAGYATA**.



1.5.2 Guidelines for the Development of e-content for School and Teacher Education (version 3.0)

MHRD(now MoE) had earlier set up a committee to delineate guidelines to be used by various stakeholders to enable planning, preparation, curation and dissemination of quality digital contents for school and teacher education. The specific activities pertaining to analysis, design, development, implementation, and evaluation of e-content have been detailed out in this document. It also provides the parameters for assessing the quality of e-content during the process of development as well as curation² by various organisations and stakeholders like administrators, teachers and students. **The guidelines recommended in the document are intended to supplement and replace the existing guidelines.**



1.5.3 UGC Guidelines fore-content development

It delineates the eligibility, honorarium, and procedure for developing e-content. These can form a preliminary baseline for developing similar procedures for e-content development at the school level.

1.6 Users Feedback on DIKSHA Desktop and Android App

1.6.1 **Accessibility related issues**³

- Slowing down of system
- System and screen reader frequently freeze and shut down

²Process of identification, evaluation and selection of appropriate content to meet learning outcomes

³Based discussions with parent’s organizations, associations, disability advocacy forums, and general feedback and inputs from members

- Elements are not labelled appropriately
- Text books are in image format
- No audio descriptions for the videos and visual content/PPTs
- No sign language
- Captions are not there in many videos
- App is extremely cumbersome
- Problems encountered while downloading and opening of files
- Video clips take too much to download
- Lack of specially designed accessible websites
- Screen readers like JAWS are not accessible on all the websites
- Border of the pages are left unread by the screen readers
- The entire text is not accessible in word, PDF and DAISY formats
- PDF to text converter is not accessible
- It is difficult to convert PDF into audio
- Hindi and regional languages are not properly accessible by the screen reading software
- Inaccessibility of images, graphs, maps, handwriting etc. Proper description of the images, graphs, diagrams, photographs etc. should be provided while preparing e learning material.
- Screen readers in Indian voice and software compatible to Indian languages are needed
- Fast typing not supported by screen reader
- Default goes landscape mode while opening PDF book which access makes difficult with screen reader user
- PDFs are not accessible with talkback
- Combo box not tagged properly
- Interactive part - shows questions unable to answer the question.
- Problem of voice clarity and pronunciation

1.6.2 Suggestions received for improving accessibility

- Apart from textbooks (which are central), an additional link should be added for easier understanding via visuals such as ppt, picture depiction, real examples, activities etc.
- Add fun elements, animated stories, etc. would help to keep the attention and to explain the concepts. Interactive games will also have positive impact.
- Add simple step-by-step guide to lessons.

- Videos in ISL should be developed for certain topics, where a deaf educator explains certain concepts in detail in sign language. It should be an additional link for those who may need it. (This is over and above the ISL box in the videos)
- Modules on functional literacy and other life skills should be added.
- Create on-line libraries and strengthen distribution channel for e-learning material and setting up institutions to convert books in e-text, audio books and Braille books, which should be available at one single repository
- The common factors like bigger font size, simple (not stylish) font style, good colour contrast and uncluttered material have to be considered while developing e content.
- Content / training materials should be added for teachers on inclusive education.
- Videos for learning ISL should also be added for students, teachers and others.
- All digital books should be created in Unicode font to support screen readers
- USE CLOSED CAPTIONS (captions that can be turned on or off with the click of a button) not just SUBTITLES to describe background sounds, phone ringing and other audio cues that need describing.

1.7 Need for Specific Guidelines for Children with Disabilities

The existing guidelines for development of e-content recommend UDL approach for content design. During interaction with parents and other organisation, it emerged that there is a need to also develop e-content for meeting the specific needs of certain disabilities. As stated earlier, it is reiterated that these guidelines are supplement to the existing “Guidelines for the Development of e-content for School and Teacher Education” (DIKSHA) Version 3.0 published by MHRD (MoE).

1.8 Methodology Adopted

1.8.1 Study of GIGW manual

A copy of the second edition of Guidelines for Indian Government Websites (GIGW) published in February 2019, which forms an integral part of Central Secretariat Manual of Office Procedure, was shared with all the sub-committee members. Two separate sub-groups were created; one for studying provisions of GIGW guidelines and another for Web Content Accessibility Guidelines (WCAG 2.1) guidelines.

1.8.2 Kick off meeting

A virtual kick off meeting was held on 28th August 2020 to develop a common understanding about the scope, methodology, and processes to be followed for completing the assigned task. The two sub-groups made presentations on technical standards and a brief glimpse of NCERT’s experience in developing exemplar accessible content based on UDL principles was provided to

the committee members. A copy of the Minutes of Meeting (MoM), along with the presentations made are attached at **Appendix-1**.

1.8.3 Presentation on technical standards

On the request of the members, a detailed presentation on the above stated technical standard was made by Mr. Dipender Manocha on 1stSeptember 2020.

1.8.4 Constitution of sub-groups

The sub-committee experts were divided into nine separate sub-groups to develop guidelines pertaining to technical standards and for content adaption for meeting specific needs of children with specific disabilities.

1.8.5 Preparation of Draft Report

The draft report has been prepared by consolidating inputs received from the sub-groups ii) experience and lesson learnt during development of NCERT’s exemplar series- *“Barkhaa-A Reading Series for All”* based on UDL principles (both print and digital formats), iii) adaption of poems from NCERT text books in Accessible Digital formats iv) UNICEF’s experience in developing Accessible Digital Textbooks based on UDL principles in five countries and v) literature survey on the subject.

1.8.6 Final Report

The comments and feedback on draft report were incorporated in this final report.

1.8.7 Task-Responsibility Matrix

RPwD Act 2016 specifies 21 disabilities, which have been defined in the next section of this document. For the purpose of developing these guidelines, the disabilities were grouped into six categories as tabulated below.

Sub-Group	Task	Responsibility
1	Technical Standards and Guidelines pertaining to accessibility	Mr.Dipendra Manocha, Dr. Sam Taraporevala, Dr.Bhuban Mahapatra, Dr. Angel Rathnabai, Mr. Sai Bhagat, Mr. Anubhav Mitra and Ms. Neha Trivedi
2	Guidelines to address specific learning needs of children having Intellectual Disability, Autism Spectrum Disorder, Mental illness, Multiple Disabilities and Blood Disorders	Dr. Jayanthi Narayan, Dr. Merry Barua, Dr. Nibedita Patnaik, Prof. K. Balabaskar, Prof. P. Kamaraj, Mr.S.Shankar Subbiah
3	Guidelines to address specific learning needs of children who are Deaf, Hard of hearing, Speech and Language disability	Dr. Varsha Gathoo, Dr.Mrutyunjaya Mishra, Dr. P.J.Mathew Martin, Dr. Gayatri Ahuja, Ms. Monica Punjabi, Ms. Atiya Haji, Ms.Sharmishtha Oak and Mr. Gourav Verma
4	Guidelines to address specific learning needs of children having Learning Disabilities in Languages,	Dr.Geet Oberoi, Dr.Shyamala Dalvi, Dr.Renu Malaviya, and Dr. Sudha Acharya

Sub-Group	Task	Responsibility
	Social Sciences, Science & Maths at primary and upper primary stages	
5	Guidelines to address specific learning needs of Blind and Low Vision children and Exemplar video based on UDL principles and other guidelines	Prof. Sudesh Mukhopadhyay, Prof. Sujata Bhan, Dr. Annie Koshi, Ms. Yukti Gupta and Dr. Akila Surendran
6	Guidelines to address specific learning needs of children with Physical Disability	Prof. Anupam Ahuja

1.8.8 Categories of Disabilities for developing e-Content for Children with Disabilities

Typically learning content for students with disabilities is developed for five broad categories of disabilities. For example, UNICEF in its publication “*Emerging lessons to guide and support ministries of education, publishers, technology and content developers, teachers and implementers*” has considered five broad categories of disabilities namely; 1) Blind or low vision, 2) Deaf or hard of hearing, 3) Intellectual and developmental disabilities, 4) Learning disabilities and 5) Motor disabilities.

In the RPwD Act 2016 the 21 disabilities have been clubbed under five broad categories. The sub-committee has covered these five categories in Sections 6 to 10 of the report as tabulated below.

Disability Categories (as per RPwD Act 2016)	Disabilities under each category (as per RPwD Act 2016)	Relevant Section of the report
1. Physical Disabilities	A) Locomotor disability	
	1. Locomotors Disability	
	2. Leprosy Cured persons	
	3. Cerebral Palsy	Section 10
	4. Dwarfism	
	5. Muscular Dystrophy	
	6. Acid Attack victim	
	B) Visual impairment—	
	7. Blindness	Section 8

	8. Low-vision	
	C) Hearing impairment—	
	9. Deaf and Hard of Hearing	Section 9
	D) Speech and Language disability	
	10. Speech and Language disability	
2. Intellectual Disabilities	11. Intellectual Disability	Section 6
	12. Autism Spectrum Disorder	
	13. Specific Learning Disabilities	Section 7
3. Mental Behaviour	14. Mental Illness	Section 6
4. Disabilities caused due to Chronic Neurological conditions and Blood Disorder	a) chronic neurological conditions, such as	
	15. Chronic Neurological conditions	
	16. Multiple Sclerosis	
	17. Parkinson’s disease	
	b) Blood Disorder	Section 6
	18. Haemophilia	
	19. Thalassemia	
	20. Sickle Cell disease	
5. Multiple Disabilities	21. Multiple Disabilities including deaf-blindness	

Further, it may be noted that special content is not required for all 21 disabilities. For example, students having disabilities like Thalassemia, Sickle Cell disease and Haemophilia have intelligence and sensory motor functions as other typically growing children. However, due to their blood disorder, they may be on medication and may require periodic blood transfusion, which may affect their regularity in attending the school. In addition, they may get tired more easily in comparison to their peers and may require adjusting their seating arrangement for comfortable sitting to reduce fatigue etc. Similarly, children having physical disabilities like dwarfism, acid attack victims may require “accommodations” rather than "special content”.

In summary, it is suggested that content providers may develop special content for the following categories of disabilities:

1. **Visual impairment—**Blindness and Low-vision

2. **Hearing impairment**— Deaf and Hard of Hearing
3. **Intellectual and mental disorders** - Autism Spectrum Disorder, Chronic Neurological conditions etc.
4. **Specific Learning Disabilities and**
5. **Physical/Motor disabilities**

1.9 Recommendations

- It needs to be ensured that all websites, mobile apps as highlighted at 1.3 above may be checked for compliance with GIGW accessibility Guidelines. There is a need to obtain Website Quality Certification from STQC or any other Govt approved agency.
- Under PM *VidyaDaan*, experts, teachers, individuals and organizations are being encouraged to upload content on DIKSHA. It is recommended that before uploading content, its quality and accessibility is validated. UGC Guidelines for e-content development provide for the constitution of an Expert / Peer Committee to meet periodically to scrutinise e-content proposals. Similar or some other suitable monitoring mechanism may be put in place for uploading content on DIKSHA.
- The users feedback as highlighted at 1.7 above regarding accessibility issue and the suggestion may be incorporated and the shortcomings be addressed expeditiously.

SECTION-2

**DISABILITY CENSUS
AND LEGAL RIGHTS OF
PERSONS WITH
DISABILITIES**

Professor Anupam Ahuja

SECTION-2: DISABILITY CENSUS AND RIGHTS OF PERSONS WITH DISABILITIES

2.1 Purpose of this Section

Before embarking on formulating guidelines for Children with Disabilities, it was considered essential to understand the census data on disabilities (as per Census 2011) and legal Rights available to Persons with Disabilities. Accordingly, this section deals with these two critical aspects and recommendations drawn at the end to ensure that legal rights provided to persons with disabilities are implemented effectively.

2.2 Global Disability Status in the World

It is estimated that more than one billion people around the world have some form of disability⁴– with over four in five persons living in developing countries⁵ – and 93 million of them are children under the age of 14 living with a ‘moderate or severe disability’. Despite these rough estimates, there is a lack of concrete and accurate data showing the true scale of discrimination worldwide and on a national level. Approximate figures show that the situation is worrying with about 62 million children at primary school age having a disability around the world and 186 million children with disabilities who have not completed primary school education⁶.

“Persons with disabilities remain less likely to attend school and complete primary education and more likely to be illiterate than persons without disabilities. Available data reveals that, on an average, one in three children with disabilities of primary school age is out of school, compared with one in seven children without disabilities. Primary school completion is also lower for children with disabilities. These trends are reflected in the lower literacy rate of persons with disabilities: 54 per cent of persons with disabilities compared to 77 per cent of persons without disabilities are literate). In some countries, more than 10 per cent of persons with disabilities have been refused entry into school because of their disability); and more than a quarter of persons with disabilities reported schools were not accessible or were hindering to them....

Many countries continue to strengthen national policies and legal frameworks to improve access to education for persons with disabilities, with 34 out of 193 United Nations

⁴ World Health Organization and World Bank, World Report on Disability, 2011, p. xi, accessible at: http://whqlibdoc.who.int/publications/2011/9789240685215_eng.pdf?ua=1

⁵International Labour Organization, 2007, Geneva, p. 1, accessible at: http://www.ilo.org/wcmsp5/groups/public/--dgreports/---comm/documents/publication/wcms_087707.pdf and FAO expert Labor Stloukal, FAO Newsroom, 2006, Rome, accessible at: <http://www.fao.org/newsroom/EN/news/2006/1000453/index.html>

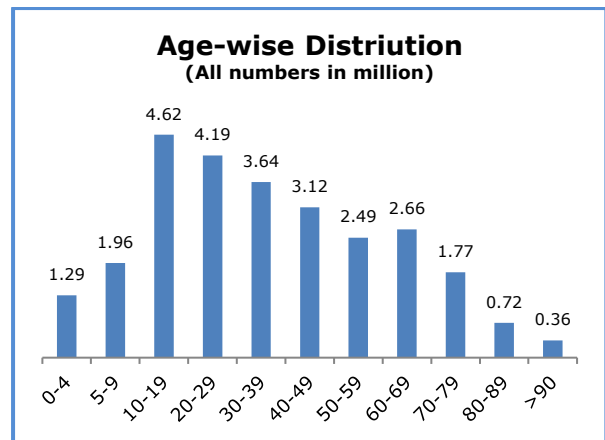
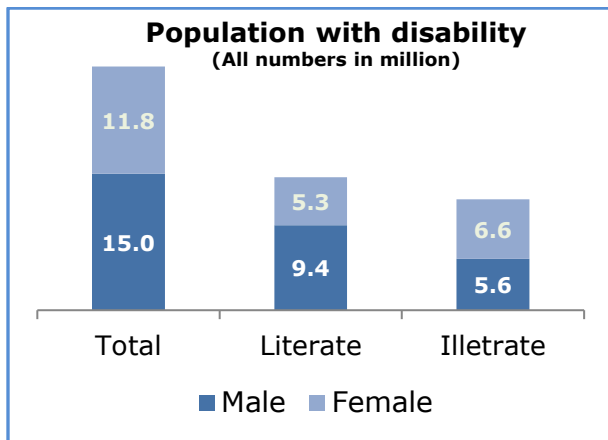
⁶ NESCO, Empowering persons with disabilities through ICTs, p. 5, 2009, Paris, accessible at: <http://unesdoc.unesco.org/images/0018/001847/184704e.pdf>

Member States guaranteeing in their constitutions the right to education for persons with disabilities or providing protection against discrimination based on disability in education. Yet, in 44 per cent of United Nations Member States, students with disabilities cannot be taught in the same classroom as other students⁷

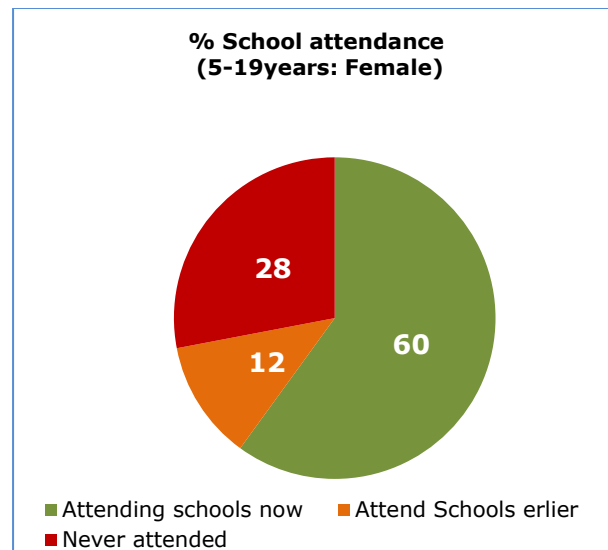
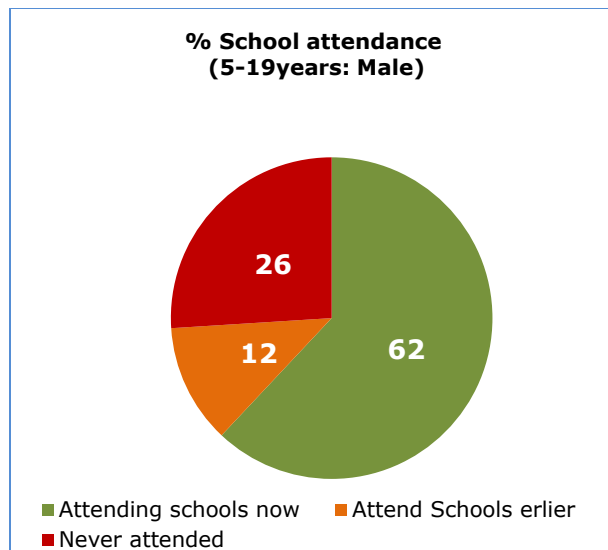
As many as 93 million to 150 million primary and lower secondary-school age children with disabilities in developing countries are out of school; they are less likely to enrol and complete a full cycle of basic education. Children with disabilities are and more likely to leave school before completing primary or secondary education. (Cynthia Chassy, Josh Josa, USAID).

2.3 Disability in India: An Overview

As per 2011 Census, there were 26.8 million persons with disability (*divyangjan*) in India, which corresponded to 2.21 % of the total population of 1.2 billion. Out of the total 26.8 million PwDs, only 14.7 million (55%) were literate and 12.2 million (45%) were illiterate. The sex-wise, age-wise and disability-wise break ups are depicted in the graphs below. It is also possible that many cases of not attending school and disabilities are not reported during census due to societal pressures.



⁷ Realizing the Sustainable Development Goals (SDG) by, for and with Persons with Disabilities-Ensuring inclusive and equitable quality education for all persons with disabilities (Goal 4)-United Nations



2.4 Rights of Persons with Disabilities

2.4.1 United Nations Convention on the Rights of Persons with Disabilities

The United Nations General Assembly adopted its Convention on the Rights of Persons with Disabilities (UNCRPD) on the 13th day of December 2006. India is a signatory to the Convention and has ratified the Convention on the 1st day of October 2007. [Article 24](#) of UNCRPD *interalia* mandates that:

- Reasonable accommodation of the individual's requirements is provided;
- Facilitating the learning of Braille, alternative script, augmentative and alternative modes, means and formats of communication and orientation and mobility skills, and facilitating peer support and mentoring;
- Facilitating the learning of sign language and the promotion of the linguistic identity of the deaf community;
- Ensuring that the education of persons, and in particular children, who are blind, deaf or deaf / blind, is delivered in the most appropriate languages and modes and means of communication for the individual, and in environments which maximize academic and social development.

2.4.2 National Policy on Universal Electronic Accessibility, 2013

In 2013, the government launched the National Policy on Universal Electronic Accessibility to facilitate equal access to electronic and other information and communication technologies to PwDs. Clause 6.2.1 of the policy mandates that *electronics & ICT curricula shall include accessibility standards, guidelines and universal design concepts.*

2.4.3 Accessible India Campaign, 2015

In 2015, the Department of Empowerment of Persons with Disabilities under the Ministry of Social Justice and Empowerment outlined the Accessible India Campaign. This campaign is geared towards achieving universal accessibility and comprises of three components: i) accessibility of the built environment (physical infrastructure accessibility), ii) accessibility of the transportation system (airports, railways stations), and iii) **accessibility of information(making public documents and Websites accessible)**



2.4.4 Envision2030: 17 goals to transform the world for Persons with Disabilities

In September 2015, the UN General Assembly adopted the 2030 Agenda for Sustainable Development that includes 17 Sustainable Development Goals (SDGs). Disability is referenced in multiple parts of the SDGs, specifically in the parts related to education in Goal 4. *The Goal SDG 4.5 states that “By 2030, eliminate gender disparities in education and ensure equal access to all levels of Education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations”*



2.4.5 The Rights of Persons with Disabilities Act, 2016

To fulfil India’s obligation to the UNCRPD, India enacted the Rights of Persons with Disabilities Act, 2016 (RPwD Act) on 27th December 2016.

The Act defines a Person with disability as “*Person with long term physical, mental, intellectual or sensory impairment, which, in interaction with barriers, hinders his full and effective participation in society equally with others*”.

Article 40 of the Act prescribes that:

- *All contents available in audio, print and electronic media must be in accessible format*
- *Persons with disabilities must have access to electronic media by providing audio description, sign language interpretation and close captioning;*
- *Electronic goods and equipment, which are meant for everyday use, are available in universal design.*

TYPES OF DISABILITIES INCREASED TO 21 IN ACT		
<ul style="list-style-type: none">▶ The Rights of Persons with Disabilities Act, which overwrote the former Persons with Disabilities Act of 1995, was passed by Parliament in Dec 2016▶ The number of disabilities have been increased from seven to 21▶ It added acid attack victims, speech and language disability and specific-learning disability among the list of disabilities		<ul style="list-style-type: none">▶ Dwarfism and muscular dystrophy have been indicated as a separate class of specified disability▶ The Act also casts the responsibility up on the state governments to take measures to ensure that the disabled persons enjoy their rights equally with others▶ Additional benefits such as reservation in higher education, government jobs and reservation in allocation of land have also been provided for such persons
<ul style="list-style-type: none">▶ The new categories of disabilities also include three blood disorders – Thalassemia, Hemophilia and Sickle Cell disease		

Article 17 of the Act enumerates specific measures to promote and facilitate inclusive education, which is defined as “a system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities”

The 21 disabilities specified in the schedule of the Act are tabulated below:

2.4.6 Specified Disabilities in RPwD Act

No.	Disabilities	Definition
Physical		
1	Locomotors Disability	A person’s inability to execute distinctive activities associated with movement of self and objects resulting from affliction of musculoskeletal or nervous system or both
2	Leprosy Cured persons	A person who has been cured of leprosy but is suffering from: (i) loss of sensation in hands or feet as well as loss of sensation and paresis in the eye and eye-lid but with no manifest deformity; (ii) manifest deformity and paresis but having sufficient mobility in their hands and feet to enable them to engage in normal economic activity; (iii) extreme physical deformity as well as advanced age which prevents him/her from undertaking any gainful occupation, and the expression “leprosy cured” shall construed accordingly
3	Cerebral Palsy	A group of non-progressive neurological condition affecting body movements and muscle coordination, caused by damage to one or more specific areas of the brain, usually occurring before, during or shortly after birth
4	Dwarfism	Medical or genetic condition resulting in an adult height of 4 feet 10 inches (147 centimetres) or less
5	Muscular Dystrophy	A group of hereditary genetic muscle disease that weakens the muscles that move the human body and persons with multiple dystrophies have incorrect and missing information in their genes, which prevents them from making the proteins they need for healthy muscles. It is characterised by progressive skeletal muscle weakness, defects in muscle proteins, and the death of muscle cells and tissue
6	Acid Attack victim	A person disfigured due to violent assaults by throwing of acid or similar corrosive substance.
Sensory		
7	Blindness	A condition where a person has any of the following conditions, after best correction—

		<p>(i) total absence of sight; or</p> <p>(ii) visual acuity less than 3/60 or less than 10/200 (Snellen) in the better eye with best possible correction; or</p> <p>(iii) limitation of the field of vision subtending an angle of less than 10 degree.</p>
8	Low-vision	<p>A condition where a person has any of the following conditions, namely:—</p> <p>(i) visual acuity not exceeding 6/18 or less than 20/60 upto 3/60 or upto 10/200 (Snellen) in the better eye with best possible corrections; or</p> <p>(ii) limitation of the field of vision subtending an angle of less than 40 degree up to 10 degree.</p>
9	Deaf and Hard of Hearing	<p>a) “Deaf” means persons having 70 DB hearing loss in speech frequencies in both ears; 36</p> <p>(b) “Hard of Hearing” means person having 60 DB to 70 DB hearing loss in speech frequencies in both ears</p>
10	Speech and Language disability	A permanent disability arising out of conditions such as laryngectomy or aphasia affecting one or more components of speech and language due to organic or neurological causes.
Intellectual		
11	Intellectual Disability	A condition characterised by significant limitation both in intellectual functioning (reasoning, learning, problem solving) and in adaptive behaviour which covers a range of every day, social and practical skills, including—
12	Specific Learning Disabilities	A heterogeneous group of conditions wherein there is a deficit in processing language, spoken or written, that may manifest itself as a difficulty to comprehend, speak, read, write, spell, or to do mathematical calculations and includes such conditions as perceptual disabilities, dyslexia, dysgraphia, dyscalculia, dyspraxia and developmental aphasi;
13	Autism Spectrum Disorder	A neuro-developmental condition typically appearing in the first three years of life that significantly affects a person's ability to communicate, understand relationships and relate to others, and is frequently associated with unusual or stereotypical rituals or behaviours.
Mental Illness/ Disorder		
14	Mental Illness	A substantial disorder of thinking, mood, perception, orientation or memory that grossly impairs judgment, behaviour, capacity to recognise reality or ability to meet the ordinary demands of life, but does not include retardation which is a condition of arrested or

		incomplete development of mind of a person, specially characterised by sub normality of intelligence.
Chronic Neurological conditions		
15	Chronic Neurological conditions	Not defined
16	Multiple Sclerosis	An inflammatory, nervous system disease in which the myelin sheaths around the axons of nerve cells of the brain and spinal cord are damaged, leading to demyelination and affecting the ability of nerve cells in the brain and spinal cord to communicate with each other.
17	Parkinson's disease	A progressive disease of the nervous system marked by tremor, muscular rigidity, and slow, imprecise movement, chiefly affecting middle-aged and elderly people associated with degeneration of the basal ganglia of the brain and a deficiency of the neurotransmitter dopamine.
Blood Disorder		
18	Haemophilia	An inheritable disease, usually affecting only male but transmitted by women to their male children, characterised by loss or impairment of the normal clotting ability of blood so that a minor wound may result in fatal bleeding;
19	Thalassemia	A group of inherited disorders characterised by reduced or absent amounts of haemoglobin.
20	Sickle Cell disease	A haemolytic disorder characterised by chronic anaemia, painful events, and various complications due to associated tissue and organ damage; "haemolytic" refers to the destruction of the cell membrane of red blood cells resulting in the release of haemoglobin
Multiple Disabilities		
21	Multiple Disabilities including deaf-blindness	(more than one of the above specified disabilities) including deaf blindness which means a condition in which a person may have combination of hearing and visual impairments causing severe communication, developmental, and educational problems

2.5 Recommendations

- **As highlighted in this section, one of the reasons for low attendance or getting “pushed out” of schools of students with disabilities is lack of accessible material. Post approval of New Curriculum Framework (NCF), which is likely in 2021, existing textbooks will need to be revised. It is recommended that content for new textbooks may be designed in a manner that it becomes accessible to Children with disabilities.**
- **As mandated in National Policy on Universal Electronic Accessibility, 2013, accessibility standards, guidelines and orientation to Universal Design of Learning (UDL) may be included in ICT curricula for students. It may also form a part Teacher’s Training Modules under NISHTHA.**
- **As mandated in RPwD Act 2016, all contents available in audio, print and electronic media must be in accessible format and Persons with Disabilities must have access to electronic media by providing audio description, sign language interpretation and close captioning.**

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SECTION-3
ACCESSIBLE E-
CONTENT: ESSENTIAL
COMPONENTS AND
TECHNICAL STANDARDS

Professor Anupam Ahuja

SECTION-3: ACCESSIBLE E-CONTENT: ESSENTIAL COMPONENTS AND TECHNICAL STANDARDS

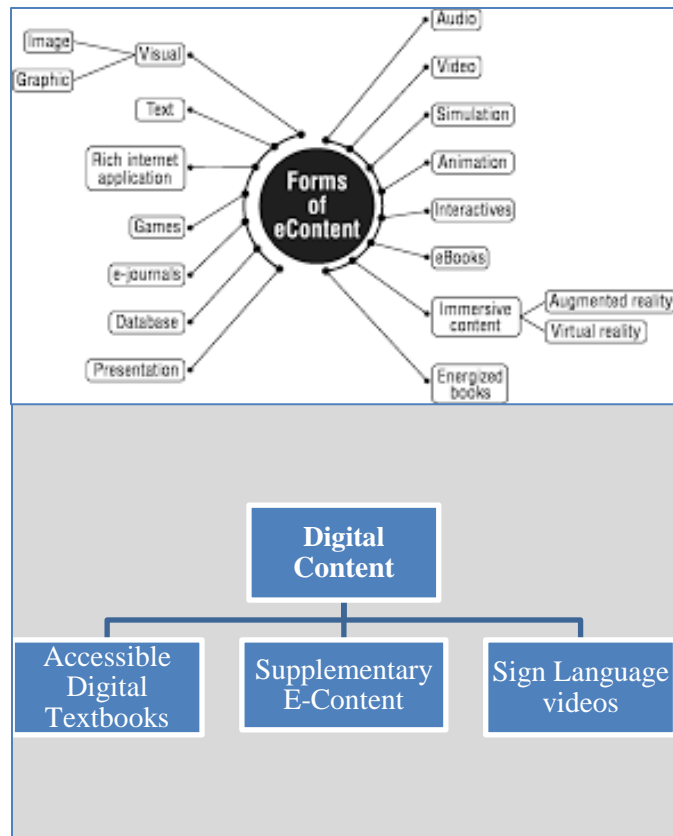
3.1 Purpose of this Section

The Government version 2.0 of GIGW Guidelines is meant for making all Government websites and smart phones accessible to all. However, it has been observed that while technologists, content developers and publishers have knowledge of these standards, a large number of academicians who write the content, teachers who teach the content and children who use the content are not fully aware of the technical standards and guidelines. As a result, often content is being created based on individual experiences rather than adhering to well researched standards, leading to inaccessible content unknowingly. This section aims at helping all the stakeholders in the chain, starting from the content writers and ending with content users, get on the same wavelength and together they create a demand for producing accessible websites and content. This section also acts as a preamble for the next section, since this understanding of the standards will help to grasp the specific standards presented in the next session.

3.2 Forms of e-Content

Electronic content (e-content) refers to the content, information delivered over network based electronic devices, or that is made available using computer network such as internet. For the purpose of this document, e-content has been grouped into three broad categories:

1. Accessible Digital Textbooks based on UDL Principles to meet learning needs of ALL learners,
2. Sign language videos for deaf learners, and
3. Supplementary e-content -This includes other forms of e-content, excluding 1 and 2 above.



3.3 Attributes of Accessible Content

Let us look closely at a few terms used in the context of designing e-content.

3.3.1 Accessible

"Accessible means a person with a disability is afforded the opportunity to acquire the same information, engage in the same interactions, and enjoy the same services as a person without a disability in an equally effective and equally integrated manner, with substantially equivalent ease of use. The person with a disability must be able to obtain the information as fully, equally, and independently as a person without a disability. Although this might not result in identical ease of use compared to that of persons without disabilities, it still must ensure equal opportunity to the educational benefits and opportunities afforded by the technology and equal treatment in the use of such technology" (Office for Civil Rights (OCR), USA Compliance Review No. 11-11-6002)

3.3.2 Web accessibility

"Web accessibility means that people with disabilities can also perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. It encompasses all disabilities that affect access to the Web, including visual, auditory, physical, speech, cognitive, and neurological disabilities" (GIGW Manual).

3.3.3 Accessibility in the digital world

"Accessibility in the digital world applies to the process of ensuring technology products, devices and services are usable, accessible and comprehensible to all people regardless of disability. It addresses three concerns: how persons with disabilities access electronic information; how content designs and developers ensure web pages, publications and other forms of digital content function correctly with assistive devices and services; and how content and digitization can be made 'born accessible', that is, designed from the onset for all users including those with disabilities and involving persons with disabilities" (UNICEF).

3.3.4 Accessible materials

"Accessible materials are aimed at ensuring that people with disabilities can navigate, perceive, and understand content that takes into account the physical, visual, speech, auditory, neurological, and cognitive disabilities of the user (Gray &Blackorby, 2017)"

3.3.5 Reasonable Accommodation

Reasonable accommodation as defined in the CRPD means that schools have the resources to provide the individual support/s a student may require in order to fully participate, without placing a disproportionate or undue burden on the school. Reasonable accommodation is complimentary to accessibility. The examples of accommodation include modified curriculum, additional assistance

for the classroom teacher, additional time for taking tests, or moving a class from the second to the ground floor for a student with a mobility impairment.

3.4 Essential Components of Accessible-Content

The following five components are essential to create accessible content for students with disabilities:

3.4.1 Content is appropriately adapted to meet the needs of Students with Disabilities

Students with disabilities have the right to receive information in a way they understand. Therefore, the content must be presented in a manner that students with all types of disabilities are able to comprehend process and respond to appropriately.

3.4.2 Content complies with Accessibility Technical Standards

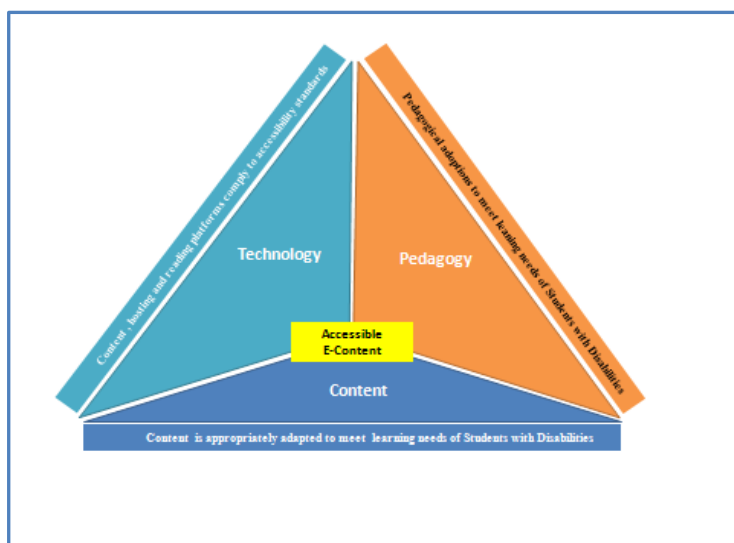
- Content including text, tables, diagrams, visuals, audios, videos etc. must comply with accessibility standards as detailed out in this section.

3.4.3 Distribution and Reading platforms comply with the Accessibility Technical Standards

- Distribution platforms like DIKSHA on which content is uploaded and distributed must comply with technical standards as detailed out in the current and following sections.
- Reading platforms like e-Pathshala or electronic devices on which content is accessed and interacted with must also comply with technical standards as detailed out in this section.

3.4.4 Pedagogical Adaption

Adaption refers to adjusting assessments, materials, curriculum, or classroom environment to a student's needs so that he/she can participate in and achieve the teaching learning goals. Modifications involve making changes to learning goals, pedagogy, assignments, assessments and evaluation to accommodate a student's learning needs⁸. Curriculum modifications will need to be undertaken, within curriculum framework and pedagogical processes in the classroom, by the teacher for meeting needs of students with disabilities. Handbooks on ["Including](#)



⁸ including children with special needs

[children with Special Needs published by NCERT](#) both for [Primary stage](#) and [Upper Primary Stage](#) can be downloaded by clicking on underlined links.

3.4.5 Role of a teacher in the classroom

It is of paramount importance to realise that accessible e-contents are supplement and not a replacement to the role of the teacher in the classroom. Teachers need to be trained to recognise different learning styles in the classroom and modify the content and pedagogy appropriately to meet the specific needs of learners in the classroom (fit-for-user). Teachers may also require education and support on the use of technology to efficiently and effectively adopt it to achieve learning outcomes.

3.5 Need for Standards

Standards are *engineering or technical specifications* that help e-content developers to establish uniformity and consistency across various digital platforms. According to the International Organization for Standardization (ISO), standards can be defined as “*documented agreements containing technical specialization or other precise criteria to be used consistently as rules, guidelines or definitions of characteristics to ensure that materials, products, processes and services are fit for their purpose.*” Standards are rules that e-content developers should abide by while developing accessible content.

3.6 International Technical Standards and Guidelines

3.6.1 WEB CONTENT ACCESSIBILITY GUIDELINES (WCAG)

Web Content Accessibility Guidelines (WCAG) provide comprehensive standards and guidelines for making Web content accessible to persons with disabilities. These guidelines also benefit people without disabilities as a key principle of accessibility is designing websites that are flexible to meet different user needs, preferences and situations. These guidelines are developed by W3C, an international, vendor-neutral group that determines protocols and standards for the web. These guidelines are organised around the following four principles:

- **Perceivable:** users must be able to perceive the information being presented i.e. it cannot be invisible to all of their senses.
- **Operable:** users must be able to operate the interface and the interface cannot require interaction that a user cannot perform.
- **Understandable:** users must be able to understand the information as well as the operation of the user interface.
- **Robust:** users must be able to access the content as technologies advance.

Under each principle, there is a list of guidelines to make content accessible to persons with disabilities. Furthermore, under each guideline, there are Success Criteria that describe specifically what must be achieved in order to conform to this standard. Each Success Criterion is written as a

statement that will be either true or false when specific Web content is tested against it. The WCAG success criteria are organized into three levels of conformance:

- Level A is a basic requirement for some users with disabilities to be able to access and use web content.
- Level AA indicates overall accessibility and removal of significant barriers to accessing content.
- Level AAA provides improvements and enhancements to web accessibility for some users with disabilities.

These levels are cumulative. To claim Level AA conformance, a website must meet all Level A and AA success criteria. Likewise, Level AAA conformance implies that all the success criteria from all three levels have been met.

WCAG 2.0 was published in December 2008, which was updated to WCAG 2.1 in June 2018 to further improve accessibility guidance for users with cognitive or learning disabilities, low vision, and users with disabilities on mobile devices.

3.6.2 EPUB

EPUB or ePub, a short form for electronic publication, is a file format that is the current industry standard in digital publishing. EPUB 3.0 is an advanced format- including texts, audio, video and even interactive contents in various subject areas (including Science, Maths, etc.) and can be included as per need. In brief, the following guidelines should be adhered to while creating accessible EPUB files:

- All text must be available in a logical reading order
- Separate presentation and content
- Provide complete navigation
- Create meaningful structure wherever possible
- Define the content of each tag: include semantic information to describe the content of a tag
- Use images only for pictures, not for tables or text
- Use image descriptions
- Include page numbers
- Define the language(s)
- Use MathML
- Provide alternative access to media content
- Make interactive content accessible
- Use accessibility metadata
- Use only Unicode fonts
- Ensure validity EPUB Check

EPUBs are opened by an 'EPUB reader', software that displays the contents of an EPUB on the screen. The EPUB format is supported by most e-book readers, with the exception of Amazon Kindle devices.

3.6.3 DAISY

Digital Accessible Information System (DAISY) is an open standard published by the National Information Standards Organization (NISO) and maintained by the DAISY Consortium for people with print disabilities. DAISY has wide international support with features for multimedia, navigation and synchronization. It is considered the best accessibility standard for audio books.

3.6.4 DIAGRAM CENTER

The DIAGRAM (**D**igital **I**mage **A**nd **G**raphic **R**esources for **A**ccessible **M**aterials) Center is a research and development center whose goal is to change the way e-content for Accessible Educational Materials is produced and accessed, so that students with disabilities are provided equal access to the general education curriculum, especially science, technology, engineering, and math (STEM).

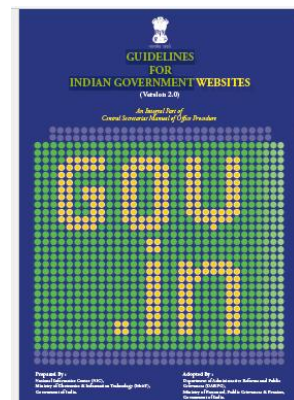
3.6.5 UNICODE

Unicode Standard is the universal character encoding standard for written characters and text. It defines a consistent way of encoding multilingual text that enables the exchange of text data internationally and creates the foundation for global software. As the default encoding of HTML and XML, the Unicode Standard provides the underpinning for the World Wide Web and the global business environments of today. Required in new Internet protocols and implemented in all modern operating systems and computer languages such as Java and C#, Unicode is the basis of software that function all around the world.

3.7 Government of India Guidelines

3.7.1 [GUIDELINES FOR INDIAN GOVERNMENT WEBSITES \(GIGW\)](#)

These Guidelines have been framed with an objective to make the Indian Government Websites conform to the essential prerequisites of UUU trilogy i.e. i) **Usable**, ii) **User-Centric** and iii) **Universally Accessible**. These Guidelines are based on International Standards including ISO 23026, WCAG 2.0, Rights of Persons with Disabilities Act 2016 and Information Technology Act of India. These guidelines are placed in three categories: **advisory, mandatory, & voluntary**. Mandatory standards are the minimum criteria that every website **MUST** meet; advisory standards are the guidelines that websites **SHOULD** endeavour to comply with; & voluntary standards are those which websites **MAY** adopt based on their discretion.



GIGW aims to ensure that people with disabilities can perceive, understand, navigate, interact and contribute through Web. The GIGW guidelines relating to web accessibility and mobile accessibility are tabulated below along with corresponding guideline number of WCGA. These guidelines are categorized as ‘MUST’ i.e. inclusion of these in a website is mandatory for ensuring compliance to GIGW.

Compliance to these guidelines makes the websites accessible to persons with various disabilities like low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities and combinations.

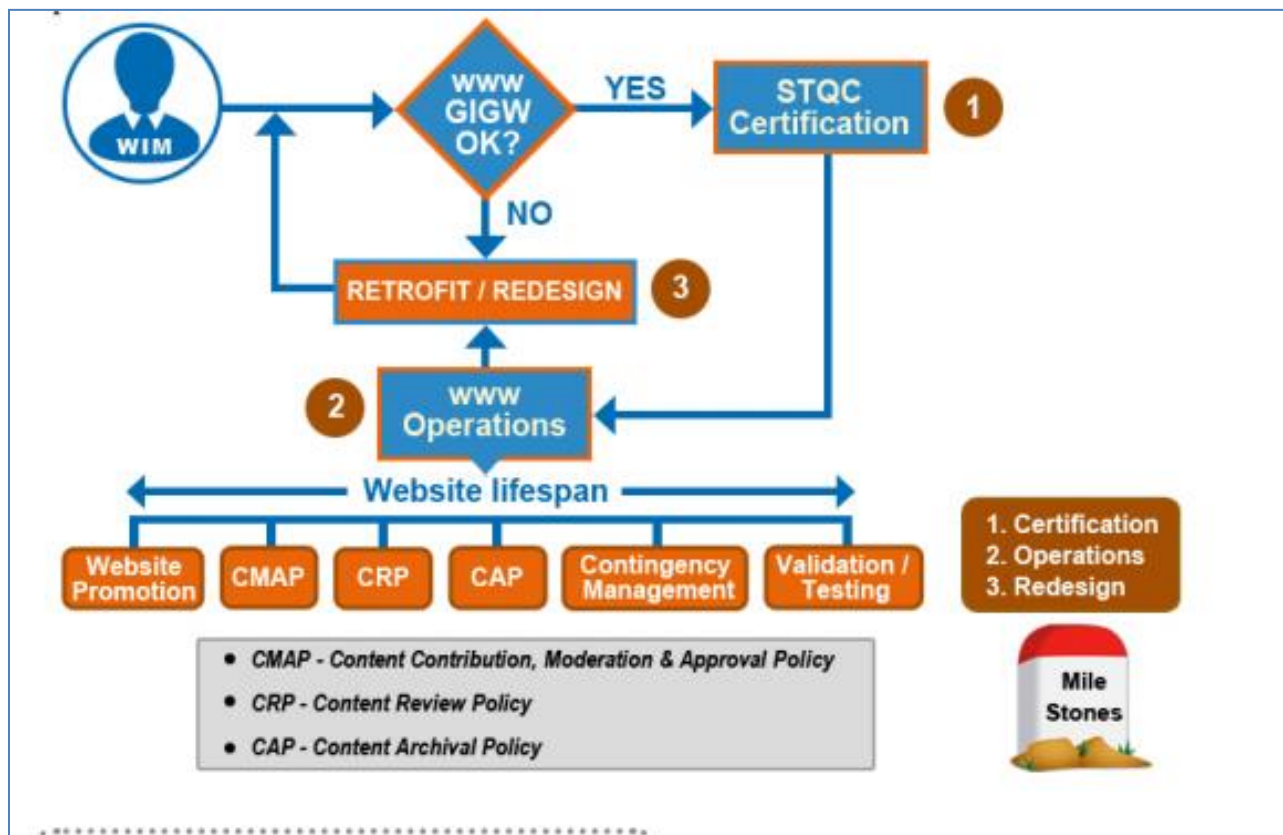
[Click here to download GIGW manual](#)

[Click here to download compliance and certification handbook](#)



These also form the basis for obtaining Website Quality Certification from STQC (Standardisation Testing Quality Certification), an organisation of Ministry of Electronics & Information Technology, Government of India.

Website stakeholders need to ensure compliance with the mandatory guidelines are complied with in such a manner that both user interface and backend policies are fully compliant



3.7.2 Mandatory Websites Accessibility Guidelines (GIGW)

GUIDELINE (In short) ⁹	GIGW	Equivalent WCAG 2.0 guidelines
All non-text content has a text alternative that provides equivalent information as the image itself.	6.6.3	1.1.1
Use of images for representing text be limited	6.6.1	1.4.5
The visual presentation of text and images of text has a contrast ratio of at least 4.5:1 between the foreground and background. Large scale text and images of text have a contrast ratio of 3:1.	6.5.1	1.4.3
Text can be resized without assistive technology up to 200 percent without loss of content or functionality.	6.4.5	1.4.4
There is a mechanism to pause, stop or hide scrolling, blinking or auto updating content that starts automatically and lasts for more than 5 seconds.	6.7.3 (b)	2.2.2
Web pages do not contain any content that flashes for more than three times in a second.	6.7.3 (a)	2.3.2
Instructions provided for understanding and operating content do not rely solely on sensory characteristics such as shape, size, visual location, orientation, or sound.	7.5 (d)	1.3.3
Colour is not used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element.	6.5.4	1.4.1
Captions or transcript are provided for all pre-recorded and live audio and video content.	6.7.2 (a, b)	1.2.1, 1.2.2 and 1.2.3
For any audio on a Web page that plays automatically for more than 3 seconds, a mechanism is available to pause, stop or control the volume of the audio independently by from system volume level.	6.7.3 (c)	1.4.2
Information, structure, and relationships that are conveyed visually on a web page must also be programmatically determined or are available in text.	5.6.3	1.3.1
When the sequence in which content is presented affects its meaning, a correct reading sequence can be programmatically determined.	5.6.4	1.3.2
All functionality that is available on the web page is operable through keyboard.	7.5 (f)	2.1.1
Complete web page is navigable using keyboard only (using tab or arrow keys).	7.5 (g)	2.1.2
Current navigation location (Keyboard focus indicator) is visible on the	7.5 (o)	2.4.7

⁹ For complete guideline, readers may download GIGW manual and refer to corresponding guideline number.

webpage while operating or navigating the page through a keyboard.		
Web pages allow the user to bypass blocks of content like navigation menus that are repeated on multiple pages (by using the skip to content link).	6.8.8	2.4.1
Any web page within the website is locatable either through “search” or a “sitemap”.	6.9.1, 6.10.1	2.4.5
Navigational mechanisms that are repeated across the website occur in the same relative order on each page.	6.8.2, 6.2.1	3.2.3
If a webpage can be navigated sequentially and the navigation sequence affect the meaning of operation, then all components must receive focus in the same meaningful sequence (Creating a logical tab order through links, form controls, and objects).	7.5 (m)	2.4.3
The purpose of each link is clear.	7.5 (h)	2.4.4
Time limit for time dependent web functions is adjustable by the user.	7.5 (c)	2.2.1
Complete & self-explanatory title that describes the topic and purpose of the page has been provided.	2.1.6	2.4.2
Headings wherever used, correctly describe topic or purpose of content.	5.6.1	2.4.6
Language of the complete web page has been indicated. If there is a change in language within a webpage it also indicated.	5.3.7	3.1.1 and 3.1.2
Nomenclature of components that have the same functionality is uniform across the website.	5.4.2	3.2.4
When any component on the web page receives focus or its settings are changed it does not initiate change in context.	7.5 (j)	3.2.2
Changing the setting of any user interface components does not automatically cause a change in context.	7.5 (i)	3.2.1
If an input error is detected, the item is identified and the error is described to the user in text. Suggestions for correction if known are provided to the user.	7.5 (e) 7.5 (p)	3.3.1 3.3.3
Labels or instructions have been provided wherever input from the users is required.	7.5 (b)	3.3.2
For Web pages that cause legal commitments or financial transactions a mechanism is available for reviewing, confirming, and correcting information before finalizing the submission.	7.5 (q)	3.3.4
Web Page uses mark up language as per specification.	7.5 (a)	4.4.1
Name and Role of all interface components can be programmatically determined.	7.5 (n)	4.1.2

3.7.3 Mandatory Mobile Accessibility Guidelines of GIGW

S.N	GUIDELINE	Guideline No..
1	Platform accessibility features have been optimally used and they behave as intended.	11.4.1
2	Proper labels have been provided for all User Interface (UI) elements.	11.4.2
3	The role for a UI element is available programmatically so that assistive technology can report this either through speech or Braille.	11.4.3
4	Hints have been provided for all active UI control elements.	11.4.4
5	The changes of state of UI controls are dynamically updated and accurately available to the assistive technologies.	11.4.5
6	Related UI elements have been grouped together.	11.4.6
7	A non-interactive space of at least one point for iOS or 1 DP for android has been provided between actionable UI elements.	11.4.7
8	Touch targets are at least 9x9mm regardless of screen size.	11.4.8
9	Focus is always on the active UI control.	11.4.9
10	When a UI control has context specific menu items, users are informed that such a menu is present and are able to activate those menu items.	11.4.10
11	Content when navigated using the screen reader gestures forms a meaningful sequence.	11.4.11
12	The app resizes its UI elements in accordance with device settings for text size.	11.4.13
13	Colour contrast ratio between foreground text for up to 18 point font and background is at least 4.5:1.	11.4.14
14	Colour & shape is not the only means to communicate important information.	11.4.15
15	Focus is changed only when the user activates a UI element that is designated for confirming an action such as the Submit button.	11.4.16 (a)
16	Appropriate keyboard is invoked by the app depending on the type of field or the data that needs to be provided by the user.	11.4.16 (b)
17	Apps is compatible with hardware keyboard.	11.4.16 (c)
18	Gestures do not require 3 or more fingers to interact with UI elements.	11.4.17
19	Session timeouts have been avoided. If a timeout cannot be avoided, then an option has been provided for users to extend the time limit before the timeout occurs.	11.4.18
20	Captions have been provided for all audio content and subtitles/transcript have been provided for all video content that is accompanied by audio.	11.4.19
21	For videos that do not have an audio equivalent, audio description for the video content that is crucial for blind users to understand the content has been provided.	11.4.20
22	No content flashes more than 3 times in one second.	11.4.21

3.7.4 GIGW recommended Web Accessibility Validation Tools

- <http://wave.webaim.org/>
- <http://www.stanford.edu/group/accessibility/cgi-bin/accessibilitychecker/checker/index.php>
- <http://www.etre.com/tools/accessibilitycheck/>

3.8 New Guidelines issued in WCAG 2.1 version

The new guidelines introduced in WCAG 2.1 in June 2018 are tabulated below:

WCAG Guideline No	Attributes
1.3- Adaptable	
1.3.4 - Orientation (AA)	<ul style="list-style-type: none"> • Orientation of web content is not restricted to only portrait or landscape, unless a specific orientation is necessary
1.3.5- Identify Input Purpose (AA)	<ul style="list-style-type: none"> • Input fields that collect certain types of user information have an appropriate auto complete attributes completed
1.3.5- Identify Input Purpose (AAA)	<ul style="list-style-type: none"> • HTML5 regions or ARIA landmarks are used to identify page regions. • ARIA is used, where appropriate, to enhance HTML semantics to better identify the purpose of interface
Guideline 1.4 -Distinguishable	
1.4.10- Reflow (AA)	<ul style="list-style-type: none"> • No loss of content or functionality occurs and horizontal scrolling is avoided when content is presented at a width of 320 pixels. <ul style="list-style-type: none"> ○ This requires responsive design for most web sites. This is best tested by setting the browser window to 1280 pixels wide and then zooming the page content to 400%. • Content that requires horizontal scrolling, such as data tables, complex images (such as maps and charts), toolbars, etc are exempted
1.4.11-Non-Text Contrast (AA)	<ul style="list-style-type: none"> • A contrast ratio of at least 3:1 is present for differentiating graphical objects (such as icons and components of charts or graphs) and author-customized interface components (such as buttons, form controls, and focus indicators/outlines). • At least 3:1 contrast must be provided in the various states (focus, hover, active, etc.) of author-customized interactive components
1.4.12 -Text Spacing (AA)	<ul style="list-style-type: none"> • No loss of content or functionality occurs when the user adapts paragraph spacing to 2 times the font size, text line height/spacing to 1.5 times the font size, word spacing to .16 times the font size, and letter spacing to .12 times the font size. • This is best supported by avoiding pixel height definitions for elements that contain text
1.4.13 Content on Hover or Focus (AA)	<ul style="list-style-type: none"> • When additional content is presented on hover or keyboard focus: • The newly revealed content can be dismissed (generally via the Esc key) without moving the pointer or keyboard focus, unless the content presents an input error or does not obscure or interfere with other page content. • The pointer can be moved to the new content without the content disappearing.

	<ul style="list-style-type: none"> The new content must remain visible until the pointer or keyboard focus is moved away from the triggering control, the new content is dismissed, or the new content
Guideline 2.1 Keyboard Accessible	
2.1.4 Character Key Shortcuts (A)	<ul style="list-style-type: none"> If a keyboard shortcut uses printable character keys, then the user must be able to disable the key command, change the defined key to a non-printable key (Ctrl, Alt, etc.), or only activate the shortcut when an associated interface component or button is focussed
Guideline 2.2 Enough Time	
2.2.6 Timeouts (AAA)	<ul style="list-style-type: none"> Users must be warned of any timeout that could result in data loss, unless the data is preserved for longer than 20 hours of user inactivity
Guideline 2.3 Seizures	
2.3.3 Animation from Interactions (AAA)	<ul style="list-style-type: none"> Users can disable non-essential animation and movement that is triggered by user interaction
Guideline 2.5 Input Modalities	
2.5.1 Pointer Gestures (A)	<ul style="list-style-type: none"> If multipoint or path-based gestures (such as pinching, swiping, or dragging across the screen) are not essential to the functionality, then the functionality can also be performed with a single point activation (such as activating a button)
2.5.2 Pointer Cancellation (A)	<ul style="list-style-type: none"> To help avoid inadvertent activation of controls, avoid non-essential down-event (e.g., on mouse down) activation when clicking, tapping, or long pressing the screen. Use on click, on mouse up, or similar instead. If on mouse up (or similar) is used, you must provide a mechanism to abort or undo the action performed
2.5.3 Label in Name (A)	<ul style="list-style-type: none"> If an interface component (link, button, etc.) presents text (or images of text), the accessible name (label, alternative text, aria-label, etc.) for that component must include the visible t
2.5.4 Motion Actuation (A)	<ul style="list-style-type: none"> Functionality that is triggered by moving the device (such as shaking or panning a mobile device) or by user movement (such as waving to a camera) can be disabled and equivalent functionality is provided via standard controls like buttons
2.5.5 Target Size (AAA)	<ul style="list-style-type: none"> Clickable targets are at least 44 by 44 pixels in size unless an alternative target of that size is provided, the target is inline (such as a link within a sentence), the target is not author-modified (such as a default checkbox), or the small target size is essential to the functionality
2.5.6 Concurrent Input Mechanisms (AAA)	<ul style="list-style-type: none"> AA) Content does not restrict input to a specific modality, such as touch-only or key board only, but must support alternative inputs (such as using a keyboard on a mobile device)
Guideline 4.1 Compatible	
4.1.3 Status Messages (AA)	<ul style="list-style-type: none"> If an important status message is presented and focus is not set to that message, the message must be announced to screen reader users, typically via an ARIA alert or live region

3.9 Recommendations

- **GIGW manual may be uploaded on all educational portals under administrative control of MoE for creating awareness so that the content developed by individuals, NGOs and organisations complies with the mandatory GIGW accessibility guidelines.**
- **Advisory may be issued that take care to ensure that before uploading new content on DIKSHA, accessibility may be validated using above validation tools.**
- **The module on accessibility may be included in all Teachers Training programmes.**

SECTION-4 TECHNICAL STANDARDS, GUIDELINES AND POLICY MEASURES

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SECTION 4: RECOMMENDED TECHNICAL STANDARDS, GUIDELINES AND POLICY MEASURES

4.1 Overview

In the previous section an overview of the international and Government of India guidelines pertaining to accessibility were delineated to enhance the awareness amongst all stakeholders. In this section, specific recommendations of the sub-committee pertaining to accessibility of distribution platforms, reading platforms and content itself will be detailed out. Compliance to the standards and guidelines recommended in this section is essential to ensure that the e-content becomes accessible as per the current best international standards. In addition, some policy measures are also being recommended for encouraging and sustaining accessibility in the long run. The section is sub divided into following three sub-sections:

- 4.2 **Recommended updations in the existing document “[Guidelines for Development of e-content for School and Teacher Education](#)” Version 3.0” to address t the accessibility needs.**
- 4.3 **Recommendations on the policy and process framework to ensure that standards recommended above meet the end result.**
- 4.4 **Review of the GIGW standards itself and see whether the same meets the latest international standards (since Diksha is compliant to GIGW).**

In addition to compliance to the above guidelines, **pedagogical adaption** of the content is also essential to enhance its comprehensibility. The recommendations pertaining to this component for creation of ‘born *accessible*’ e-content will be discussed in the subsequent sections.

Given below are the Sub-committee’s recommendations on each of the above three key areas.

4.2 Recommended Updations in the “Guidelines for Development of e-content for School and Teacher Education” Version 3.0

4.2.1 Standards for creating accessible Content and Automated Testing Tools for validation

The e-content includes three major presentation formats namely: text, audios and videos. The sub-committee observed that the existing guidelines for the development of e-content (version 3) do not provide comprehensive guidelines to ensure accessible content. Thus upgradation of the same is being recommended in the table below.

In addition to upgrading the guidelines, it is crucial that before uploading the content, the same is tested for compliance to recommended accessibility standards using automated tools. Accessibility Testing Tools and Evaluation Performa are recommended at three levels namely: i) Individual content creator, ii) Content curator and iii) DIKSHA platform level API centralized tool

Guidelines to ensure Accessible Content and Automated Testing Tools for Validation

Item Type	Current Standard Annexure-I (version 3)	Recommended Standards for uploading on DIKSHA	Recommended Automated Testing Tools ¹⁰
Text	PDF, ODT, DOCX and EPub	EPub	EPUB Accessibility Check for EPUB (ACE) https://inclusivepublishing.org/inclusive-publishing-hub-resources/
Images and Graphics ¹¹	PNG, JPEG, JPG, SVG, GIF	PNG, JPEG, JPG, SVG, GIF	
Image Description	Not specified	Diagram Centre Image Description Guidelines http://diagramcenter.org/table-of-contents-2.html	MS word accessibility checker, ACE and WCAG validators will detect absence of alternative text of images.
Language Style and Complexity- Easy to Read Content	Not specified	Government of New Zealand Easy to Read Guideline https://www.odi.govt.nz/guidance-and-resources/a-guide-to-making-easy-read-information/	Currently Not Available
Font for Indian languages	Not specified	Unicode Standard 13.0.0 http://www.unicode.org/versions/Unicode13.0.0/	NA
Audios	MP3, WAV, AAC	DAISY for Audio Books https://daisy.org/activities/standards/daisy/	DAISY validator https://inclusivepublishing.org/inclusive-publishing-hub-resources/axe
Videos	MP4, MOV, AVI, WMV, OGG (preferably in 16:9 aspect ratio in HD Quality)	Comply with WCAG 2.1 with AA mandatory and AAA recommended https://www.w3.org/WAI/media/av/	AXE https://www.deque.com/axe/ Accessibility Insight https://accessibilityinsights.io/ Accessibility Scanner https://support.google.com/accessibility/android/faq/6376582?hl=en https://support.google.com/accessibility/android/faq/6376582?hl=en

¹⁰ These tools are illustrative only and similar equivalent tools may be adapted to check compliance to the standards.

¹¹ In case of PNG, JPEG and JPG images, resolution should be minimum 5 megapixels and image size should be less than 20 MB

4.2.2 Standards for Accessible Distribution platforms/ Hosting Platforms, Reading System and Automated Testing Tools for validation

The proposed changes in Annexure II of existing guidelines to ensure Accessibility of Distribution platforms / Hosting Platforms and Reading Systems are presented in the table below. Since GIGW guidelines are yet to be updated for WCAG 2.1, the committee is recommending use of WCAG 2.1 standards

Accessibility of Distribution platforms/ Hosting Platforms and Reading System (Annexure II)			
Item Type	Current Guidelines	Recommended Guidelines	Recommended Automated Testing Tools ¹²
Web Framework and Structure for both Web Pages and Mobile App	GIGW (currently following WCAG 2.0 with AA standards)	WCAG 2.1 with AA mandatory and AAA recommended https://www.w3.org/TR/WCAG21/	AXE https://www.deque.com/axe/ Accessibility Insight https://accessibilityinsights.io/ Accessibility Scanner https://support.google.com/accessibility/android/faq/6376582?hl=en (https://support.google.com/accessibility/android/faq/6376582?hl=en)
Uploading Structure System	Currently Absent	WCAG 2.1 compliant tools https://www.w3.org/TR/WCAG21/	AXE https://www.deque.com/axe/ Accessibility Insight https://accessibilityinsights.io/ Accessibility Scanner https://support.google.com/accessibility/android/faq/6376582?hl=en https://support.google.com/accessibility/android/faq/6376582?hl=en

4.2.3 Metadata Guidelines

There is no point of creating or collecting digital materials if they cannot be found or searched by persons who need them. Metadata is a collection of information about any publication, document, video, or any other instructional material which helps users to find them when they need it. Contrary to the physical library where one does not have to be a specialist to distinguish Braille books from regular printed books, the accessibility of digital publications cannot be perceived

¹² These tools are illustrative and similar equivalent tools may be adopted.

easily. Many aspects play a role and users might not even notice them until they get stuck. To add to the complexity, requirements differ depending on the type of print impairment: a publication that might be perfectly usable for someone with dyslexia might be not for someone who is blind and vice versa.

Accessibility metadata

Besides capturing information about the content, it is necessary to know accessibility features of the publication. As an aftermath of Marrakesh treaty¹³ and several other initiatives, designers, publishers, distributors, booksellers and libraries use standard metadata. For example, Content producers generally use Schema.org, Publishers and Distributors use ONline Information EXchange (ONIX), Libraries use MACHine-ReadableCataloging (MARC21) or Bibliographic Framework (BibFrame).

The committee strongly recommends including schema.org accessibility metadata in all e-content to be made available on DIKSHA portal to enable discovery no matter how the publication is distributed or consumed.

Complete details about the schema.org metadata are available at:

<http://kb.daisy.org/publishing/docs/metadata/schema.org/index.html>

Item Type	Current Guidelines	Recommended Guidelines	Recommended Automated Testing Tools
Metadata Scheme Format	Currently Absent	Digital content format - Schema.org	AXE (https://www.deque.com/axe/) Accessibility Insight (https://accessibilityinsights.io/) Accessibility Scanner (https://support.google.com/accessibility/android/faq/6376582?hl=en) (https://support.google.com/accessibility/android/faq/6376582?hl=en)

The recommended fields defined under schema.org metadata on accessibility are listed below:

- Accessibility Summary
- Accessibility Feature
- Accessibility Hazard
- Access Mode
- Access Mode Sufficient

¹³The Treaty was adopted on June 27, 2013 in Marrakesh and it forms part of the body of international copyright treaties administered by World Intellectual Property Organization (WIPO). Its main goal is to create a set of mandatory limitations and exceptions for the benefit of the blind, visually impaired, and otherwise print disabled (VIPs).

- Accessibility API

These fields are recommended to be made part of the database of the catalogue. It can also be included in the EPUB package document to provide an overall picture of the accessibility of the given rendition of the publication.

Complete details about the schema.org metadata is available at: <http://kb.daisy.org/publishing/docs/metadata/schema.org/index.html>

4.2.4 Integration of Accessibility checks and compliance pointers

It is recommended to integrate the accessibility check and compliance pointers in existing documents, under sections related to –

- Within Learner Analysis in the Analysis step, a mention needs to be made about identifying needs of students with disabilities.
- Design Fonts (add Unicode standard with cross reference to Annexure II).
- Technical Design Section and Compliance section (add accessibility standards with referencing to Annexure II).
- Prototype testing and Post production evaluation tools (add accessibility testing reference with referencing to Annexure II).

This integration is critical to ensure that accessibility is built within the overall process and not seen as an afterthought.

4.2.5 Guidelines for Packaging and Download Options

- For any books uploaded as E-Books, the book to have an index with Chapter Names as links that open to an HTML page on website itself with complete content of the chapter in Unicode based font.
- Each book to have the following packaging and Download options: Download complete book as
 - EPUB (text only)
 - DAISY (Full text and audio synchronized)
 - BRF (Braille formatted file)
 - Easy to Read Format
- For Video content the following packaging and download options need to exist: Download complete video as
 - Video with Sign Language and close caption
 - Video with Audio Description

The sub-committee recommends that the above guidelines need to be added as an additional Annexure in the existing guidelines as “Packaging and Download Options” of e-content on DIKSHA.

4.3 Recommendations on the policy and process framework

4.3.1 Strengthening the Supplementary Educational Resources for Students with Disabilities

Students with disabilities are at a significant disadvantage with regards to availability and accessibility of educational content. Recognizing this need the Copyright Amendment Act (2012) under its clause 52 (za)¹⁴ has permitted conversion of content into accessible formats for persons with print disabilities. The existing Government and NGO collaborative Projects such as *Sugamyapustakalaya* may be brought into the ambit of Digital Learning Mission to encourage building of similar platforms. This will ensure that students with disabilities will have access to material otherwise out of their reach and Copyrighted content that cannot be made available on open access platforms such as DIKSHA.

4.3.2 Policy and Process Framework

To incentivize implementation of the guidelines, the following suggestions are made:

- **An accessibility rating for all content uploaded on platforms may be done. The curating process to have an inbuilt system of reviewing the content on accessibility and giving a rating. Each content uploaded on the portal should have accessibility rating in the range of 1 to 5, where 1 is poor and 5 is excellent. The ratings should be derived from the combination of automated accessibility evaluation tools and manual human audit results.**
- **At the user's end, by including metadata on accessibility, enable filtering of content based on accessibility features for end users to locate accessible content on the portal. Powerful and swift search mechanisms must be designed for filtering the content based on its type [PDF, e-pub, multimedia], accessibility ratings, suitability.**

¹⁴after clause (za) and the *Explanation* thereunder, the following shall be inserted, namely:-

"(zb) the adaptation, reproduction, issue of copies or communication to the public of any work in any accessible format, by-

(i) any person to facilitate persons with disability to access to works including sharing with any Person with Disability of such accessible format for private or personal use, educational purpose or research; or

(ii) any organisation working for the benefit of the persons with disabilities in case the normal format prevents the enjoyment of such works by such persons:

- **Since projects are floated on DIKSHA portal, include the criteria of accessible content in the project brief at the project generation stage.**
- **Each uploaded content should have dedicated feedback area where students and teachers can share their experience after using the content.**
- **Create a system for regular user testing of DIKSHA Platform by Student with Disabilities in partnership with National Institutes and NGOs and results of the same should be integrated by the portal development team and content rating system.**
- **Create E-Modules of training content developers and curators to understand how to create and curate accessible content and make it mandatory for all content developers and curators to go through the training module.**
- **Awareness sessions and workshops related to accessibility, assistive technologies and PWDs should be arranged for system development and design team.**
- **Technical training sessions related to international accessibility standards and GIGW should be arranged for core development and design team.**

SECTION-5
GUIDELINES FOR
ADAPTION OF PRINTED
TEXTBOOKS INTO
ACCESSIBLE DIGITAL
TEXTBOOKS FOR ALL

Professor Anupam Ahuja

SECTION-5: GUIDELINES FOR ADAPTION OF PRINTED TEXTBOOKS INTO ACCESSIBLE DIGITAL TEXTBOOKS(ADTS) FOR 'ALL' CHILDREN BASED ON UDL PRINCIPLES

5.1 Overview


The lack of accessible textbooks most often results in children with disabilities dropping out, or being pushed out of school or staying in school and facing segregation. Printed textbooks cannot offer all the features needed to ensure access for children with disabilities. Digital versions of textbooks are required and the digital version of NCERT textbooks can be accessed from E-Pathshala and other portals. However, these digital books do not have all the features that are required for these books to be classified as accessible books. ADTs lead to true inclusion as students with and without disabilities learn together in an inclusive environment from a single digital publication.

Research shows that inclusion is the most cost effective and more effective academically and socially, than segregated schooling, since all children benefit from learning together. Inclusive practices begun early in the school lead to inclusive societies and ultimately to an inclusive nation. Accordingly, this section is devoted to recommending guidelines for the adaption of printed textbooks into ADTs.

5.2 Diverse learning styles of Children: A Challenge

The enactments and enabling policies have led to an increased diversity in the classrooms- children from socially, economically backward groups, and those with special needs and from diverse cultures, are all learning in the same classroom. Inclusive classrooms catering to diversity provide equal opportunities to 'All' students in the learning process.

▪ **Children have varied background, strengths, needs, and interests**



I like to draw pictures.

I need to have text read out loud!

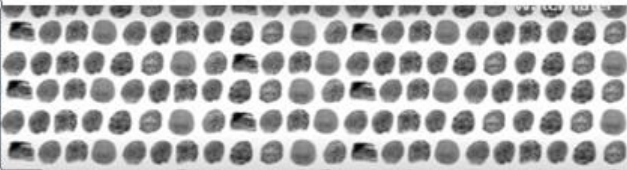
I like to conduct experiments.

I learn when I see pictures

I learn when text is read loud

I learn when I conduct experiments

• **The way the children learn is as unique as their fingerprints**
(research based evidence)



We often notice that even twins raised in the same environment have different strengths needs, interests and learning styles. Therefore, creating accessible material for ALL continues to a big challenge for academicians across the globe.

5.3 UDL: an approach to address the challenge of diversity

In the nineties, the Centre for Applied Special Technology (CAST) challenged the “one-size-fits-all” approach to curriculum and propagated Universal Design of Learning (UDL) to address diverse learning needs of ALL learners. UDL endeavours to address learning in three different parts of the brain: 1) Recognition networks, which are “what” we learn, 2) Strategic networks, which are “how” we learn, and 3) Affective networks, which addresses “why” we are learning.



The recognition networks are the ways that we recognize content and connect it to things that we already know. Strategic networks are about how we plan and organize our tasks and express our thoughts. Affective networks are how we become engaged in learning and what motivates, challenges, and interests the learner. Accordingly, three principles of UDL were suggested for addressing diverse learners:

1. **Multiple means of representation,**
2. **Multiple means of action and expression, and**
3. **Multiple means of engagement.**

One question that often comes up in discussions is the difference is between “accessibility” and “UDL”. It is argued by many authors that UDL extends beyond accessibility to address learner preferences, styles, and methods of instruction that meet needs of ALL learners.

Content Creation based on UDL guidelines involves using certain non-standard techniques and publishers are less familiar with this approach, but interest in it is growing¹⁵.

Based on the above three principles of UDL, CAST released comprehensive set of guidelines. **A complete set of UDL content and pedagogy guidelines as downloaded from CAST website is attached in Appendix-2.**

¹⁵<https://www.accessibletextbooksforall.org/accessible-epub-guide>

5.4 NCERT's Experience in developing accessible e-content based on the principles of UDL and Inclusion

5.4.1 Barkhaa: A Reading Series for 'All'¹⁶

Based on the principles of UDL and Inclusion, the Department of Education of Groups with Special Needs (DEGSN) at NCERT developed *Barkhaa: A Reading Series for 'All'*. It consists of 40 set of story booklets in Print and Digital forms to promote reading for all children in an inclusive setting and sensitise them on accessibility concerns during the foundational years.

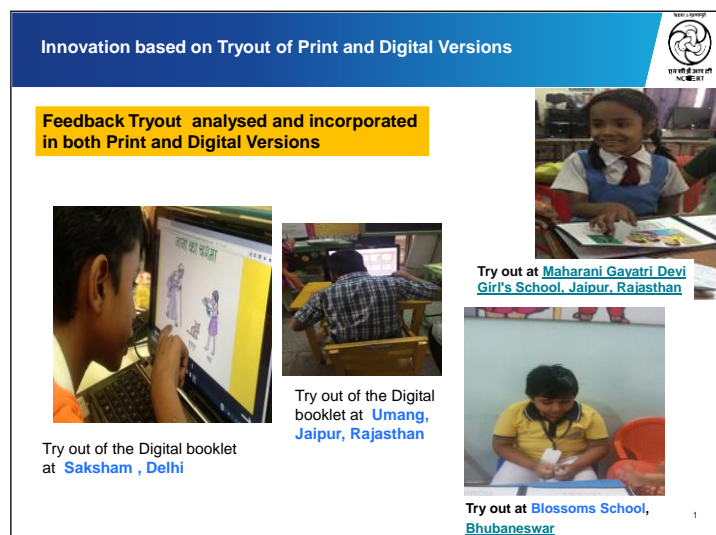
The guidelines for the development of the series were finalized through an array of national level workshops, involving experts from different disabilities.

The entire series can be accessed from NCERT website at:

<https://ncert.nic.in/dee/NCERTBarkhaseries/Start.html?playsound=yes&theme=&zoom=>

5.4.1.1 Features of Digital version

- [Story Introduction in dominant language](#) (click to view).
- [Story introduction in sign language](#)(click to view).
- The introduction of each story in regular and sign language video formats helps to arouse curiosity and make reading interesting.
- [How to Use page](#) with simple steps to follow for using the digital version (click to view).
- Content can be viewed in three different background colour combinations.
- Option to increase size of text and image.
- Picture window with real images of key words (in print and in Braille).
- Black border on all four sides to bring focus to the illustration and text.
- Green dot and red dot to indicate beginning and end of the sentences.
- Arrows that indicates turning of page.



¹⁶ Part of the MHRD project “Adapting the Barkhaa Series for visually challenged children and other CWSN according to UDL in Hindi”.

- A note for parents and teachers page focussing on encouraging appropriate reading skills during the early years.

5.4.1.2 Field Try Out

The field tryout of the print and digital versions by children with and without disabilities was conducted based on a one-day orientation programme organised for all those engaged in the countrywide tryout. The analysis of data indicated positive acceptance of the additional features in both print and digital formats.

5.4.2 Accessible Textbooks for All¹⁷

The project takes forward the learning from “*Barkhaa: A Reading Series for All*” to adapt nine stories and poems from NCERT textbooks of Class 1 to 5 into following accessible formats. These include features such as:

- Videos with illustrations, sub titles, and a teacher sharing the content of the story or poem using sign language.
- Audio Tracks with fluent reading and with highly dramatic storey telling.



5.4.2.1 Videos with illustrations, audio subtitles, and a teacher using sign language- Exemplars/Prototypes

To view these videos, ctrl+click on either of the following stories /poems and then click on play button.

- [Chakai ka Chakdum](#)
- [Bahadur Bitto](#)
- [Koi LaakeMujhe De](#)
- [Ek Din kiBadshahat](#)
- [Who will be Ningthou?](#)

¹⁷Academic Coordinators for the Project: Anupam Ahuja, Professor, DEGSN and Head, IRD and Ms. ZoyaChadha, SRA, DEGSN

- [Idgah](#)
- [Chuskit Goes to School: POEMS](#)
- [Hathi ChallamChallam](#)
- [PuraneBachche](#)

5.4.2.2 Key features of the videos

- The video of each story and poem has the following four elements:
 - illustrations,
 - subtitles,
 - audio, and
 - a teacher using sign language to tell the story or narrate the poem.
- **Introduction:** At the beginning of each audio/video track, an introductory section is given to arouse curiosity, build interest, and scaffold the story or poem.
- **Conclusion:** At the conclusion of each story and poem there is a question regarding the story/poem, which is open-ended and based on the viewer/listener’s individual thinking.
- **Glossary:** There is a glossary of difficult words appended to each story and poem. Furthermore, there is also a glossary of difficult signs appended to each story and poem.

5.4.3 Audio Tracks -Exemplars/Prototypes

- [Chakai ka Chakdum](#)
- [Bahadur Bitto](#)
- [Koi LaakeMujhe De](#) (Fluent Reading without dramatization)
- [Ek Din kiBadshahat](#)
- [Who will be Ningthou?](#)
- [Idgah](#)
- [Chuskit Goes to School](#)
- [Hathi ChallamChallam](#) (Fluent Reading with music)
- [PuraneBachche](#)

5.4.4 Key features of Audio Tracks

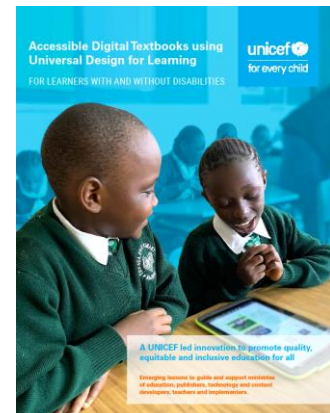
- Two Types of Audio tracks:
 - “Audio track with highly dramatic storytelling” which has a great deal of dramatization, voice modulation, and sound effects that enhance the effect and emotion of the story.
 - “Audio track with fluent reading”, which is paced and without sound effects. Listeners can listen to the story while reading the text or on their own.
- Listeners can choose between the two different types of audio tracks of each story to suit their learning styles.

5.5 UNICEF and its Partners' experience in the development of Accessible Digital Textbooks (ADTs) based on UDL principles

5.5.1 Process adopted by UNICEF

- UNICEF conducted wide-ranging consultations on ADTs, involving education, technology experts, software developers, publishers and Organizations of Persons with Disabilities (OPD) from 2014 to 2016.
- UNICEF and Partners' Experts Workshop¹⁸ on “Principles for the Production of Accessible Digital Textbooks” was held in September 2017 at Gallaudet University, Washington D.C., USA. The NCERT exemplar “Barkhaa: A reading Series for All “was presented during the workshop. It was highly appreciated as a pioneering UDL Reading series for the foundational stage of development.
- Subsequently four regional workshops to develop guidelines for producing ADTs were held in Argentina, Brazil, Paraguay and Uruguay. Ministry of Education representatives, specialists of inclusive education, members of OPD, developers and children with disabilities participated in these workshops.
- **Initially the focus was to develop specific guidelines for specific disabilities. However later on it evolved to include the UDL approach.**
- Based on UDL principles, the first prototype of ADT was developed in Brazil and thereafter three global meetings were held to review the Guidelines.
- *In November 2019, UNICEF published a document titled “Accessible Digital Textbooks using Universal Design for Learning (for Learners with and without disabilities)”. This publication describes emerging lessons to guide and support development of ADTs.*

<https://www.accessibletextbooksforall.org/>



5.5.2 Learn my way Demo-Prototype of UDL proof of concept

The 'Learn My Way' reader prototype is a proof-of-concept shared by UNICEF that demonstrates UDL principles based on Radium¹⁹ and the



¹⁸Professor Anupam Ahuja, and Shri Dipendera Manocha, participated in this workshop from India.

¹⁹ An open source technology for EPUB reader on Chrome

EPUB technology infrastructure. The application features the English translation of the textbook for Grade 1 learners in Brazil. In the pilot, the underlying content was preserved but the exercises were modified to make use of the UDL framework with multiple methods of representation and stimulation, along with engaging ways to present the content. Special attention was given to providing ways for learners to express what they know through interactivity.

<https://www.youtube.com/watch?v=cp8Zxd4U7u4>

5.6 Pilot Study findings of ADT

The pilot study of the ADT in Grade 1 was undertaken in March 2019²⁰. A mixed method research design was used where both quantitative and qualitative data was concurrently collected. The study sought to find out the challenges learners and teachers faced in the utilization of the digital textbook. In 23 schools (5 schools for HI, 1 school for VI, 3 schools for Physical impairment, 7 schools for intellectually different and 7 integrated schools), 46 learners participated in the sample study.

It has been reported that out of 46 learners, only 12 learners (26%) were able to navigate the content with ease, 18 learners (39%) could turn the audios and videos on and off with ease, and only 3 learners (6%) could identify and follow videos in terms of speed with ease.

The teachers *interalia* gave the following possible solutions to the challenges:

- Content designers should involve the relevant stakeholders before coming up with the content.
- The content is not properly adopted for learners who are intellectually different.
- Enlarge font to cater for learners who are virtually impaired.
- Provide a short course and continuous training to all the teachers in handling and manipulating the digital textbooks and more time for the training.
- Provide a table of contents on the digital textbooks.

5.7 Recommendations

According to the [World Blind Union](#), nearly 95 percent of all published knowledge is “locked” in printed form. Students with disabilities such as blindness, low vision, dyslexia, or mobility impairments that affect their use of print, are not able to access this material. The solution to this is to create books that are accessible during the publishing process. As long as a book is “born digital,” it can be “born accessible²¹.” While, NCERT materials and Boards prescribe textbooks of

²⁰Accessible Digital Textbook for Learners with Disabilities: Opportunities and Challenges by Mary W. Wambaria
Kenya Institute of Curriculum development

²¹ Source: Top tips for creating Accessible EPub3 files benetch.org

all subjects and grades that can be accessed from various websites, these do not comply with prescribed accessibility standards.

Further, as stated in Section 1 of this document an inherent thread that runs throughout NEP-2020 is an extensive use of digital technology to provide accessible content to CwSN learners (*Divyang* students). NEP-2020 also endorses all the provision of RPwD Act 2016 and stresses on inclusive education wherein “*students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities*”. Digital revolution during the last few years has made it possible to publish ADTs with multi-media content at an affordable cost. This digital revolution needs to be utilized to adapt printed textbooks into ADTs to meet the learning needs of students with disabilities as mandated in RPwD Act 2016. .

In view of the above, the sub-committee makes the following recommendations:

- **Post NCF 2021, textbooks are likely to undergo major revision. The new textbooks may be published in accessible digital format ab initio so that they are ‘born accessible’.**
- **The process to develop prototypes of a few selected existing textbooks of maths, social sciences and languages for Class 1 to 5 may be initiated immediately so that by the time new books are ready for publication, the optimised features of these ADTs can be tested and evaluated by users and teachers. This will allow content creators and developers to publishers ADTs parallel to the printed version. To facilitate the process, committees of subject teachers, special educators, inclusive education experts, technology experts and developers may be created for different subjects.**
- **Initially the focus of UNICEF was to develop digital textbooks for specific disabilities but after a number of workshops and discussions across all stakeholders, it was finally decided to develop ADTs based on the UDL approach. The sub-committee endorses that in order to promote inclusion, ADTs in India should be developed for ‘ALL’ based on UDL principles.**
- **The features of ADTs and content adaption guidelines are given in Section 10 of this document. These may be shared with all authors and content developers.**
- **It is also recommended that hyper-links may be provided in the ADTs to existing content or new content related to new curriculum for enhancing comprehensibility of students with disabilities, especially Intellectual Disability.**



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**SECTION-6 GUIDELINES
FOR E-CONTENT FOR
STUDENTS WITH
INTELLECTUAL
DISABILITIES, AUTISM
SPECTRUM DISORDER,
MULTIPLE DISABILITIES,
MENTAL ILLNESS AND
BLOOD DISORDERS**

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SECTION-6: GUIDELINES FOR E-CONTENT FOR STUDENTS WITH INTELLECTUAL DISABILITIES, AUTISM SPECTRUM DISORDER, MENTAL ILLNESS, MULTIPLE DISABILITIES AND BLOOD DISORDERS

6.1 Introduction

Students with intellectual and developmental disabilities, multiple disabilities, and Autism Spectrum disorders (IDD, MD and ASD) because of their impairment in cognitive ability or processing difficulties require adaptation in the content and the transaction process. Students having intellectual or other developmental disabilities differ from students having sensory or motor impairment, in that while the latter need support for compensating for their sensory or motor impairments, their cognitive ability does not affect their learning. If given adequate support to compensate for their loss/limitation and to use the existing sensory or motor functions, they will be in a position to learn with their peers. The e-content that is developed for those with IDD, MD and ASD has to focus on simplification of content and suitable modifications. When adapting the content, both accommodation and modification have to be considered. Accommodation refers to changing the method of teaching the child without having to change the lesson. For some children with mild disability accommodation will be effective. Modification refers to changing the content of the lesson as well as the process to meet the student's needs. **Those with multiple disabilities and complex cognitive impairment require to have the content and the way of teaching both to be modified.**

Simplifying the contents by highlighting the core ideas and linked vocabulary through incorporation of more checkpoints and multimodal style of evaluation are emphasised while adapting the lesson. When simplified, with the presentation taking a multisensory mode, the lesson becomes meaningful for all children in class, in tune with the **Universal Design for Learning (UDL)**. Therefore, this must be the first step for all lessons of all subjects and all classes. These aspects need to be addressed while developing e-content for students with IDD and MD. The required additional support has to be provided based on the student's specific needs such as children with autism spectrum disorder, combination of ID with visual impairment or deaf blindness or cerebral palsy.

While developing e-content, this fact has to be primarily kept in mind. In addition, the learning characteristics of students with each of the developmental disabilities have to be considered and accordingly e-content must be developed. Therefore, the learning characteristics and the adaptation required are given below. In addition, a brief description of existing programmes in India for students with IDD and their web links are provided. Other sources have been listed as well. Simple exemplars are added to facilitate understanding the adaptation for students with IDD, ASD and MD.

The e-content developed for learning purposes can be for class curriculum of Languages, Social Sciences, Science and Maths at primary and upper primary (Foundational and preparatory, middle) stages of education in India.

The content may be delivered as a teaching and learning material with text, images/graphical representations, animations, gamified activities including audio visuals in the formats of:

- Documents, Spreadsheets, Presentation Slides
- PDFs/EPUB Files
- Portals/Website pages/Applications/App or interactive forms
- Clickable, Selectable, Editable or Swiped, Typed content in computers, tablet, or mobile devices

(Example: Content delivered through NCERT's ICT@Schools Programme, DIKSHA, ePathshala, Swayam, eSkillIndia, Educational Apps like BYJU, Vedantu, Clicker, Khan Academy, CourseEra, Udemy, Upgrad and many other literacy support Apps.

6.2 Intellectual Disabilities (ID)

6.2.1 Learning Characteristics

- Limited/below average ability to understand.
- Need repeated instruction.
- Learn better when a concept is taught with concrete examples before moving to abstractions.
- Have limited memory – experiential learning is better retained than teaching by lecture methods.
- Have difficulty in understanding cause – effect relationship when explained verbally. (e.g. A utensil on fire is hot and touching it hurts, not following traffic rules result in accidents, if you fall you can get hurt. As they grow older, understanding the meaning and consequences of sexual abuse among other things.)
- Slow in understanding and executing instructions, more so with multiple instructions
- They take more time to learn and respond, require more reaction time.
- Difficulty in generalisation – applying a concept learnt in one environment to another environment. (e.g. transferring the classroom learning of counting with blocks and beads to home environment of counting spoons, glasses, vegetables etc.)
- Limited attention span, get distracted easily.
- Many of them can have poor gross and fine motor ability and poor eye hand coordination.
- Their learning ability will be below their age-based class level in varying degrees due to the limited cognitive ability.
- Many can have difficulty in expressing themselves fluently, by aligning their thought process to speech; may grope for words while talking, and need time to express themselves.

- Some can have additional disabilities such as cerebral palsy, autism, and neurological conditions such as epilepsy.
- As the extent of intellectual disability is of varying degrees, it will impact learning in the student.
- Can have difficulty in problem solving, understanding cues, need clear instruction.

6.2.2 e-Content Development Guidelines

- **Lessons must be simplified and move from concrete to abstract.**
- **Need repeated instruction.**
- **Special efforts must be taken to generalise the learnt concept to be applied in varied environments contextually. For example, a mathematical computation skill must have the mathematical application of the concept simultaneously with examples.**
- **Multi sensorial input must be ensured to teach a concept, but should not be cluttered as too many details presented at one time will distract and confuse the students.**
- **Frequent memory checks are to be incorporated as they forget learnt concepts easily. Provide more practice to retain the learnt skills followed by opportunity to apply the learnt skills.**
- **A number of cause-effect situations, especially involving health, hygiene and safety, have to be incorporated through video/other visual modes so as to help the student comprehend.**
- **If the student is found to have poor motor coordination, suitable customised hardware should be provided.**
- **The student must be given opportunity to express himself/herself in modes other than verbal alone, if he is nonverbal or having poor speech. For example, if s/he cannot speak, instead of asking 'What is this?', showing a visual, provide multiple choices and ask the student to point to the answer, in order to understand his comprehension of a concept.**
- **Provide opportunities for self-learning and monitoring self-learning through rewards that s/he can see (on the screen, a smiley face or a tick mark or pleasant music.)**
- **Evaluation procedures to be modified to suit the student's profile and need.**
- **To sustain attention, without changing the objective, change the activity frequently.**

- Use of software that allows for alternative ways of responding to learning activities and evaluations following the prescribed curriculum.
- Step by step instructions with gradual fading of support as the student learns.
- Design extended tasks to expand the student's existing knowledge.
- Adapt the range, sequence, graphics and variety in course material.
- Apply effective questioning techniques.

6.2.3 Assistive Technology/ICT Support Recommended

- Immersive Readers that have Layout changes, Line Focussed Reading, Syllables Aided Reading, Background Colour.
- Worksheets and Online activities from various online sources (www.twinkl.com / mathisfun.com).
- Ease of Access Settings for Changing Mouse, Cursor point size, colours, shape, highlighters.
- Onscreen Keyboards with Word Predictions.
- Spelling and Grammar support in applications.
- Dictate instead of type facilities.
- Visual Schedulers, Timer Alert mechanisms for Transition between Levels.
- Reinforcement and motivation call outs, bubbles mechanism during assessment.
- Clicker Literacy Support Software (<https://www.cricksoft.com/uk/clicker>) for content creation and delivery.
- Virtual Simulation applications for activities.
- Augmented Reality / Virtual Reality Apps.
- Adapted Colour Coded Keyboards.

6.3 Autism Spectrum Disorder (ASD)

6.3.1 Learning Characteristics

Persons with autism have their unique combination of strengths and challenges. Many have average intelligence, but will have a different learning style from the non-autistic persons. The methods of teaching implemented have to be based on their unique learning styles that factor in their strengths and challenges. Further, experiential and hands-on teaching methods enable them to 'learn how to learn'. When the teaching does not address their needs, often in their effort to cope, they compensate by using their strength in memorising. This makes it appear that they are doing well in their lessons, when in reality their conceptual foundation remains shaky. This is one of the

reasons why students with autism often drop out after primary school, despite average or above average intellectual ability.

If the teaching in the primary years addresses the needs of the autistic learners, in later years they may not require the kind of intensive supports that are necessary in the early years.

People with autism may:

- Have difficulty in having eye contact.
- Not respond when being called or spoken to.
- May not play with others.
- Have difficulty in communication and socialisation.
- Have difficulty in joint attention. (looking at/seeing/watching something along with others such as seeing the pages in a book along with others; difficulty in responding to ‘Let us look at this...kind of situations). When teacher says: “Open your math books”, the student with autism may have difficulty in following the instruction.
- Have trouble understanding the point of view of others, or understand or predict their behaviour.
- Appear shy, reserved or introvert; appear to enjoy pursuing their interest rather than social ‘chit-chat’.
- Find it hard to make friends or interact with other children of their age; not be able to have a ‘best friend’.
- Relate better with people older or younger to them.
- Use limited or no speech for communication.
- Use limited gestures, facial expressions, or body language to express themselves.
- Those who speak may repeat what they have heard from other people, or on television, radio, the Internet and etc.
- Have an unusual flat tone or a sing song voice.
- May communicate to fulfil needs but may not maintain social conversation.
- Have difficulty sharing experiences with others.
- May have difficulty in understanding tone of voice and body language or facial expressions or emotions.
- Have difficulty in understanding abstractions.
- Have limited imagination or pretend play.
- Those with fluent speech may have one-sided conversation about a favourite subject that others are not interested in, and will not give others a chance to respond.
- Have a literal understanding of language: struggle to read between the lines, and to understand analogy, metaphors, jokes, or sarcasm.
- May have specific and restricted interest in objects and activities.
- Enjoy repetitive activities such as particular body movements, rotating or spinning objects, playing with toys only in one particular way, talking about specific topics, asking the same questions.

- Seem hyperactive or inattentive.
- Avoid or seek experiences with specific sounds, smells, tastes, or textures. So, they may find some lighting, sounds, textures, touch etc. deeply distressful, or may seek certain visual, tactile, oral or audio stimulation.
- May have poor hand-eye and motor coordination, manifested in difficulty in writing by hand, participating in sporting events, copying from the blackboard.
- Seem to get upset easily, for no apparent reason or by slight changes in routine.
- May take longer to process information.
- Even when very intelligent, appear simple and honest individuals and not ‘street-smart’ or ‘worldly wise’.
- Have focused and intense interests that may seem unusual, and information on a specific topic like pre-history, automobiles, space, cricket, etc.
- Be good at following rules and routines.
- Display an astute attention to details.
- Have a great memory for events, places, routes, etc.
- Be great at some skills such as music, science or math, and yet struggle with things that seem obvious, simple, or easy.
- Many are found to do well with computer skills because of the structure and predictability.
- Most, though not all, learners with autism are strong visual learners.

6.3.2 e-Content Development Guidelines

- **Should be simple, clean and structured both in layout and in content. Have wide clear margins in the page and generous spacing in the text. Should have a lot of visual input, but not clutter.**
- **Use concrete language in explaining concepts especially in the beginning. Avoid abstract terms like kind queen, honest farmer, magnificent palace, cruel king etc. Generalise the learning with real environment - examples in everyday experiences.**
- **Use language that is simple, direct, precise and logical. Avoid complicated sentence construction. Use as little metaphorical language as possible. However, do not make the language childish**
- **All of the above are particularly important in the early years.**
- **Allow the use of adaptations for students with challenges in motor coordination**
- **Use bullets, graphic organisers, tables to list and illustrate lessons. Allow different modes of response to illustrate comprehension of lessons.**
- **Audio formats will be beneficial for some learners with autism.**

- **Keep it interesting.**

6.3.3 Assistive Technology/ICT Support Recommended

- Immersive Readers that have a layout changes, Line Focussed Reading, Syllables Aided Worksheets and Online activities from various online sources (www.twinkl.com / mathisfun.com).
- Ease of Access Settings for Changing Mouse, Cursor point size, colours, shape, highlighters etc.
- Onscreen Keyboards with Word Predictions.
- Spelling and Grammar support in applications.
- Clicker Literacy Support Software (<https://www.cricksoft.com/uk/clicker>) for content creation and delivery.
- Facesay social skills software games (<http://www.facesay.com/>).
- Virtual Simulation applications for activities.
- Augmented Reality / Virtual Reality Apps.
- Visual Schedulers, Timer Alert mechanisms for Transition between Levels.
- Reinforcement and motivation call outs, bubbles mechanism during assessment.
- Assisted and Augmented Communication devices such as ‘Go Talk’, ‘Quick Talker’, (<https://www.attainmentcompany.com/catalogsearch/result/?q=go+talks>).
- Assisted and Augmented Communication Apps such as ‘AVAZ’, ‘Jellow Plus’, ‘KAVI PTS’.
- Adapted Colour Coded and Rugged Keyboards / Mouse.

6.4 Multiple Disabilities (MDs)

6.4.1 Learning Characteristics

- Have a combination of two or more disabilities. Hence, the learning characteristic is specific to the student based on the combination of disabilities.
- May need assistive devices (low tech/mid tech/high-tech) for their personal and daily living activities.
- May use wheelchair and adapted seats in class.
- May have low vision aids or if blind, tactile aids.
- May be a hearing aid user.
- May use assistive devices for speech/communication.
- Can have intellectual disability in addition to other disabilities (e.g. Can have cerebral palsy and intellectual disability and speech disorder).
- May communicate only with their head movements.
- May express their needs only through eye movements.

- May forget the task learnt easily and may need repeated learning opportunities over a period of time.
- Perform their regular activities as any other but require support of a person.
- Good at studies but can have associated conditions and physical deformity.
- Can have symptoms of mental illness with comorbidly conditions (such as mood swings, aloofness) or a combination of intellectual disability with mental illness.
- Students with deaf blindness may depend on total tactile learning or may use suitable assistive device or technology to optimally utilize their residual vision/hearing optimally.

6.4.2 Content Adaption Guidelines

- **Simplified lessons. Concrete to abstract with ample examples.**
- **Step by step instructions with gradual fading of support as the student learns. Audio visual and tactile experiences to learn and respond.**
- **Frequent checks for memory of learnt concepts.**
- **Provision for responding to/participating in class discussion using alternate modes other than speech/writing. May need enlarged screen display, screen contrast display, screen reader may need touch screen facilities.**
- **May need sensor access program to display in the monitor to access the content for learning.**
- **Model, Video having the features of Multisensory inputs to access the content Animations may be easy for them to learn.**

6.4.3 Assistive Technology/ICT Support Recommended

- Immersive Readers that have Layout changes, Line Focussed Reading, Syllables Aided for those with learning difficulties.
- Worksheets and Online activities from various online sources (www.twinkl.com / mathisfun.com).
- Ease of Access Settings for Changing Mouse, Cursor point size, colours, shape, highlighters, ease of access keyboard settings, magnifiers for those with locomotive, visual difficulties.
- Accessibility in Settings of Mobile Devices for visual, hearing, input access difficulties.
- Onscreen Keyboards with Word Predictions for those with locomotive, cognitive, learning difficulties.
- Spelling and Grammar support in applications.
- Clicker Literacy Support Software (<https://www.cricksoft.com/uk/clicker>) for content creation and delivery.
- Facesay social skills software games (<http://www.facesay.com/>) for those with ASD.

- Augmented Reality / Virtual Reality Apps for those with hearing, cognitive difficulties or ASD.
- Virtual Simulation applications for activities.
- Visual Schedulers, Timer Alert mechanisms for Transition between Levels those with cognitive difficulties or ASD.
- Reinforcement and motivation call outs, bubbles mechanism during assessment for those with cognitive difficulties or ASD.
- Assisted and Augmented Communication devices such as ‘Go Talk’, ‘Quick Talker’, (<https://www.attainmentcompany.com/catalogsearch/result/?q=go+talks>).
- Assisted and Augmented Communication Apps such as ‘AVAZ’, ‘Jellow Plus’, and ‘KAVI PTS’.
- Adapted Colour Coded and Rugged Keyboards, Mini Keyboards, Perfect Keyboard, GBoard, FlexiKey Apps for adapted keyboard.
- Adapted Mouse like Trackball, Joystick, Foot pedal Mouse, Camera Mouse, Sip and Puff Mouse, Input access Switch (Contact or Non-Contact), Eye Gaze based Switch, EVA Mouse App for Mobile devices for those with severe locomotive, cognitive difficulties or ASD.
- Mouth Stick or Head Pointers for Keyboard or Onscreen operations.
- Refreshable Braille Display and Note Taker (with Screen Reader Text to Braille), Bluetooth connectivity.
- Digital Magnifiers, Magnifier Apps.
- Screen Readers and Speech to Text Software.
- Sign Language Interpretation, Closed Captioning, Amplification facilities / Apps for those with hearing difficulties.

Note: Not all students will use all of the above. Based on the combination of disabilities that the student has, the support needed will vary, most of the time, individualised.

6.5 Common points for students with ID, ASD and MD

- **Content must be simplified, moving from concrete to abstract.**
- **Have visual input, but do not clutter.**
- **Use simple and direct instruction.**
- **Have provision for checking memory of what is learnt.**
- **Inbuilt feature for generalization of learnt concepts.**
- **Provision for different modes of response by the student to ensure comprehension.**
- **Use adaptations if the student has challenges with motor coordination.**
- **Use of alternate mode of communication where needed.**
- **Make the learning experience interesting, use variety of activities.**

Note: Students with intellectual disability have limited cognitive functioning and hence the lessons have to be totally simplified and multiple modes of teaching /learning options have to be adapted. Therefore, all children with developmental disabilities or without disabilities will benefit with the simplified material made thus. Additional compensatory support if a child has a specific disability is to be given as seen in the exemplars.

6.6 General Delivery Guidelines for User Interfaces

- **Elegant, non-cluttered content layout structure with clear and defined spacing between elements. (For example, not too many columns, multiple elements to choose from or work upon in a single page with varied content holder shapes, colours, background.)**
- **Avoid pull-down or multi layered menu structure to avoid hidden content and for easy navigation of children with motor difficulties or screen reader users.**
- **Easy to understand pictographic navigation elements like buttons with text captions, appropriate colour codes and contrast.**
- **Facilitate navigation between activity sections, levels, pause, save, bookmark, return, continue, in page navigation elements without scrolling. (For example, Back, Next, Pause, Home, Exit, Activity Levels.)**
- **Ensure navigation through keyboard, screen reader or other input devices like Braille display for deaf blind conditions. Also, scanning mode of navigation and operations through access switches.**
- **Tolerant for error or unintentional movements while navigating or acting upon, particularly for those children with Cerebral Palsy.**
- **Adhere to target size for pointing, selecting as inputs for any given screen size to 44 x 44 pixels size as per WCAG 2.1. (2.5.5 Target Size Level AAA) for use by children with motor difficulties.**
- **Hints and tool tips in simple and short text with pictographic representation for contextual elements that require explanation to understand.**
- **Reduced use of unnecessary motion elements and highlights, underlining, colours to avoid distraction.**
- **Ensure that the media developers adhere to content accessibility compliance for people with cognitive and learning disabilities by World Wide Web Consortium (W3C).**



Above is an example of content presentation for children with or without disabilities, as it has the key features including picture, text, options of exit, restart or continue. It can be enhanced with read aloud or interactive features such as drag and drop. Based on the need of the student it can be optimally utilised. Link below gives further details:

(UNICEF/2018/Elias Constantopedos - Creating the Learn My Way EPUB and Reader)
(<https://www.accessibletextbooksforall.org/stories/creating-learn-my-way-epub-and-reader>)

6.7 General Delivery Guidelines for Content

- **Intuitive and user-friendly introduction on content.** (For example, simple questions to create curiosity with text and pictures, pause to understand and proceed further)
- **Simple and unambiguous language text, with abbreviations expanded, jargon avoided, clear purpose and meaning to context.**
- **Use of animation and images / pictures context to specific demographic for better relativity and learning for children with cognitive and learning difficulties.**
- **Use Multimodal representation of content with visual (images, videos), auditory feedback (sound that can be enabled and disabled on choice),**

text and size scalability elements to address children with multiple needs.

- Breakup larger amount of content to smaller with navigation, interactive activities and, levelling for cognitive abilities.
- Enable profiling for individual user's requirements, performance levels to facilitate assessment and proceed based on prior learning.
- Promote flexibility and customization in contents delivery to address specific needs and preferences of larger groups, smaller group, or a specific user, if required. (For example, picture or text alteration, additional information for better understanding.)
- Interactive engagement in content always to have confirmations, reassurances and motivation elements that are subtle and clear to understand. Not to create greater excitement to hasten or loose the objectives of expected learning outcomes.

6.8 Available material in the Indian context for students with IDD and ASD

6.8.1 e-SAADHYA

(https://www.cdac.in/index.aspx?id=pdf_eSaadhya_Brochure_autism)

Developed by the Center for Development of Advanced Computing (C-DAC) Bangalore, Ministry of Communication and Information Technology, in collaboration with NIEPID, (2015) has developed 'e-SAADHYA', an adaptable and accessible learning framework for children with Mental retardation (as it was named earlier to refer to ID) and Autism. It is field tested with SSA programmes in selected states.

The standards and technology implemented include:

- World Wide Web Consortium's (W3C) Web Accessibility Initiative (WCAG) 2.0
- IMS Global Learning Consortium's (IMS GLC), Question and Test Interoperability (QTI)
-

It is available in English, Hindi, Kannada and Telugu. It has the tests and training kits developed by NIEPID including *Aarambh* (early childhood inclusive education package), Functional assessment Checklist for programming (FACP), Indian Scale for Assessment of Autism (ISAA) and Grade Level Assessment Device (GLAD), e-programmed with facility for auto recording and generation of reports, as well as student monitoring. It has specific environment for teachers and environment for students that is interactive and helps learning lessons.

Involving C-DAC for developing the e-content for IDD, ASD and MD will be helpful as they have already done it in the past.

6.8.2 Computer assisted instruction for students with ID – NIEPID

(<http://niepid.nic.in/CAI%20Write%20up.pdf>)

The Computer assisted Instruction (CAI) package is another set of materials developed at NIEPID on different themes, available in the form of CDs. They were developed exclusively, keeping in view that the students with IDD and were field tested and further modified.

6.8.3 E- Content Development and MOOCs

(<http://www.mgncre.org/pdf/PMMMNTT/Module%2009%20E-Content%20Development%20and%20MOOCs.pdf>)

Faculty Development Centre (Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching), Mahatma Gandhi National Council of Rural Education, Department of Higher Education, Ministry of Human Resource Development Hyderabad, has provided in their Module 9: E-Content Development and MOOCs, Block 5: Integrating e-learning, the e-learning Standards though not mentioned, is applicable for Persons with Disabilities.

6.9 Key words /descriptor search

Every lesson will have a certain vocabulary or terms specific to that lesson. For example, a lesson on digestive system will have oesophagus, intestines, enzymes, digestion and so on. A lesson in geometry will have words such as angles, right angle, degree, acute angle and so on. A lesson on Volcano will have words like eruption, lava, ashes, and so on. The e-content development must help students identify them so that they can do a net search on their own/with support to find the relevant references/videos/work books.

Some other words and concepts that the teacher should be familiar with to facilitate net search to help students are as follows:

- Technology for students with disabilities
- Assistive technology (AT)
- Information and communication technology for persons with disabilities (ICT)
- Augmentative and alternative communication (AAC)
- Enlarged screen display, screen reader
- Alternative key boards, switch soft ware
- Grammar and spell checkers
- Onscreen instructions – visual and audio
- UDL support
- User options for teacher and learner in ICT

6.10 Blood Disorders

This group as seen in the RPwD Act (2016) includes Thalassemia, sickle cell disease and haemophilia. These children have average or above average intelligence and have sensory motor

functions as other typically growing children. However, due to their blood disorder, they may be on medication and may require periodic blood transfusion which may affect their regularity in attending the school. In addition, they may get tired more easily in comparison to their peers and may require adjusting their seating arrangement for comfortable sitting to reduce fatigue.

When it comes to use of technology, they may use technological support as any other peer. The teachers need to be understanding and be supportive to facilitate their learning.

Home learning support with the use of technology will be of immense benefit to these children if they are unable to go to school or are irregular to attend school due to their health conditions.

Student-specific decisions on what should be the technological support provided must be taken. Once decided, the suitable support can be drawn for the pool of supports developed for children with disabilities in general.

6.11 Mental Illness Disorder

In recent years mental health issues in school-going children are on the rise and has come to the notice of professionals and the government aiming at providing suitable support.

These children require timely support from psychologists and/or psychiatrists to lead a comfortable life. An alert and understanding teacher will be of significant help to these students. Keeping a watch on the student's behavioural changes and moods by the teacher, and referring them for appropriate intervention will help these students significantly.

Use of technology can be like that of any other peer, once they understand and apply their skills. Teachers may support them by choosing the programmes from the pool of available ones for education of children in general. If required, this can be done in consultation with the mental health support staff, so that the choice is appropriate according to the needs of the child.

6.12 Exemplars

6.12.1 7th Standard Geography

<https://drive.google.com/file/d/1V9XAJmZ4GleXPBJAZ5hguHZz5WAZfL0i/view?usp=sharing>

6.12.2 2nd standard Math,

<https://drive.google.com/file/d/1h9Yfq8Gj-WfA4wn2ylyGeTkfLFRTBGxj/view?usp=sharing>

6.12.3 3rd standard EVS.

<https://drive.google.com/file/d/1RB-4oXOD1W7V5KMLQDxwjnlWfYiRU-B5/view?usp=sharing>

Serial numbers 1 and 3 above have direct instructions for the student to operate, while serial number 2 has instructions and guidelines for teachers. In order to illustrate how this can be done and show different ways in which the lessons can be made, variations have been incorporated.

6.13 Additional Websites, Resources, References

- i) UNICEF - ABCS of digital accessibility
(<https://www.accessibletextbooksforall.org/abcs-digital-accessibility>)
- ii) Understanding WCAG 2.1 (<https://www.w3.org/WAI/WCAG21/Understanding/>)
- iii) Making Content Usable for People with Cognitive and Learning Disabilities
(<https://www.w3.org/TR/coga-usable/>)
- iv) Guidelines for Development of E-CONTENT for School & Teacher Education
(https://ciet.nic.in/upload/Guidelines_E-CONTENT_v1.pdf)
- v) Reach more users: 4 tips for designing accessible apps and websites
(<https://www.thinkwithgoogle.com/marketing-strategies/app-and-mobile/website-app-accessibility-guidelines/>)
- vi) Creating the Learn My Way EPUB and Reader
(<https://www.accessibletextbooksforall.org/stories/creating-learn-my-way-epub-and-reader>)
- vii) DAISY Consortium Standards for DAISY / EPUB (<https://daisy.org/activities/standards/>)
- viii) Understanding Assistive Technology: How Do Deaf-Blind People Use Technology?
(<https://www.levelaccess.com/understanding-assistive-technology-how-do-deaf-blind-people-use-technology/>)
- ix) User Requirements When Designing Learning e-Content: Interaction for All
- x) (https://link.springer.com/SECTION/10.1007/978-3-319-94794-5_6)
- xi) RGD Ontario's Access-Ability: A Practical Handbook on Accessible Graphic Design.
(https://www.rgd.ca/database/files/library/RGD_AccessAbility_Handbook.pdf)
- xii) Using Book Creator To Make Engaging Literacy Materials
(<https://www.pathstoliteracy.org/technology/using-book-creator-make-engaging-literacy-materials>)
- xiii) Access Utilities Alternate Keyboards Interface Devices Environmental Controls Switches, Switch Software Word Prediction Programs Electronic Pointing Devices Augmentative Communication
(<https://kv1devlalibrary.wordpress.com/e-contents-for-classes-ix-xii/>)

SECTION-7
GUIDELINES FOR E-
CONTENT FOR
CHILDREN WITH
SPECIFIC LEARNING
DISABILITIES (SLD)

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SECTION-7: GUIDELINES FOR E-CONTENT DEVELOPMENT FOR CHILDREN WITH SPECIFIC LEARNING DISABILITIES (SLD)

7.1 Introduction

According to the RPwD Act 2016; “*Specific learning disabilities*” means a heterogeneous group of conditions wherein there is a deficit in processing language, spoken or written, that may manifest itself as a difficulty to comprehend, speak, read, write, spell, or to do mathematical calculations and includes such conditions as perceptual disabilities, dyslexia, dysgraphia, dyscalculia, dyspraxia and developmental aphasia.

http://legislative.gov.in/sites/default/files/A2016-49_1.pdf

The most commonly found types of SLDs are:



- **Difficulties in reading** is associated with Dyslexia
- **Difficulties in writing** is associated with Dysgraphia
- **Difficulties in mathematical calculations** is associated with Dyscalculia
- **Difficulties in motor planning** is associated with Dyspraxia



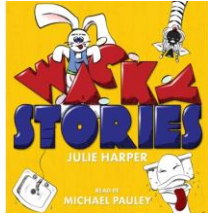



In order to provide a wholesome set of guidelines for e-learning content for SLD, the ‘difficulties’ mentioned in the RPwD Act 2016 have been focussed on and their corresponding warning signs (**red flags**), strategies and e-learning guidelines have been given. In other words, the focus is on reading, writing, comprehension, mathematics and perception. Other secondary skills, which have been referred to include attention, memory and social skills.

At the onset, it is imperative to keep in mind that each child with SLD comes with a unique set of weaknesses (limitations) and strengths, and will have a different set of combinations of deficits as mentioned in the upcoming paragraphs. All skills may not be affected in a similar manner, which implies that for some reading is a struggle, while mathematics a strength and for others, mathematics poses a challenge and reading is easy. Hence no two children with SLD are similar. They are different persons with their unique profiles!

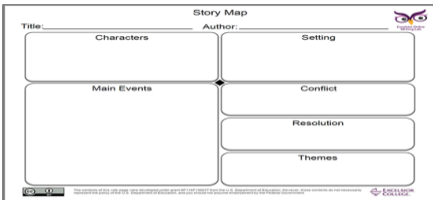
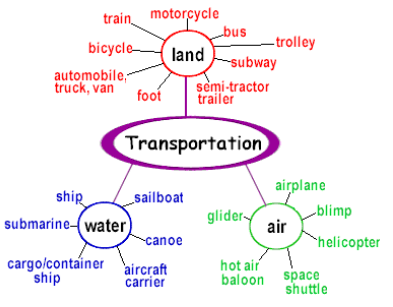
It has been emphasised that Specific Learning Disability (SLD) is NOT a disability but an umbrella term for a number of permutations and combinations of disabilities and characteristics of the major disabilities, which come under this umbrella have been highlighted, along with the difficulties, issues and possible pedagogical strategies. The specific guidelines have been suggested to enable the e-content writer (whose expertise would be more in most cases in content writing) to have a clearer picture of the rationale of why the particular e-guideline have been suggested. Individuals with SLD are affected by executive functioning difficulties. RPwD Act 2016 has emphasised attention, perception, memory and comprehension.

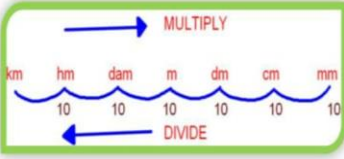
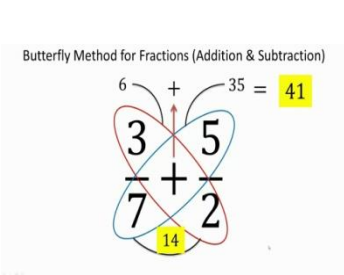
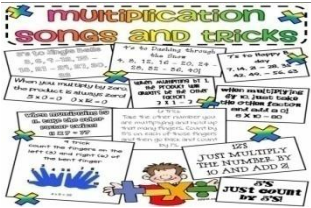
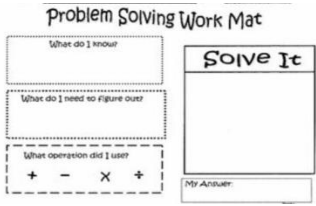
Thus, an attempt has been made to link the e-learning-teaching guidelines to the UDL approach in order to facilitate mainstream inclusive classrooms.

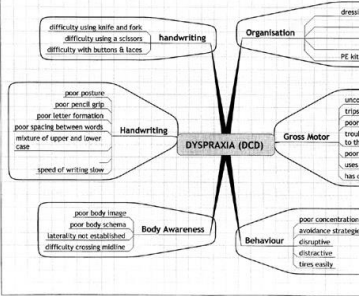
Characteristics	Difficulties/ Issues in learning	Possible Strategies	E-learning-teaching Guidelines
Reading Difficulties/ Dyslexia	Segmenting (breaking sounds to read words)	Letter-sound associations strengthened. (Audio-visual strengthening activities)	*Audio books with captions to read along. (read along activity) 
	Sequencing (especially related declarative learning)	Graded readers Repeated reading for increasing pace of reading.	*Audio and visual story starters (or endings) given. Sequencing events – by seeing options /choosing the correct option
	Confused with similar sounds/ words (difficulty with closer differentiations)	Paired reading Reading using different text but with similar level of complexity Using Highlighters for difficult spelling or spelling having similar sounds/ near similar spellings	*Podcast *Spell-check , word building ,crosswords games 
	Unable to sound out unfamiliar words (difficulty in transferring linguistic rules to new situations)		Keyboarding for idea generation from options given: <ul style="list-style-type: none"> ● speech to text tools ● text to speech tools ● games on phonetics with visual clues ● fill in the blanks ● put in the missing ● sound/letter ● choose the correct spelling option ● rhyming words
	Blending (joining sounds to write words) mispronouncing words/ phrases	Phonetics approach followed starting at 3 letter level i.e. CVC (consonant-vowel-consonant)	<ul style="list-style-type: none"> ● digital soft board to add sight words ● developing personal word list ● reading windows with timed opening (to increase the pace of reading) ● tracking of words on screen ● identifying the words on audio cue

	Decoding/Coding (word reading)	Use of word families (similar pattern) for drill / practice using flashcards etc Reinforcement of sight words through different instructional aids and methods (repeated exposure to low frequency words) Previewing / highlighting difficult words	    
	Oral reading (Laboured reading): Fluency / Pace / Automaticity		
	Articulation (Dropping endings of words/ phrases/ sentences, understanding relationship of punctuations in sentence formation)		<ul style="list-style-type: none"> • Digital graphic organisers • Self assessing quizzes
	Move to comprehension		
Writing difficulties/ Dysgraphia	<p>Difficulty in:</p> <p>Graph motor issues in Formation & Relationships: Difficulty between size, form, shapes, arrangements leads to illegibility in handwriting:</p> <ul style="list-style-type: none"> • slow and sloppy • unusual hand and paper /body positioning, pencil / pen awkward gripping) 	<p>Pattern writing for graphomotor:</p> <ul style="list-style-type: none"> • correct letter formation input • practice writing with correct grip, spacing and paper orientation • spelling intervention using a phonetic approach • simultaneous sight word approach for non-phonetic words 	<p>Tracing on screen for letter formation:</p> <ul style="list-style-type: none"> • digital graphic organisers


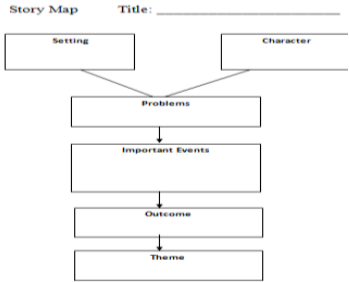

	<ul style="list-style-type: none"> • incorrect formations of alphabet / shapes • irregularity in shapes and size of letter • combination of small and capital letters • preference to write print • same letter inconsistency • punctuation errors • slow and sloppiness 		
	<p>Spatial-temporal issues:</p> <ul style="list-style-type: none"> • challenges in organising letters, words or sentences on a page • using mixture of cursive and print material • spelling errors despite extra input in phonetic and non-phonetic words • incomplete words • missing alphabet • typical alphabet/ word/ combinations • concept of spacing 	<ul style="list-style-type: none"> • frequently practicing writing time based exercises • card boards, paper clips to position paper properly • providing time to draw margins or help in drawing margins and keeping required things on the table • providing choice between labelling and drawing diagrams 	
	<p>Sequential ordering:</p> <ul style="list-style-type: none"> • difficulty in determining the correct or logical order of letters, words, ideas etc • inappropriate shape and size of letter, numbers. • often difficulty in sentence structure, grammar 	<p>Practicing proof reading skills</p>	<ul style="list-style-type: none"> • mnemonics • spell-check • grammar- check • sentence-alternatives • sequencing events from a jumbled lot with audio and visual inputs • self assessing quizzes

	<ul style="list-style-type: none"> poor spatial planning (executive function) difficulty planning and organising ideas in a flow 	<p>Frequent use of graphic organizers, mind maps, pointers, story maps.</p>	<ul style="list-style-type: none"> keyboarding for idea generation from options given audio and visual story starters (or endings) given. audio recording with text conversions graphic with audio recording/pictorial
	<p>Automation difficulties (recalling spellings, grammar, punctuation rules etc)</p> <p>Difficulty in :</p> <ul style="list-style-type: none"> putting thoughts on paper((but able to express orally) tracking of thoughts already written down writing an thinking at the same time <p>Over concentration on :</p> <ul style="list-style-type: none"> writing over comprehension or comprehension over writing 	<p>Permitting audio recording the ideas and then listening to the recording to write</p>	<ul style="list-style-type: none"> verbal, visual and written prompts 
	<p>Difficulty in organising ideas and writing flow (executive function issue):</p> <ul style="list-style-type: none"> difficulty planning and organising ideas in a flow oral responses better than written responses 	<p>-Graphic organisers like flow charts, story maps, mind maps, Venn diagrams for ideation and composition/essay writing</p> <p>-Close passages, MCQs, fill in the blanks, match the following , true and false etc objective</p>	
<p>Maths Difficulties/ Dyscalculia</p>	<p>Difficulty in:</p> <p>Differentiating between signs (+,-,X etc.)</p>	<p>Highlighting the signs & symbols</p> <p>Use of flash and reinforcing the concepts regularly</p>	<p>Games / activities related to basic operations</p> <p>*Finding the correct operations games.</p> <p>*Tricks to solve problem using visuals for addition and subtraction of fractions</p>

	<p>Understanding maths language greater than, less than, difference, product etc.</p> <p>Understanding maths facts (Time and money concepts, fractions, decimals, angles, conversion concepts etc.)</p> <p>Performing basic operations and mental calculations</p> <p>Sequencing in solving problem</p> <p>Comprehending story sums</p> <p>Pointing graphs, using protectors, scales.</p>	<p>Regular practice of basic operations as a mixed bag (Multiplication & addition table, basic operations)</p> <p>Hands on experience: (clock activity – preparing time table using Analog clock etc)</p> <p>Highlighting keywords such as: for addition (in all, total, sum,all together)</p> <p>For subtraction(left ,minus, difference etc)</p> <p>Using acronyms, mnemonics- (king henry die mother didn't cry much)</p>  <p>Use of math kits (protectors with markers and recognising angles or making angles.</p>	<p>butterfly trick</p>  <p>Songs, jingles for basic operations</p>  <p>*Reinforcement of math facts for fast rate of calculation</p> <p>*Math games based in real life experiences- time and money based games</p> <p>*Visualisation of story sums and maths facts</p> 
<p>Developmental Coordination Disorder/ Dyspraxia</p>	<p>immaturity of the organization of movement.</p> <p>Difficulty planning and organizing thoughts and tasks.</p> <p>Poor balance & posture (clumsiness)</p> <p>Differences in speech</p>	<p>Clear short instructions</p> <p>Specific praise with reasons</p> <p>Balance assistance and independence</p> <p>Keep the environment as predictable as possible</p> <p>Remove distractions</p> <p>Buddy system</p>	<p>Mind maps</p> <p>Reading games</p> <p>e-buddy</p> <p>Indication of correct answer with the reason why</p>

	<p>Poor hand-eye coordination</p> <p>Fidget more than other children</p> <p>Hard to focus on one thing for long</p> <p>Less sensitive to non-verbal signals.</p>	 <p>The diagram is a mind map centered on 'DYSPRAXIA (DCD)'. It has five main branches:</p> <ul style="list-style-type: none"> Handwriting: difficulty using knife and fork, difficulty using a scissors, difficulty with buttons & laces. Organisation: dress, PE kit. Gross Motor: unco, trips, poor, tired, to sit, poor, uses, has c. Body Awareness: poor body image, poor body schema, laterality not established, difficulty crossing midline. Behaviour: poor concentration, avoidance strategies, disruptive, times easily. 	
<p>Attention</p>	<p>Difficulty in:</p> <ul style="list-style-type: none"> • sustaining attention • not able to complete work • gaps in learning/ receiving information • unable to pay attention to the key points • unable to sift relevant from irrelevant content • missing instructions • poor writing • gaps in answering questions from the comprehension passage, completing homework, recalling basic facts) • difficulty in remembering the story from yesterday, recall classroom routines, retrieve words, • inability to take down notes • difficulty in learning poems, tables • unable to use 	<p>Increase novelty of lessons</p> <p>Incorporate the children's interests into lesson plan</p> <p>Instructions to be clear, simple and specific.</p> <p>Decrease the length of assignments.</p> <p>Worksheets / other teaching aids on :</p> <ul style="list-style-type: none"> *visual motor skills, *visual figure ground, *visual discrimination, *form constancy, *visual memory. <p><u>Brain gym</u></p> <p>Practice in listening to instructions and acting on them</p>	<ul style="list-style-type: none"> • Use highlights, add some interesting facts not in the book, add visuals • Add a visual reminder in the text to get them to refocus. • Use appropriate colour contrast for easy focus • The font and the placement of the material on the screen • Examples from the child's life to be included

	<p>strategies to rehearse to retain information</p> <ul style="list-style-type: none"> • difficulty in recalling relevant information • unable to recall in sequential manner • excessive day-dreaming • highly distractible 		
Perception	<p>Difficulty in :</p> <ul style="list-style-type: none"> • interpretation and understanding visual and auditory information • differentiating between foreground and background (e.g., hear a teacher's voice over background noise) • recognizing shapes and patterns • noting similarities and differences • association of letter shapes and/or sounds to write • completion of tasks with several different steps (i.e. writing tasks) 	<ul style="list-style-type: none"> • Worksheets on developing - visual motor skills, visual figure ground, visual discrimination, form constancy, visual memory. • Brain gym • Practice in listening to instructions and acting on them 	<ul style="list-style-type: none"> • Keep in mind the visual discrimination of foreground, background, • The form, size, colour, position of the content on the screen • Practice online fun visual perception games • While recording instructions to be mindful of the speed, length and clarity • Give an overview of the lesson • Have graphic organizers to help focus on rehearsing key facts. • Use mnemonics to help learn • Have questions • Repetition practice exercises after every new concept <p>Provide multisensory experiences(visual, auditory, tactile, kinesthetic)</p>

<p>Memory</p>	<p>Shows difficulty in short term memory</p>	<p>Memory games</p> <p>Recalling stories</p> <p>Treasure hunt</p> <p>Presenting content using various formats</p> <p>Providing key concepts/ vocabulary as supplement to the text</p> <p>Using mnemonics & graphic organisers for ease in retention</p>	 <p>Visuals for important Terms</p>
<p>Comprehension</p>	<p>Poor spatial planning (executive function)</p> <p>Difficulty in:</p> <ul style="list-style-type: none"> • understanding the given information. • sequencing in the text. • multiple directions/ instructions • answering – open ended questions. • summarizing the text / story. <p>Sequencing (especially related declarative learning)</p> <p>Linguistic: analysis and synthesis</p>	<p>*Highlighting important events</p> <p>*Using story maps organising the sequence of the story</p> <p>*Objective type Question Answers: Multiple choice questions, true false , fill in the blanks</p> <p>*Practicing Word attack strategies:</p> <ul style="list-style-type: none"> • skimming /scanning of the text • re- reading • visualising main ideas, story structure etc. 	<p>*Pictorial representation of the story</p> <p>*Graphics organizers for understanding</p>  
			<p>*Games /quiz with multiple choice to sequence the event happened in the story</p>

7.2 Guidelines

Developing e-content while keeping in mind the Universal Design for Learning (UDL) means creating/designing content in such a way that it addresses the learning needs of a wide-ranging group. In line with this thought, given below are some pointers based on the above described characteristics and intervention ideas for children with SLD.

I. Multiple ways of presentation: Presenting ideas and information in multiple ways	Variety in presentation formats	Given that children with learning disabilities benefit through multisensory techniques, presenting content visually, through auditory mode, giving a tactile experience will be helpful.
	Organization of instructional materials	Children with SLD have difficulties in organizational skills. While planning and presenting the information it is essential that it is structured, systematic, and related to their life experiences.
	Delivery of the content	As children with SLD have working memory deficits, it is important to present content in parts rather than as a whole. Highlighting key points, providing word lists, having questions in between for checking understanding as well as retaining focus will be helpful.
II. Multiple ways of Expression: Providing students with many ways to express their learning	Varying formats for student response	Children with SLD will benefit when given options to respond. Alternative assignment formats like oral report instead of written, reducing the length of the assignment, giving the work in short formats, allowing portfolio as a means of expression etc will be helpful.
	Flexibility in time limits	For children who may need extra time, flexibility in time will encourage them to submit/complete the task.
	Layout of presentation	The organization on the screen, the fonts, colour code, text size, the amount of matter on one sheet etc is important for children with visual perception issues. During verbal description the speed, tone and clarity of the sound has to be appropriate to help children having auditory perceptual difficulties.
III. Multiple ways of Engagement: Providing multiple means of engagement	Number of examples	Children with SLD will perform better when there are concrete examples, anecdotes, real-life experiences, and personal contact. Ensure that the examples, activities are relevant to student lives.
	Interest levels of children	Allow students more options to choose methods that support their interests and skill levels, such as allowing students to select topics of interest for final projects and allowing them to be creative in how their projects are presented. This will help in sustaining attention and interest of children with SLD.
	Opportunities for hands on activities	The text discussion will be better understood when time to time a hands-on activity is given to substantiate the learning.

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SECTION-8
GUIDELINES FOR E-
CONTENT FOR
STUDENTS WITH
BLINDNESS AND LOW
VISION

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SECTION 8- GUIDELINES FOR E-CONTENT FOR STUDENTS WITH BLINDNESS AND LOW VISION

8.1 Ensuring accessibility of content

8.1.1 Essential Features for users of Screen readers/ Magnifiers/ Refreshable Braille Displays

- Ensure that the content is text based and not an image PDF.
- Ensure that effective browsing navigation and heading levels, page numbers, tables, numbering, and bullets are inserted.
- Ensure pictures wherever presented have been given image descriptions.
- Ensure no information is presented only visually.
- Ensure that effective colour contrast is maintained when using colours.
- Ensure Audio Visual Content conveys meaning through storyline as well, rather than only visually, and is supplemented by Audio Description tracks whenever necessary.
- Ensure if content uses CAPTCHA for access, then all CAPTCHA is voice enabled and vision enabled.

The technical standards by which the above features are incorporated in e-content have already been highlighted in Section 2 of this document and hence will not be repeated here.

8.2 Ensuring comprehensibility of content

8.2.1 Pedagogical Guidelines

The biggest challenge to a blind or low vision student in accessing educational content, especially in the pre-primary and primary classes, is the use of visual cues, pictures and images in textbooks and educational material. Many times information is explained purely visually using images. The same challenge is also heightened in sections related to practice exercises. The issue related to giving visual based activities is more in mathematics and science textbooks. There are ways of ensuring that information in textbooks whilst presented visually is supplemented with non-visual content as well to make it accessible and inclusive to all. Presented below are key pedagogical guidelines to keep in mind by all educational writers to make information accessible to students with blindness and low vision.

8.2.1.1 Numbering

Do not leave lists, options, MCQ questions unnumbered. When sighted students are asked to circle/tick/cross right options students with blindness would use numbering system to answer the questions and hence it is always useful to have options numbered.

8.2.1.2 Picture Interpretation Content/Questions/Picture Counting Questions

If the learner is expected to either understand a concept or answer questions based on a picture then alternative textual description must accompany the image. The textual description ideally also need to be accompanied with an instruction file for a sighted assistant on how to create a tactile diagram or how to use 3D models/real objects of the objects shown in the picture to the student with blindness to enhance learning and to answer the question more effectively.

8.2.1.3 Mathematics Content

For students using screen readers, the mathematics content of the books should be presented in MathML format. If the same is presented in non MathML or as an image then it will not be read out by screen readers.

8.2.1.4 Geometry picture Questions

Unlike picture interpretation questions related to objects, for geometry picture questions it is imperative to provide a sighted assistant tactile diagram with an instruction file created to ensure that the student has access to the concept being shown through touch. This is especially critical for younger classes. Alternative textual description can supplement the instruction file but cannot replace it for geometry questions.

8.2.1.5 Labelling based Exercises

Labelling based exercises can be provided with either a sighted assistant instruction file or creating the tactile diagram for the student to solve the question or can be provided with alternative question/s. This will help in evaluating the students' knowledge of the same content being tested through the labelling exercise. E.g. instead of saying label the parts of the human heart, the alternative question could be: state and describe the location of the parts of the human heart.

8.2.1.6 Flow Charts/Tree Diagrams/Bar Graphs

Often the visual representation of information is done to present information in a more summarised and attractive manner for the sighted learner. It is critical that for these Tactile Diagram instruction files are made available for sighted assistants are provided. Further, the same data presented in these charts and graphs needs to be textually presented as a table/multi-level list retaining the same ordering and flow structure as the original image.

8.2.1.7 Activity Based Questions

Learning by doing is critical for learning. Whilst designing activities it is important to ensure that the activity is a multisensory activity, which does not depend only on vision. If there is a pure visual activity, then using the principle of sensory substitution, a note of modifying the activity by use of touch/sound/smell/, along with use of relevant tactile diagrams and 3D models or real objects has to be provided.

8.2.2 Exemplar video developed by Prof. Sujata Bhan and her team²²

<https://www.youtube.com/watch?v=I3RjrwiYOTQ&feature=youtu.be>

²²Ms. Betty Abraham, Asst. Professor, DSE, SNDT WU

Ms. Yukti Gupta, Asst. Professor, DSE, SNDT WU

Ms. Monica Punjabi, Director, Indian Deaf Bilingual Academy, Indore

Mr. Gaurav Verma, Sign language interpreter, Indian Deaf Bilingual Academy, Indore

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SECTION-9 GUIDELINES FOR E- CONTENT FOR STUDENTS WITH DEAFNESS AND HARD OF HEARING (SWDHH)

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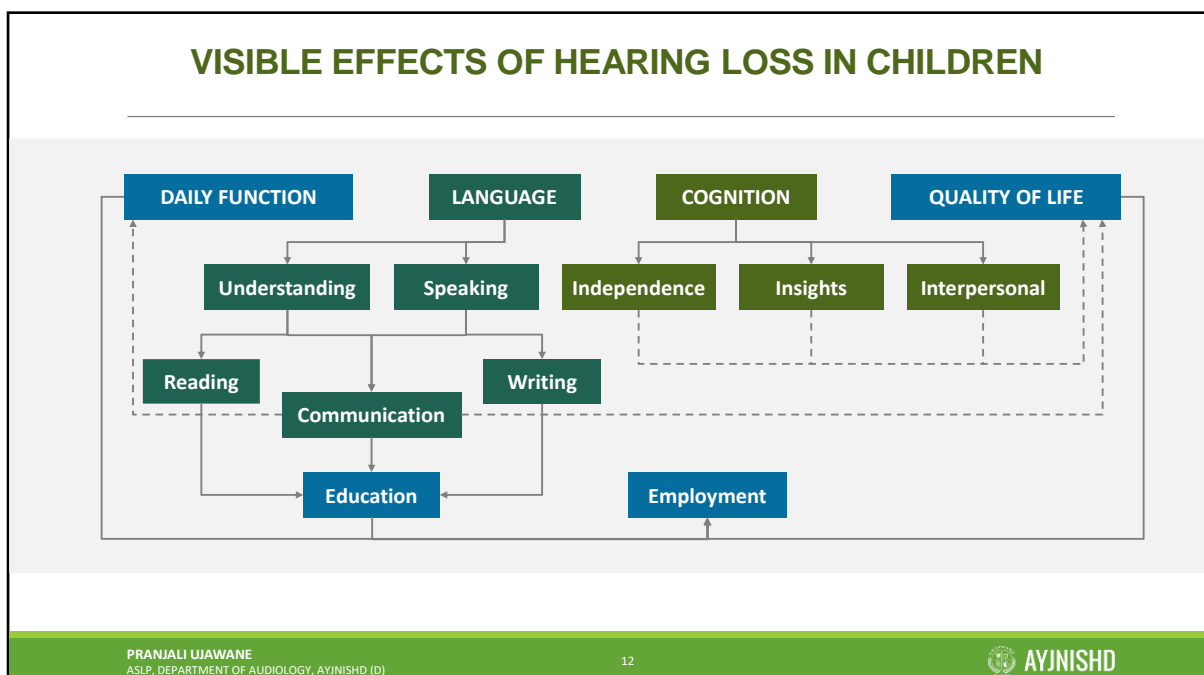
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SECTION-9: GUIDELINES FOR E-CONTENT DEVELOPMENT FOR DEAF AND HARD OF HEARING STUDENTS (DHHS)

9.1 Introduction

The main barriers in educating Deaf and Hard of Hearing Students (DHHS) are that of language, communication and those related to literacy aspects. Deafness, which is usually referred to as an invisible disability, has many visible effects on the overall daily life and lifecycle, as depicted diagrammatically.



The DHHS mentioned in the RPwD Act,2016 are actually two groups, categorised on the basis of degrees of hearing loss. They are referred to as deaf (severe to profound hearing loss) or hard of hearing (moderate hearing loss). It is important to note another important aspect that the DHHS as a group may be very heterogeneous due to many other aspects. Depending upon the age of onset of their deafness, parental hearing status, philosophy that the family and the school believes in and the learning styles, along with the choices of the student themselves, there could be following preferences that DHHS may exhibit:

- Use of Indian sign language (ISL),
- Speech/lip reading,
- Speech and auditory,
- Print or reading,
- Air writing, and
- Multi modal style.

Hence the e-content may also be required in various forms, such as:

- Video lectures with option of sign language and or captioning inserts,
- Audio podcasts,
- Virtual labs,
- Simulations,
- e-Books, and
- Live virtual classroom.

9.2 Guidelines for Deaf learners (sign language users)

9.2.1 General Guidelines for Content Production.

9.2.1.1 Introductory video: This may include –

- **Recapitulating related information,**
- **Current topics and subtopics,**
- **Objectives, and**
- **Outcome expected from the learners.**

9.2.1.2 Summary Video

Video should highlight the summary of each sub topic.

9.2.1.3 Glossary

This may include words with meaning and relevant examples for deaf learners to provide clarity on key concepts. Synonyms also to be shared. Grammatical concepts need to be highlighted and explained with suitable examples, wherever possible.

9.2.1.4 Check your progress

This may be done in between to ascertain the learners pace and level of understanding.

9.2.1.5 Self- assessment element

This can be done through activities (simple assessment - subjective / objective) after completion of each sub unit / module or in some cases after explanation of each concept.

9.2.1.6 Content may have relevant day to day examples from daily life.

9.2.1.7 Use of graphics and visuals must be balanced

Too many graphics, besides distractions, may also adversely affect reading comprehension. Visuals should be clear and uncluttered in the video frame.

9.2.1.8 E-content for younger classes could have intonational markings for enhancing reading skills such as:


- Phrasing or syllable marking,
- Emphasising words marking,
- Poems with hyperlink for video, and
- Story characters with speech balloons & thinking clouds.

9.2.2 Other Requirements of Deaf students

- ISL video content with subtitles / captions
- Vocabulary list
- Self-assessment through exercise / comprehension styled questions

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SECTION-10 SUMMARY OF RECOMMENDATIONS

Professor Anupam Ahuja

SECTION-10: SUMMARY OF RECOMMENDATIONS

10.1 Purpose of this Section

This section may be widely shared with content creators, content designers, developers, publishers and E-Distributors already engaged or likely to be engaged for developing, uploading and distributing e-content. The recommended forms of e-content are:

1. Accessible Digital Text books (ADTs) for ALL children
2. Supplementary learning material and
3. Sign Language videos

Standards and guidelines for the development of Accessible Digital Textbooks and supplementary learning material are detailed out in this section. Technical standards and guidelines for production of Sign Language videos are given in Appendix-1.

10.2 Standard and Guidelines for Development ADTs for ALL

10.2.1 Features of Accessible Digital Textbooks for ALL

The Accessible Digital Textbooks should be developed on the basis of UDL approach and thereby broadly comply with its three basic principles, namely;

1. Content in ADTs to be provided in multiple formats (text, audio, video, SL etc) so that it is perceivable and comprehensible by all students, including children with varied disabilities.
2. ADTs should provide flexibility to the students to respond to its content/exercises in multiple ways.
3. ADTs should provide multiple means of engaging attention of the students to the content and make it an enjoyable experience.

The technical features as suggested by UNICEF²³ for the development of ADTs are tabulated below. However, these are not sacrosanct and can be customised according to local conditions, and discussions with technical experts of digital publishing.

The final refinements will need to be made based on getting feedback from students and teachers on the prototypes:

²³ As suggested by UNICEF based on its experience of developing ADTs

Function	UNICEF Suggested Features
Mandatory	
Opening Menu	All multi-media functions must be provided in opening menu, from which a student can choose his/her individual preferences and create a profile. The menu should have an optional sound, vibrations, sign language video and voice feedback.
Memory	The software should be able to store such information as preferences, layout and answers to exercises, and to mark where the student last opened the book.
On/off function	All multimedia objects should include an ON/OFF option (for sounds, audio, moving objects, video, etc.).
Navigation	The document navigation must be facilitated with tagging. The text must be tagged with the structure of the book, including headings, page numbers, and the table of contents, the glossary, images, videos, graphs, exercises and references.
Portrait orientation	The screen orientation of the book must be available in both portrait and landscape format. When selected in the menu, the preferred screen orientation should always remain the same to avoid confusion and disorientation.
Subtitles	All audio recordings must be converted into text and videos must have subtitles in local language and subtitles for the deaf and hard of hearing (both ON/ OFF selectable).
Highlighting	The text block must be highlighted when the user browses with a mouse or finger and when the narration reads the text.
Media or visual support	The software must allow pictures, images, graphics and videos to be inserted.
Narration (text to speech)	A narration of all the text in the book must be available, including headings, page numbers, titles and references. The text must be synchronized with the narration. Ideally, the recording should be made using human voices, with local accent and vocabulary.
Vibration feedback	Vibration feedback must be available to acknowledge a user command for an operation, such as to acknowledge an answer or to confirm that a key has been pressed on the screen, or for feedback prompting the end of an action.
Audible feedback	Audible feedback must be available to acknowledge a user command for an operation, such as to acknowledge an answer or to confirm that a key has been pressed on the screen, or for feedback prompting the end of an action.
Audio description	Audio descriptions must be available for the user to access descriptions when required, such as for videos, images, pictures or graphs.
Narration	Ideally, the recording should be made using human voices, with local accent and vocabulary.
Drag and touch functions	The user should be able to drag a finger around the interface and hear the content on the screen (with or without vibration). The user should also be able to point/click without dragging.
Adjustable positioning of the	The user should be able to position the video where desired on the screen.

Function	UNICEF Suggested Features
video	
Adjustable video size	Three sizes of the window—small, medium, large— should be available in the settings.
Subtitles for deaf and hard of hearing	All audio materials must be accompanied by transcript and video materials must be accompanied by subtitles for the deaf and hard of hearing.
Synchronization	
Synchronized video with a sign language teacher/narrator who is fluent or a native deaf signer	A video of a local sign language teacher/narrator must be included next to the corresponding text, word, image or paragraph; the sign language interpreter should be fluent or a native deaf signer who signs the content of the text or the activities in local sign language, with voice-over and subtitles (with visible/non- visible options).
Synchronized video	A video synchronized with the text, the image, the exercise or the graph must be available next to the corresponding reference. The size and positioning of the window on the screen should be adjustable. Subtitles in the local language should be part of the video (so they move along with the video).
Synchronized narration	The narration must be synchronized with the text for the headings, page numbers, titles and references. The audio description should be synchronized with headings, page numbers, the table of contents, the glossary, images, videos, graphs, exercises and references.
Synchronized video and audio narration	The narration and sign language video, if both are enabled, should synchronize by paragraph by waiting for the longest media element to finish playing before continuing.
Text adjustment	Adaptable fonts (upper/lower case), changeable colours, background contrast, line spacing, space between words and a simple uncluttered layout with zoom functions are all attributes that must be available to make the content more usable.
Standard size of interactive items	All interactive buttons, images or icons should be at least 9 mm by 9 mm. All touch targets should be surrounded by an inactive space in a contrasting colour.
Speed control of interactive features	The user should be able to adjust the speed of all interactive features, such as videos and screen elements.
Glossary	The textbook must have a glossary with options to access the definitions: text, icon/symbol, and audio, narration of the word, phonetic spelling and sign language video.
Future Enhancements	
Interactive support	The software should allow interactive inputs.
Voice recognition	The software should allow voice recognition that converts spoken words into typed text.

10.2.2 Technical Standards to be complied with by all e-content

Item Type	Standards/Guidelines	Automated Tool for Testing
Digital Text – File Format	EPUB	ACE: https://inclusivepublishing.org/inclusive-publishing-hub-resources/
Image Description	Diagram Centre Image description http://diagramcenter.org/table-of-contents-2.html	MS word accessibility checker, ACE and WCAG validators will detect absence of alternative text of images.
Fonts for Indian languages	Unicode Standard 13.0. http://www.unicode.org/versions/Unicode13.0.0/	NA
Audio Books	DAISY (https://daisy.org/activities/standards/daisy/)	DAISY Validator (https://inclusivepublishing.org/inclusive-publishing-hub-resources/)
Video Content	WCAG 2.1 with AA mandatory and AAA recommended https://www.w3.org/WAI/media/av/	AXE (https://www.deque.com/axe/) Accessibility Insight: https://accessibilityinsights.io/ Accessibility Scanner: https://support.google.com/accessibility/android/faq/6376582?hl=e https://support.google.com/accessibility/android/faq/6376582?hl=en
Web Framework and Structure for both Web Pages and Mobile App	WCAG 2.1 with AA mandatory and AAA recommended (https://www.w3.org/TR/WCAG21/)	AXE (https://www.deque.com/axe/) Accessibility Insight (https://accessibilityinsights.io/) Accessibility Scanner https://support.google.com/accessibility/android/faq/6376582?hl=e https://support.google.com/accessibility/android/faq/6376582?hl=en
Uploading Structure System	WCAG 2.1 compliant tools (https://www.w3.org/TR/WCAG21/)	AXE (https://www.deque.com/axe/) Accessibility Insight https://accessibilityinsights.io/ Accessibility Scanner https://support.google.com/accessibility/android/faq/6376582?hl=e https://support.google.com/accessibility/android/faq/6376582?hl=en
Metadata Scheme Format	E-content format - Schema.org	AXE https://www.deque.com/axe/ Accessibility Insight; https://accessibilityinsights.io/ Accessibility Scanner https://support.google.com/accessibility/android/faq/6376582?hl=e https://support.google.com/accessibility/android/faq/6376582?hl=en

10.2.3 Guidelines for Creating Accessible EPUB 3 Files

Guidelines for creating accessible EPUB 3 files can be accessed at:

<https://drive.google.com/file/d/1w4886Wcgy1SxnbtzO88wiGJBFgCJUaRt/view?usp=sharing>

10.2.4 Learn my way Demo-Prototype of UDL proof of concept

The '[Learn My Way](#)' (click on the link to view) reader prototype is a proof-of-concept shared by UNICEF that demonstrates adaption of English translation of the textbook for Grade 1 learners in Brazil into Accessible content for All children on UDL principles.



10.2.5 ADTs-Content Adaption, Pedagogical and Easy to Read Guidelines

Content conceptualization and writing process precedes the content production process. How an author explains a concept determines its degree of comprehensibility to diverse group of learners, including students with disabilities. Thus, to create accessible content, compliance to technical features and standards as presented above needs to be complemented by content adaption and pedagogical guidelines. **The complete set of UDL guidelines in this regard are given in the Appendix-1. A summary of salient guidelines based on the experience of the sub-committee are given below.**

10.2.6 Content Adaption and Pedagogical Guidelines

- At the beginning of each section/topic provide an introduction to the topic in the mother tongue/dominant language and sign language to arouse curiosity and make reading interesting.
- Provide instruction on “how to use” (preferably both in mother tongue/dominant language and ISL).
- Acronyms should be avoided whenever possible.
- Explain new concepts in multiple ways- diagrams with text, graphs with text, interactive models with text, text, flow charts, decision trees etc.
- Provide descriptive hyperlinks to access to additional information when the internet is available.
- Numbers should be written with commas as separators for ease of reading.
- Provide a glossary linked to specific words so that children can quickly access content. Ideally, these words should be provided aurally, in sign language and phonetically. Images and symbols should be included to help describe new words as much as possible.
- Icons should include a clear explanation of their meaning and appear in the glossary.
- Offer alternative exercises by creating exercises that are accessible for all.
- Provide links to additional information with descriptions.
- Use a consistent layout throughout the content.
- Step by step instructions should be given for attempting the exercises.

- Provide linkage between the textbook concepts and activities by showing images that support the purpose of the activity.
- Use a variety of exercises (True-false/MCQ/drag and drop etc.) to allow children to demonstrate their understanding of the content.
- All pages should have unique TITLES to assist screen readers as well as search engines, apart from the normal user.
- All pages should have META TAGS (Keywords and Description) related to that page.
- Clear heading structure (H1, H2 and H3) should be maintained. This helps the visually challenged user to quickly scan the main content heads of the page. There should be only one H1 tag on a page.
- Always use optimised images. Images can be optimized by using image editing software.
- Page should have a clear contrast between foreground and background.
- A "Skip to Content" link must be provided at the top of the page. This helps the user to directly go to the main content of the page, bypassing repetitive sections like page header, navigations etc.
- All functionality of the content, like links, menus, forms etc. should be operable through a keyboard interface, as the visually challenged cannot use the mouse.
- Tables must not be used for layout and presentation purposes. When used for representing data, tables should be provided with proper header row and captions and the data items should flow left to right, one line at a time.
- Frames should be avoided while designing a webpage as frames cannot be easily read by the visually impaired. When used, frames should be titled with text that facilitates frame identification and navigation.
- Attributes of colour, shape and size must not be used to represent information, as these would make the content inaccessible to the visually challenged. For example, we should avoid using statements like "All the text written in red are mandatory".
- All script function should include a NO-SCRIPT tag for those browsers or assistive technologies that do not have script support.
- Enough time should be provided to user to read and interact with content. In case, content is time-based, same should be informed to the user in advance.
- Content must be written from layman's perspective and the language must be simple and free from errors.
- Multi-lingual versions of the sites must be in sync with each other.
- Website must work well in all the major browsers.

10.2.7 [Easy to Read language](#)

Easy-to-read language²⁴ can substantially reduce the reading problems of persons with intellectual/cognitive disabilities, as well as those who suffer from various learning or reading disabilities, including dyslexia. **An accessible textbook in simple language can be a positive experience for anyone to read.** Follow the simple tips below while adapting printed textbooks into ADTs. The full set of guidelines can be accessed by clicking on the link above.

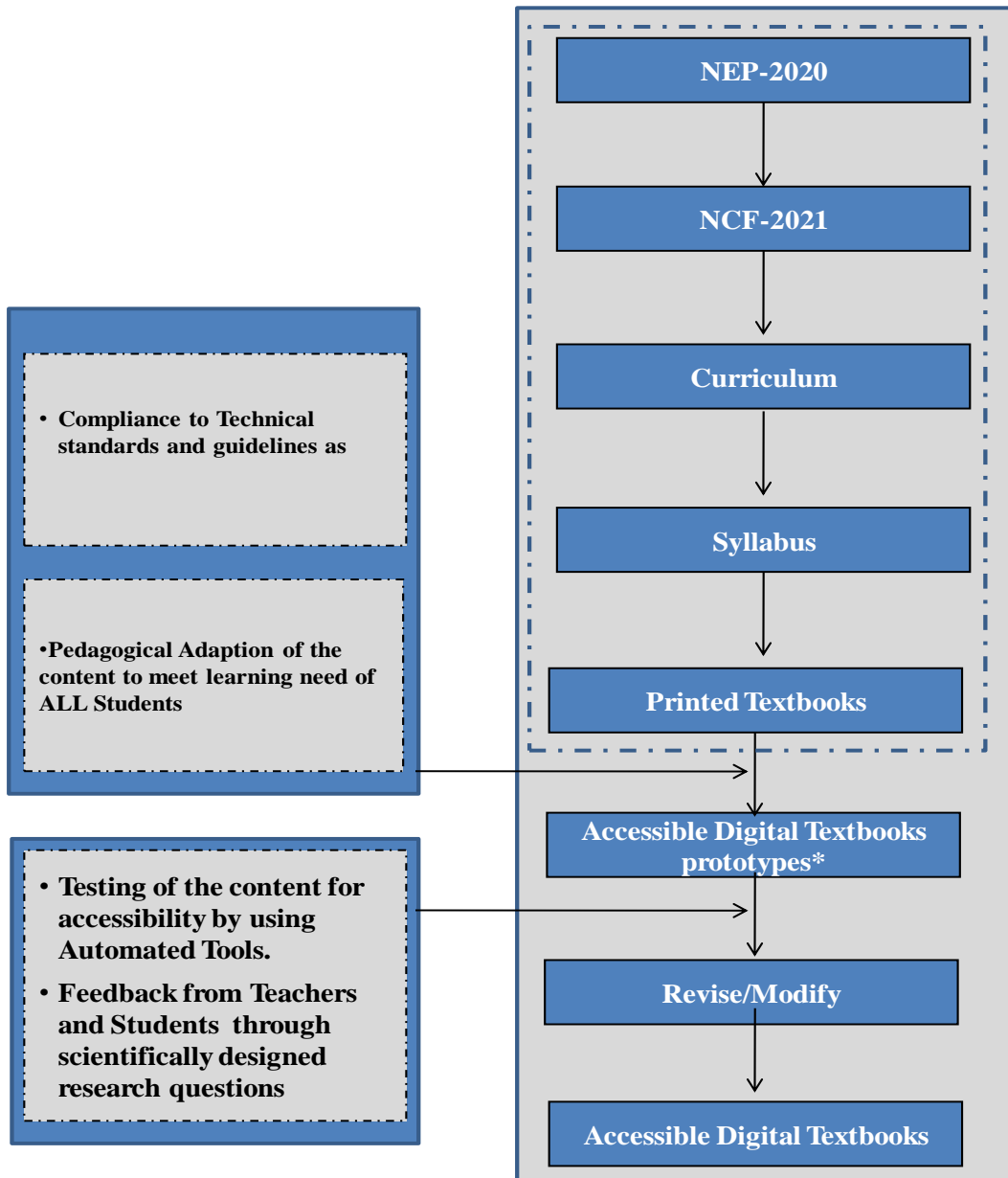
- **Avoid abstract language.**
- **Be logical**-the action should follow a single thread with logical continuity.
- **Action should be direct and simple**, without a long introduction and involvement of too many characters.
- **Use symbolic language (metaphors) sparingly.**
- **Be concise**-avoid several actions in a single sentence. Arrange words in a single phrase on one line, if possible.
- **Explain or describe complicated relationships in a concrete and logical manner**, where events take place in a logical chronological framework.
- Content creators should keep in mind that the users of the content must be informed about what it means to have reading difficulties. Let them meet their readers and hear about their experiences and daily life.
- **Test the material with actual target groups before it goes for publication.**

10.2.8 [AYJNHH Guidelines for Adaptation of School Textbooks](#)

The department of Education of AYJNHH had developed a prototype for adaption of school textbooks for meeting the learning needs of children with disabilities. The material can be accessed by clicking on the link above. The relevant tips may be complied.

²⁴Adapted from 2010© International Federation of Library Associations and Institutions. IFLA Professional Reports, No. 120, Guidelines foreasy-to-read materials, Revision by Misako Nomura, Gyda Skat Nielsen and BrorTronbacke on behalf of theIFLA/Library Services to People with Special Needs Section

Recommended Process for Developing Accessible Digital Textbooks



* Prototype Accessible eTextbooks of a few selected books can be developed and tested from existing textbooks

10.3 Guidelines for the Development of Supplementary e-content²⁵

The detailed guidelines for the development of supplementary material to be developed for students with varied disabilities are presented in **Sections 6 to 10** of this document. A summary is tabulated below:

Type of Content	Students with Deafness and Hard of Hearing	Students with Blindness and Low Vision	Students with SLD	Students with ID, ASD, MD	Common for ALL, including students with Physical disabilities
Video Content	Indian Sign Language (ISL) or Captioning	Audio Description for the Visual Element of the content not conveyed in the dialogues	NA	NA	ISL, Captioning and Audio Description
Audio Books	Indian Sign Language or Captioning	Effective navigation and browsing as per DAISY standards listed in the earlier table	Captions to read along		ISL, Captioning and Effective navigation for browsing.
Images/Pictures/Visual Explanation of Concepts	NA	Provide instructional files for sighted assistants to create tactile diagrams for the images/Use of 3D Models/Real life images to explain the image + Alternate Textual description of image (Image Description)	Non Cluttered Images	Non Cluttered Images	Non Cluttered images with instructional files for sighted assistants to create tactile diagrams for the images/Use of 3D Models/Real life images to explain the image + Alternate Textual description of image (Image Description)

²⁵ These guidelines are compiled by Ms. Neha Trivedi, Consultant, Xavier's Resource Centre for the Visually Challenged

Type of Content	Students with Deafness and Hard of Hearing	Students with Blindness and Low Vision	Students with SLD	Students with ID, ASD, MD	Common for ALL, including students with Physical disabilities
Speech and Language Style	Clear and Medium Paced (Not too fast) Tutor to speak looking straight	NA	Medium pace with adequate repetition of concepts	Medium pace with adequate repetition of concepts Simple, Direct, Precise and Logical Language Uncomplicated sentence construction but not childish.	Speed & Style: Medium pace + Tutor Speaking by looking staring + Adequate repetition of concept + Language: Simple, Direct, Precise and Logical Language Uncomplicated sentence construction but not childish.
Type of Content Preferred	Multisensory – ISL + Close Caption + Audio	Multisensory- Tactile + Audio + Visual With screen reader access	Multisensory – Audio + Visual	Multisensory _ Audio+ Visual+ touch	Multisensory – Tactile (Instructional files for sighted assistant to create tactile material for students with blindness) + Audio + Visual with screen reader access for textual material
Ordering and Presenting of Content	NA	Structured with appropriate heading levels and navigation Graphically organized information to be presented as tabular/multi-level list based information	Structured Content Broken into smaller chunks Uncluttered with limited info on each screen to prevent distraction	Structured Content Broken into smaller chunks Simplified. Move from concrete to abstract Uncluttered And clean with	Structured with heading levels Broken into smaller chunks Uncluttered and clean with limited information one each screen Simplified with

Type of Content	Students with Deafness and Hard of Hearing	Students with Blindness and Low Vision	Students with SLD	Students with ID, ASD, MD	Common for ALL, including students with Physical disabilities
		Any bulleted and points based information to be numbered	Presenting information at bullets, points, graphic organizers	limited info on each screen to prevent distraction Presenting information at bullets, points, graphic organizers	moving from concrete to abstract Graphically organized with supplementary tabular and multilevel list representing the graphics when the former is not screen reader accessible Bulleted/point based information, which are numbered.
Interactive Activities with the lessons	With Audio, ISL and Captioning	Tactile and sound based activities	Spell checks, Grammar Checks, Word Building Frequent memory check exercises	Activities to help student environmentally contextualize the concept learnt Frequent memory check exercises	Activities that enable memory check, environmentally contextualize Activity that enables word building, spelling and grammar checks Activities that are multisensory – audio, tactile and not using any one sense in isolation to complete the same.
Types of Exercises/evaluations	NA	Instruction for sighted assistant to make tactile material for visual exercise + Alternative	Options between oral and written submissions	Option to respond in multiple modes	Multiple methods of testing and

Type of Content	Students with Deafness and Hard of Hearing	Students with Blindness and Low Vision	Students with SLD	Students with ID, ASD, MD	Common for ALL, including students with Physical disabilities
		non visual question to test the same knowledge.			

The videos and audios should comply with technical standards as specified in 12.1.2 above.

As advocated by PARIVAR²⁶, supplementary material may be developed related to:

- Skills relating to personal adequacy in daily living
- Communication and language development
- Literacy and simple arithmetic skills
- Self-awareness, including needs and emotions of oneself and others
- Self-discipline and appropriate social conduct
- Awareness about physical and social environment
- Psycho-motor coordination
- Cognitive functions
- Vocational/Employment related skills
- Development of interest/hobby areas
- Vocational training should begin from the age of 14 and its preparation in earlier years.

Further suggestions of PARIVAAR as submitted by them to MoE can be assessed at:

<https://drive.google.com/file/d/1dURpKyksO6Tw4kWdTcXOLdd-CmYwpOjw/view?usp=sharing>

10.4 Guidelines for production of Sign Language Videos

Guidelines for production of Sign Language Videos are presented at **Appendix-1**.

²⁶ National Confederation of Parents' Organisations For Persons with Intellectual and Developmental Disabilities

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SECTION 11
SUGGESTIONS
AND
IMPLEMENTATION
ROAD MAP

Professor Anupam Ahuja

SECTION 11: SUGGESTIONS TO IMPROVE COMPLIANCE TO ACCESSIBILITY AND IMPLEMENTATION ROAD MAP

11.1 Purpose of this Section

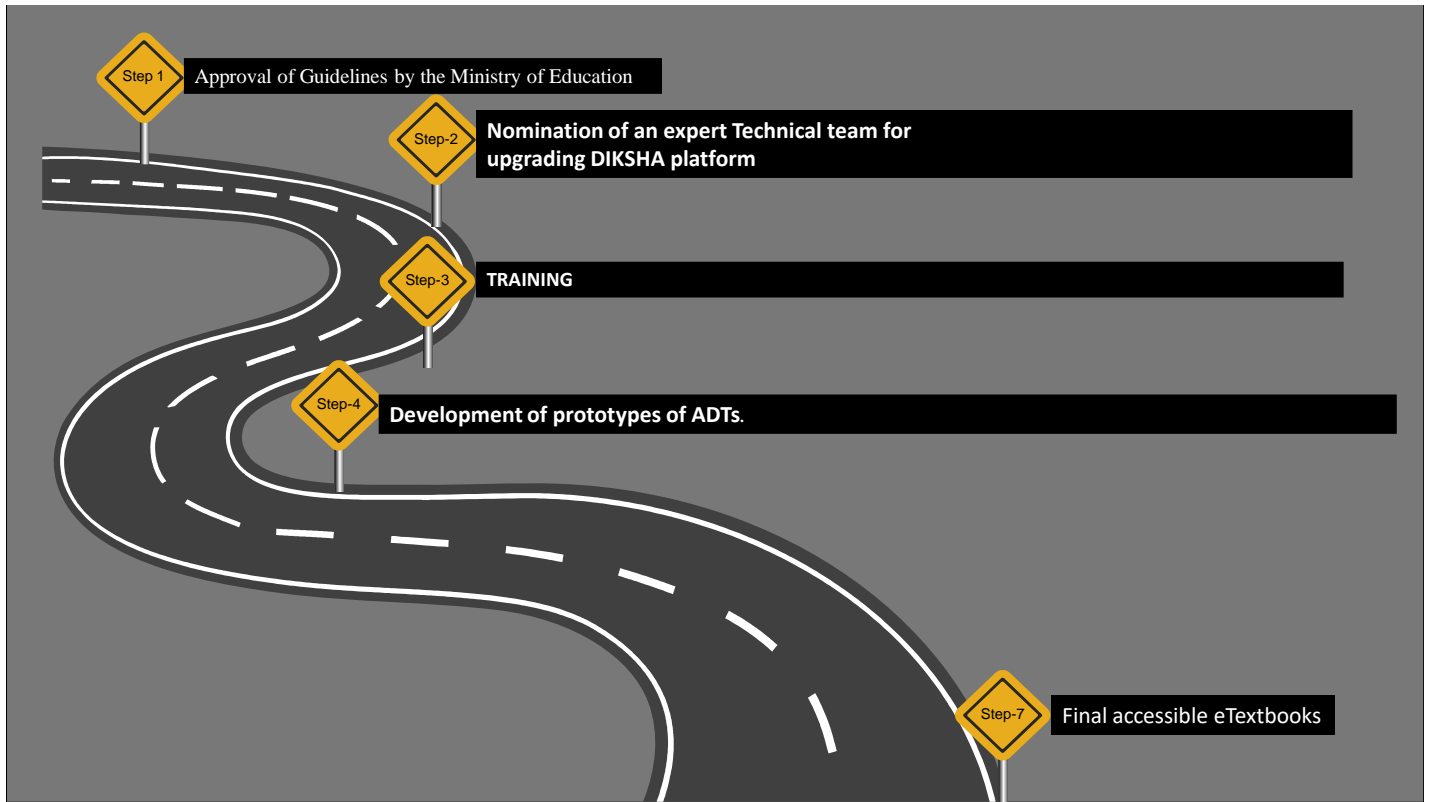
This section is for the perusal of Ministry of Education for improving compliance to accessibility standards. It also provides an implementation road map.

11.2 Suggestions to enhance accessibility compliance

- It may be ensured that all websites, mobile apps as highlighted in Section 1.3 are checked for compliance with GIGW accessibility Guidelines and obtain Website Quality Certification from STQC.
- Under PM VidyaDaan, experts, teachers, individuals and organizations are being encouraged to upload content on DIKSHA. It is recommended that before uploading content, its quality and accessibility be validated. UGC Guidelines for e-content development provide for the constitution of an Expert / Peer Committee to meet periodically to scrutinise e-content proposals. A similar or another suitable monitoring mechanism may be put in place for uploading content on DIKSHA.
- The users feedback as highlighted at Section 1.7 regarding accessibility issues and suggestions may be looked into, and shortcomings be addressed expeditiously.
- Post approval of New Curriculum Framework (NCF), which is likely in 2021, existing textbooks will need to be revised. It is recommended that the content for new textbooks may be designed in a manner, which becomes accessible for students with disabilities.
- As mandated in National Policy on Universal Electronic Accessibility, 2013, accessibility standards, guidelines and orientation to Universal Design of Learning may be included in ICT curricula for students and also form a part Teacher's Training Modules under NISHTHA.
- As mandated in RPwD Act 2016, all contents available in audio, print and electronic media must be in accessible format and Persons with Disabilities must have access to electronic media by providing audio description, sign language interpretation and close captioning.
- GIGW manual may be uploaded on all educational portals under administrative control of MoE for creating awareness, so that the content developed by individuals, NGOs and organisations at least complies with the mandatory GIGW accessibility guidelines.
- Advisory may be issued that before uploading new content on DIKSHA accessibility may be validated using above validation tools.
- Create E-Modules for Training content developers and curators to understand how to create and curate accessible content. Further, make it mandatory for all content developers and curators to go through the training modules.
- Awareness sessions and workshops related to accessibility, assistive technologies and PWDs should be arranged for system development and design teams.

- Technical training sessions related to international accessibility standards and GIGW should be arranged for core development and design team.
- Post NCF 2021, textbooks are likely to undergo major revision. The new textbooks may be published in accessible digital format *ab-initio* so that they are ‘born accessible’.
- The module on accessibility may be included in all Teachers’ Training programmes.
- An accessibility rating for all content uploaded on platforms may be done. The curating process should have an inbuilt system of reviewing the content on accessibility and giving a rating. Each content uploaded on the portal should have accessibility rating in the range of 1 to 5, where 1 is poor and 5 is excellent. The ratings should be derived from the combination of automated accessibility evaluation tools and manual human audit results.
- At the user’s end, by including metadata on accessibility, enable filtering of content based on accessibility features for end users to locate accessible content on the portal. Powerful and swift search mechanisms must be designed for filtering the content based on its type [PDF, EPUB, multimedia], accessibility ratings, suitability etc.
- Since projects are floated on DIKSHA portal, include the criteria of Accessible content in the project brief at the project generation stage.
- Each uploaded content should have dedicated feedback area where students and teachers can share their experience after using the content.
- Create a system for regular user testing of DIKSHA Platform by student with disabilities in partnership with national institutes and NGOs. Results of the same to be integrated by the portal development team and content rating system.
- Implementation Create E-Modules of training content developers and curators to facilitate understanding how to create and curate accessible content. It should be made it mandatory for all content developers and curators to go through the training module.
- Awareness sessions and workshops related to accessibility, assistive technologies and PwDs should be arranged for system development and design teams.
- Technical training sessions related to international accessibility standards and GIGW should be arranged for core development and design team.

11.3 Implementation Road map



11.4 Implementation Gantt Chart

Activities	Start	End	Duration (Days)	
Approval of Guidelines by MoE	4-Nov-20	3-Feb-21	91	
Submission of draft report	4-Nov-20	4-Nov-20	1	
Review and comments on draft report by committee members	4-Nov-20	4-Dec-20	30	
Incorporation of comments	4-Dec-20	3-Jan-21	30	
Submission of final report to MoE	3-Jan-21	4-Jan-21	1	
Approval of Guidelines by MoE	4-Jan-21	3-Feb-21	30	
Nomination of an expert Technical team for upgrading DIKSHA	3-Feb-21	4-May-21	90	
Creation of Schema.org scheme for Metadata	3-Feb-21	5-Mar-21	30	
Set up Accessibility tool testing pipeline within the DIKSHA content	5-Mar-21	4-Apr-21	30	
Create Accessibility Rating system for content creation with	4-Apr-21	4-May-21	30	
TRAINING	3-Feb-21	24-Apr-21	80	
Training of DIKSHA Technical team on accessibility	3-Feb-21	13-Feb-21	10	
Awareness training of DIKSHA Content team in accessible	13-Feb-21	15-Mar-21	30	
Creation of E Modules for content creators in creating accessible	15-Mar-21	14-Apr-21	30	
Distribution of the E Modules to content creators through the	14-Apr-21	24-Apr-21	10	
Development of prototypes of ADTs	24-Apr-21	16-Oct-21		
Nomination of multi-disciplinary teams comprising of Subject	24-Apr-21	4-May-21	10	
Short listing of one book each from Language, Social science and	4-May-21	19-May-21	15	
Adaption of content on UDL principles	19-May-21	18-Jun-21	30	
Creating of prototypes of one book each.	18-Jun-21	16-Sep-21	90	
Testing of prototypes	16-Sep-21	16-Oct-21	30	

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APPENDICES

APPENDIX-1 : GUIDELINES FOR PRODUCTION OF SIGN LANGUAGE VIDEOS

11.4.1 Proficiency of Content Signers

The content signers (deaf or interpreters) must be proficient in sign language skills with following:

- Be evaluated by ISLPT (Indian Sign Language Proficiency Test)
- Be approved by ISL experts.
- Deaf signers must possess the required qualification of DTISL and have good native sign language skills. Experience in teaching is desirable.
- Hearing interpreters shall be engaged to work with the Deaf Signers to support in content planning, content scripting and voiceover.
- Indian Sign Language (ISL) shall be the medium of expression in the e-content.
- Following the linguistic parameters of ISL (ISL Grammar). the voiceover and captioning can be created in any language based on the requirements of the learners (English or regional Languages).

11.4.2 Recording of videos

❖ Lighting

- Signer must have adequate lighting placed- overhead, left and right.
- Use of adjustable stands required to align the light effect to avoid light glare on Signer and reduce shadow.
- Use of white reflector to remove the dark effect from under the eyes, neck area of the Signer.
- Soft lights are preferred. Can use white screen (umbrella) to create a soft light effect.

❖ Screen Colour and distance from screen

- Green screen to be used behind the signer at all time. This is required for effective editing of the content and to incorporate visual graphics.
- Blue Screen to be used only if the content requires a background of night or late evening.
- Signer to stand at a distance from the green screen to avoid shadow.

❖ Camera Placement

- To be placed to be at eye level.
- Signer must look directly into the camera (avoid diagonal camera placement).
- Placement of camera required at eye level.
- Signer must be in the centre of the frame at all times.
- Signer needs to be captured from above head level to waist level in standing position. (refer point 5 for Signing Space below)

❖ **Signing space**

- The Signer needs to maintain signing space while recording. This is required to provide sufficient frame space for sign language direction, placement of objects in the frame and production of spatial descriptions.
- Signer requires 10 inches above head space,
- 15 inches each on left and right side of the Signer to avoid signing being cut off from the video frame.

❖ **Dress Code**

- Signer to avoid green colored clothes during recording.
- Plain clothes with no print required.
- The shirt / dress should be in contrast to skin colour.
- Fair complexioned Signer to wear dark colours — blue, black, grey, etc.
- Dark complexioned Signer to wear light shades — preferred pastels.
- Avoid shiny dangling jewellery / accessories (male / female).

11.4.3 Technical Aspects

- Video Resolution : 1920 x 1080 full HD
- Pixel - 1.0
- Display format — 25 FPS time code
- Audio (voiceover) - 48000Hz
- Graphics - still visuals) - 640 x 480
- Graphics to be placed at left side of the frame.
- Signer to be placed at right side of frame
- Graphics should not overlap / obscure the Signer Sign Language production.
- Background of video to be of dark but not distracting and non glossy finish to avoid glare and distraction in the video.
- Mixed graphics (still visuals and moving video clips) should not be used at the same time in the frame.

11.4.4 Voice over Audio-only (e.g., podcast)

For hard of hearing students who are not sign language user's voice over could be used:

- For pre-recorded: comply to WCAG 2.1 AA guidelines
- For live: Comply to WCAG 2.1 AA guidelines

11.4.5 Captioning & Subtitles

This is useful for print learners, sign language users as well as hard of hearing students. Various technologies are available for captioning. C-Print (Speech to text) and CART (Communication access real time translation) are the most popular tools with software and hardware, used in the USA and UK respectively (Fang, H., et al., 2015). In India CDAC-Pune is in the final process of designing and developing the tool for all Indian languages, in collaboration with AYJNISHD (D).

11.4.6 Guidelines and Features for Captioning

The following are the features of good captioning framework by Association of National Advertisers (ANA) that should be considered for inclusion in all captioning of various features in a digital video to ensure good quality closed captioning to meet the demand of captioning in India to promote accessibility to all and universal design in digital media application for education purposes.

❖ **Words**

- No deletion of letters during captioning [even if the words are very obvious in a conversation e.g.: Gn for good night, School Bell rin...]
- Inclusion of all spoken words verbatim and no paraphrasing while captioning.
- A 100% accuracy rate in captioning is a must, for expressing the concept of any particular sound described in text.

❖ **Music**

- Inclusion of the words (lyrics) for all music.
- Description of the type of music when the music does not have words, e.g., dramatic music.

❖ **Sounds**

- Identification of all sound effects.
- Inclusion of all different types of exclamation sounds such as ‘Yeah’, Yup, ‘Chee’, ‘Shooo’ ‘ums’. However, the captioner should not make editorial decisions. It is significant to provide textual information about various types of sounds in an appropriate manner or through pictograms [Example ♪ for music, or reduced sound↓] CDAC-Pune has developed for India.

❖ **Conversations**

- Inclusion of background conversations.
- Identification of the speaker when he/she not visible.
- Identification of the speaker with upper case and a colon without parentheses.
- For example, MARTIN: Yes, I want dinner.

❖ **Synchronization**

- One or two lines of captions are timed to appear simultaneously with, or just before, the utterance of the first word presented and disappears after the last word is uttered in the caption segment.
- Logical caption division is not sacrificed for exactitude in timing.
- Captions may be timed to change with shot changes for readability and aesthetic purposes.

❖ **Synchronization with Indian Sign Language**

- Captions for ISL should be timed to change with shot changes for readability and aesthetic purposes. This means one should not try to caption the dialogues or narration on a television screen, which has ISL inserted for the Viewers who are persons with Deafness.
- Whenever ISL signer/interpreter is there on the screen, the caption should match the signer/interpreter and not the speaker or narration on the television screen.

❖ **Caption Placement on a screen**

- Captions placed where they do not obscure information relevant to understanding
- Alternatively, enjoying a commercial, such as people's faces or descriptive banners.
- Captioning placed in the position of the speaker's location when there are multiple speakers on screen.

However it may be noted that on YouTube the closed captioning 'CC' can be shifted to the advantage of the viewer, as it using srt file on line number 21 for translation engine enhancement.

❖ **Captioning Style**

- Use of mixed case letters. Digital television screens now permit the adjustment of
- Font size. Updated software no longer delete the descenders' of letters such as "g"
- Or "q." Therefore, upper case should not be used exclusively.
- Use of pop-on instead of roll-up format.

❖ **Pausing of Captions**

- Adding of a clearing pulse at the beginning of a group of captions and a release at the end to let the next wave of captions pass unencumbered.
- During duplication and subsequent distribution, the captions should pass through intact with the video.

❖ **Fonts used for of Captions**

- The fonts used ideally for a good caption is 'Arial' to avoid clutter in reading which occurs due to serif [TIMES ROMAN FONT HAS SERIF].

❖ **Size of fonts used for Captions**

- The size should be 32 in size on a television screen for easy reading it from an appropriate and comfortable distance

❖ **The Captioning Text and its Background colour**

Background colours used for captioning should be easy and comfortable to read. [It could be black fonts on a white background or white fonts on a black background, depending on the scene].

UDL PRINCIPLE: PROVIDE MULTIPLE MEANS OF REPRESENTATION

Learners differ in the ways that they perceive and comprehend information that is presented to them. For example, those with sensory disabilities (e.g., blindness or deafness); learning disabilities (e.g., dyslexia); language or cultural differences, and so forth may all require different ways of approaching content. Others may simply grasp information quicker or more efficiently through visual or auditory means rather than printed text. Also learning, and transfer of learning, occurs when multiple representations are used, because they allow students to make connections within, as well as between, concepts. In short, there is not one means of representation that will be optimal for all learners; providing options for representation is essential.

Guideline 1: Provide options for Perception

Learning is impossible if information is imperceptible to the learner, and difficult when information is presented in formats that require extraordinary effort or assistance. To reduce barriers to learning, it is important to ensure that key information is equally perceptible to all learners by: 1) providing the same information through different modalities (e.g., through vision, hearing, or touch); 2) providing information in a format that will allow for adjustability by the user (e.g., text that can be enlarged, sounds that can be amplified). Such multiple representations not only ensure that information is accessible to learners with particular sensory and perceptual disabilities, but also easier to access and comprehend for many others.

Checkpoints

12.1 Offer ways of customizing the display of information

In print materials, the display of information is fixed and permanent. In properly prepared digital materials, the display of the same information is very malleable and customizable. For example, a call-out box of background information may be displayed in a different location, or enlarged, or emphasized by the use of color, or deleted entirely. Such malleability provides options for increasing the perceptual clarity and salience of information for a wide range of learners and adjustments for preferences of others. While these customizations are difficult with print materials, they are commonly available automatically in digital materials, though it cannot be assumed that because it is digital it is accessible as many digital materials are equally inaccessible. Educators and learners should work together to attain the best match of features to learning needs.

²⁷ Source: <http://udlguidelines.cast.org/>

Display information in a flexible format so that the following perceptual features can be varied:

- **The size of text, images, graphs, tables, or other visual content**
- **The contrast between background and text or image**
- **The color used for information or emphasis**
- **The volume or rate of speech or sound**
- **The speed or timing of video, animation, sound, simulations, etc.**
- **The layout of visual or other elements**
- **The font used for print materials**

12.2 Offer alternatives for auditory information

Sound is a particularly effective way to convey the impact of information, which is why sound design is so important in movies and why the human voice is particularly effective for conveying emotion and significance. However, information conveyed solely through sound is not equally accessible to all learners and is especially inaccessible for learners with hearing disabilities, for learners who need more time to process information, or for learners who have memory difficulties. In addition, listening itself is a complex strategic skill that must be learned. To ensure that all learners have access to learning, options should be available for any information, including emphasis, presented aurally.

- **Use text equivalents in the form of captions or automated speech-to-text (voice recognition) for spoken language**
- **Provide visual diagrams, charts, notations of music or sound**
- **Provide written transcripts for videos or auditory clips**
- **Provide American Sign Language²⁸ (ASL) for spoken English**
- **Use visual analogues to represent emphasis and prosody (e.g., emoticons, symbols, or images)**
- **Provide visual or tactile (e.g., vibrations) equivalents for sound effects or alerts**
- **Provide visual and/or emotional description for musical interpretation**

12.3 Offer alternatives for visual information

Images, graphics, animations, video, or text are often the optimal way to present information, especially when the information is about the relationships between objects, actions, numbers, or events. But such visual representations are not equally accessible to all learners, especially learners with visual disabilities or those who are not familiar with the type of graphic being used. Visual information can be quite dense, particularly with visual art, which can have multiple complex meanings and interpretations depending on

²⁸ In Indian context it will be Indian Sign language (ISL)

contextual factors and the viewer’s knowledge base. To ensure that all learners have equal access to information, it is essential to provide non-visual alternatives.

- **Provide descriptions (text or spoken) for all images, graphics, video, or animations**
- Use touch equivalents (tactile graphics or objects of reference) for key visuals that represent concepts
- Provide physical objects and spatial models to convey perspective or interaction
- **Provide auditory cues for key concepts and transitions in visual information**

Text is a special case of visual information. The transformation from text into audio is among the most easily accomplished methods for increasing accessibility. The advantage of text over audio is its permanence, but providing text that is easily transformable into audio accomplishes that permanence without sacrificing the advantages of audio. Digital synthetic text-to-speech is increasingly effective but still disappoints in its ability to carry the valuable information in prosody.

- **Follow accessibility standards (NIMAS, DAISY, etc.) when creating digital text**
- Allow for a competent aide, partner, or “intervener” to read text aloud
- **Provide access to text-to-speech software**

GUIDELINE 2: Provide options for Language & Symbols

Learners vary in their facility with different forms of representation—both linguistic and non-linguistic. Vocabulary that may sharpen and clarify concepts for one learner may be opaque and foreign to another. An equals sign (=) might help some learners understand that the two sides of the equation need to be balanced, but might cause confusion to a student who does not understand what it means. A graph that illustrates the relationship between two variables may be informative to one learner and inaccessible or puzzling to another. A picture or image that carries meaning for some learners may carry very different meanings for learners from differing cultural or familial backgrounds. As a result, inequalities arise when information is presented to all learners through a single form of representation. An important instructional strategy is to ensure that alternative representations are provided not only for accessibility, but for clarity and comprehensibility across all learners.

Checkpoints

13.1 Clarify vocabulary and symbols

The semantic elements through which information is presented—the words, symbols, numbers, and icons—are differentially accessible to learners with varying backgrounds, languages, and lexical knowledge. To ensure accessibility for all, key vocabulary, labels, icons, and symbols should be linked to, or associated with, alternate representations of their meaning (e.g., an embedded glossary or definition, a graphic equivalent, a chart or map). Idioms, archaic expressions, culturally exclusive phrases, and slang, should be translated.

- **Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners’ experience and prior knowledge**

- **Provide graphic symbols with alternative text descriptions**
- **Highlight how complex terms, expressions, or equations are composed of simpler words or symbols**
- **Embed support for vocabulary and symbols within the text (e.g., hyperlinks or footnotes to definitions, explanations, illustrations, previous coverage, translations)**
- **Embed support for unfamiliar references within the text (e.g., domain specific notation, lesser known properties and theorems, idioms, academic language, figurative language, mathematical language, jargon, archaic language, colloquialism, and dialect)**

13.2 Clarify syntax and structure

Single elements of meaning (like words or numbers) can be combined to make new meanings. Those new meanings, however, depend upon understanding the rules or structures (like syntax in a sentence or the properties of equations) of how those elements are combined. When the syntax of a sentence or the structure of a graphical representation is not obvious or familiar to learners, comprehension suffers. To ensure that all learners have equal access to information, provide alternative representations that clarify, or make more explicit, the syntactic or structural relationships between elements of meaning.

- **Clarify unfamiliar syntax (in language or in math formulas) or underlying structure (in diagrams, graphs, illustrations, extended expositions or narratives) through alternatives that:**
- **Highlight structural relations or make them more explicit**
- **Make connections to previously learned structures**
- **Make relationships between elements explicit (e.g., highlighting the transition words in an essay, links between ideas in a concept map, etc.)**

13.3 Support decoding of text, mathematical notation, and symbols

The ability to fluently decode words, numbers or symbols that have been presented in an encoded format (e.g., visual symbols for text, haptic symbols for Braille, algebraic expressions for relationships) takes practice for any learner, but some learners will reach automaticity more quickly than others. Learners need consistent and meaningful exposure to symbols so that they can comprehend and use them effectively. Lack of fluency or automaticity greatly increases the cognitive load of decoding, thereby reducing the capacity for information processing and comprehension. To ensure that all learners have equal access to knowledge, at least when the ability to decode is not the focus of instruction, it is important to provide options that reduce the barriers that decoding raises for learners who are unfamiliar or dysfluent with the symbols.

- **Allow the use of Text-to-Speech**
- **Use automatic voicing with digital mathematical notation (Math ML)**
- **Use digital text with an accompanying human voice recording (e.g., Daisy Talking Books)**
- **Allow for flexibility and easy access to multiple representations of notation where appropriate (e.g., formulas, word problems, graphs)**
- **Offer clarification of notation through lists of key terms**

13.4 Promote understanding across languages

The language of curricular materials is usually monolingual, but often the learners in the classroom are not, so the promotion of cross-linguistic understanding is especially important. For new learners of the dominant language (e.g., English in American schools) or for learners of academic language (the dominant discourse in school), the accessibility of information is greatly reduced when no linguistic alternatives are available. Providing alternatives, especially for key information or vocabulary is an important aspect of accessibility.

- **Make all key information in the dominant language also available in first languages for learners and in ISL for learners who are deaf**
- **Link key vocabulary words to definitions and pronunciations in both dominant and heritage languages**
- **Define domain-specific vocabulary (e.g., “map key” in social studies) using both domain-specific and common terms**
- **Provide electronic translation tools or links to multilingual glossaries on the web**
- **Embed visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc)**

13.5 Illustrate through multiple media

Classroom materials are often dominated by information in text. But text is a weak format for presenting many concepts and for explicating most processes. Furthermore, text is a particularly weak form of presentation for learners who have text- or language-related disabilities. Providing alternatives—especially illustrations, simulations, images or interactive graphics—can make the information in text more comprehensible for any learner and accessible for some who would find it completely inaccessible in text.

- **Present key concepts in one form of symbolic representation (e.g., an expository text or a math equation) with an alternative form (e.g., an illustration, dance/movement, diagram, table, model, video, comic strip, storyboard, photograph, animation, physical or virtual manipulative)**
- **Make explicit links between information provided in texts and any accompanying representation of that information in illustrations, equations, charts, or diagrams**

Guideline 3- Provide options for Comprehension

The purpose of education is not to make information accessible, but rather to teach learners how to transform accessible information into useable knowledge. Decades of cognitive science research have demonstrated that the capability to transform accessible information into useable knowledge is not a passive process but an active one. Constructing useable knowledge, knowledge that is accessible for future decision-making, depends not upon merely perceiving information, but upon active “information processing skills” like selective attending, integrating new information with prior knowledge, strategic categorization, and active memorization. Individuals differ greatly in their skills in information processing and in their access to prior knowledge through which they can assimilate new information. Proper design and presentation of information—the

responsibility of any curriculum or instructional methodology—can provide the scaffolds necessary to ensure that all learners have access to knowledge.

Checkpoints

14.1 Activate or supply background knowledge (3.1)

Information is more accessible and likely to be assimilated by learners when it is presented in a way that primes, activates, or provides any pre-requisite knowledge. Barriers and inequities exist when some learners lack the background knowledge that is critical to assimilating or using new information. However, there are also barriers for learners who have the necessary background knowledge, but might not know it is relevant. Those barriers can be reduced when options are available that supply or activate relevant prior knowledge, or link to the pre-requisite information elsewhere.

- **Anchor instruction by linking to and activating relevant prior knowledge (e.g., using visual imagery, concept anchoring, or concept mastery routines)**
- **Use advanced organizers (e.g., KWL methods, concept maps)**
- **Pre-teach critical prerequisite concepts through demonstration or models**
- **Bridge concepts with relevant analogies and metaphors**
- **Make explicit cross-curricular connections (e.g., teaching literacy strategies in the social studies classroom)**

14.2 Highlight patterns, critical features, big ideas, and relationships (3.2)

One of the big differences between experts and novices in any domain is the facility with which they distinguish what is critical from what is unimportant or irrelevant. Since experts quickly recognize the most important features in information, they allocate their time efficiently, quickly identifying what is valuable and finding the right “hooks” with which to assimilate the most valuable information into existing knowledge. As a consequence, one of the most effective ways to make information more accessible is to provide explicit cues or prompts that assist individuals in attending to those features that matter most while avoiding those that matter least.

- **Highlight or emphasize key elements in text, graphics, diagrams, formulas**
- **Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships**
- **Use multiple examples and non-examples to emphasize critical features**
- **Use cues and prompts to draw attention to critical features**
- **Highlight previously learned skills that can be used to solve unfamiliar problems**

14.3 Guide information processing and visualization

Successful transformation of information into useable knowledge often requires the application of mental strategies and skills for “processing” information. These cognitive, or meta-cognitive, strategies involve the selection and manipulation of information so that it can be better summarized, categorized, prioritized, contextualized and remembered. While some learners in any classroom may have a full repertoire of these

strategies, along with the knowledge of when to apply them, most learners do not. Well-designed materials can provide customized and embedded models, scaffolds, and feedback to assist learners who have very diverse abilities in using those strategies effectively.

- **Give explicit prompts for each step in a sequential process**
- **Provide options for organizational methods and approaches (tables and algorithms for processing mathematical operations)**
- **Provide interactive models that guide exploration and new understandings**
- **Introduce graduated scaffolds that support information processing strategies**
- **Provide multiple entry points to a lesson and optional pathways through content (e.g., exploring big ideas through dramatic works, arts and literature, film and media)**
- **“Chunk” information into smaller elements**
- **Progressively release information (e.g., sequential highlighting)**
- **Remove unnecessary distractions unless they are essential to the instructional goal**

14.4 Maximize transfer and generalization

All learners need to be able to generalize and transfer their learning to new contexts. Students vary in the amount of scaffolding they need for memory and transfer in order to improve their ability to access their prior learning. Of course, all learners can benefit from assistance in how to transfer the information they have to other situations, as learning is not about individual facts in isolation, and students need multiple representations for this to occur. Without this support and the use of multiple representations, information might be learned, but is inaccessible in new situations. Supports for memory, generalization, and transfer include techniques that are designed to heighten the memorability of the information, as well as those that prompt and guide learners to employ explicit strategies.

- **Provide checklists, organizers, sticky notes, electronic reminders**
- **Prompt the use of mnemonic strategies and devices (e.g., visual imagery, paraphrasing strategies, method of loci, etc.)**
- **Incorporate explicit opportunities for review and practice**
- **Provide templates, graphic organizers, concept maps to support note-taking**
- **Provide scaffolds that connect new information to prior knowledge (e.g., word webs, half-full concept maps)**
- **Embed new ideas in familiar ideas and contexts (e.g., use of analogy, metaphor, drama, music, film, etc.)**
- **Provide explicit, supported opportunities to generalize learning to new situations (e.g., different types of problems that can be solved with linear equations, using physics principles to build a playground)**
- **Offer opportunities over time to revisit key ideas and linkages between ideas**

UDL PRINCIPLE: PROVIDE MULTIPLE MEANS OF ACTION & EXPRESSION

Learners differ in the ways that they can navigate a learning environment and express what they know. For example, individuals with significant movement impairments (e.g., cerebral palsy), those who struggle with strategic and organizational abilities (executive function disorders), those who have language barriers, and so forth approach learning tasks very differently. Some may be able to express themselves well in written text but not speech, and vice versa. It should also be recognized that action and expression require a great deal of strategy, practice, and organization, and this is another area in which learners can differ. In reality, there is not one means of action and expression that will be optimal for all learners; providing options for action and expression is essential.

GUIDELINE 4: Provide options for Physical Action

A textbook or workbook in a print format provides limited means of navigation or physical interaction (e.g., turning pages, handwriting in spaces provided). Many interactive pieces of educational software similarly provide only limited means of navigation or interaction (e.g., using a joystick or keyboard). Navigation and interaction in those limited ways will raise barriers for some learners—those with physical disabilities, blindness, dysgraphia, or who need various kinds of executive functioning supports. It is important to provide materials with which all learners can interact. Properly designed curricular materials provide a seamless interface with common assistive technologies through which individuals with movement impairments can navigate and express what they know—to allow navigation or interaction with a single switch, through voice activated switches, expanded keyboards and others.

Checkpoints

15.1 Vary the methods for response and navigation

Learners differ widely in their capacity to navigate their physical environment. To reduce barriers to learning that would be introduced by the motor demands of a task, provide alternative means for response, selection, and composition. In addition, learners differ widely in their optimal means for navigating through information and activities. To provide equal opportunity for interaction with learning experiences, an instructor must ensure that there are multiple means for navigation and control is accessible.

- **Provide alternatives in the requirements for rate, timing, speed, and range of motor action required to interact with instructional materials, physical manipulatives, and technologies**
- **Provide alternatives for physically responding or indicating selections (e.g., alternatives to marking with pen and pencil, alternatives to mouse control)**
- **Provide alternatives for physically interacting with materials by hand, voice, single switch, joystick, keyboard, or adapted keyboard**

15.2 Optimize access to tools and assistive technologies

Providing a learner with a tool is often not enough. We need to provide the support to use the tool effectively. Many learners need help navigating through their environment (both

in terms of physical space and the curriculum), and all learners should be given the opportunity to use tools that might help them meet the goal of full participation in the classroom. However, significant numbers of learners with disabilities have to use Assistive Technologies for navigation, interaction, and composition on a regular basis. It is critical that instructional technologies and curricula do not impose inadvertent barriers to the use of these assistive technologies. An important design consideration, for example, is to ensure that there are keyboard commands for any mouse action so that learners can use common assistive technologies that depend upon those commands. It is also important, however, to ensure that making a lesson physically accessible does not inadvertently remove its challenge to learning.

- **Provide alternate keyboard commands for mouse action**
- **Build switch and scanning options for increased independent access and keyboard alternatives**
- **Provide access to alternative keyboards**
- **Customize overlays for touch screens and keyboards**
- **Select software that works seamlessly with keyboard alternatives and alt keys**

Guideline 5: Provide options for Expression & Communication

There is no medium of expression that is equally suited for all learners or for all kinds of communication. On the contrary, there are media, which seem poorly suited for some kinds of expression, and for some kinds of learning. While a learner with dyslexia may excel at story-telling in conversation, he may falter when telling that same story in writing. It is important to provide alternative modalities for expression, both to the level the playing field among learners and to allow the learner to appropriately (or easily) express knowledge, ideas and concepts in the learning environment.

Checkpoints

16.1 Use multiple media for communication

Unless specific media and materials are critical to the goal (e.g., learning to paint specifically with oils, learning to handwrite with calligraphy) it is important to provide alternative media for expression. Such alternatives reduce media-specific barriers to expression among learners with a variety of special needs, but also increases the opportunities for all learners to develop a wider range of expression in a media-rich world. For example, it is important for all learners to learn composition, not just writing, and to learn the optimal medium for any particular content of expression and audience.

- **Compose in multiple media such as text, speech, drawing, illustration, comics, storyboards, design, film, music, dance/movement, visual art, sculpture, or video**
- **Use physical manipulatives (e.g., blocks, 3D models, base-ten blocks)**
- **Use social media and interactive web tools (e.g., discussion forums, chats, web design, annotation tools, storyboards, comic strips, animation presentations)**
- **Solve problems using a variety of strategies**

16.2 Use multiple tools for construction and composition

There is a tendency in schooling to focus on traditional tools rather than contemporary ones. This tendency has several liabilities: 1) it does not prepare learners for their future; 2) it limits the range of content and teaching methods that can be implemented; 3) it restricts learners ability to express knowledge about content (assessment); and, most importantly, 4) it constricts the kinds of learners who can be successful. Current media tools provide a more flexible and accessible toolkit with which learners can more successfully take part in their learning and articulate what they know. Unless a lesson is focused on learning to use a specific tool (e.g., learning to draw with a compass), curricula should allow many alternatives. Like any craftsman, learners should learn to use tools that are an optimal match between their abilities and the demands of the task.

- **Provide spellcheckers, grammar checkers, word prediction software**
- **Provide text-to-speech software (voice recognition), human dictation, recording**
- **Provide calculators, graphing calculators, geometric sketchpads, or pre-formatted graph paper**
- **Provide sentence starters or sentence strips**
- **Use story webs, outlining tools, or concept mapping tools**
- **Provide Computer-Aided-Design (CAD), music notation (writing) software, or mathematical notation software**
- **Provide virtual or concrete mathematics manipulatives (e.g., base-10 blocks, algebra blocks)**
- **Use web applications (e.g., wikis, animation, presentation)**

16.3 Build fluencies with graduated levels of support for practice and performance

Learners must develop a variety of fluencies (e.g., visual, audio, mathematical, reading, etc.). This means that they often need multiple scaffolds to assist them as they practice and develop independence. Curricula should offer alternatives in the degrees of freedom available, with highly scaffolded and supported opportunities provided for some and wide degrees of freedom for others who are ready for independence. Fluency is also built through many opportunities for performance, be it in the form of an essay or a dramatic production. Performance helps learners because it allows them to synthesize their learning in personally relevant ways. Overall, it is important to provide options that build learners' fluencies.

- **Provide differentiated models to emulate (i.e. models that demonstrate the same outcomes but use differing approaches, strategies, skills, etc.)**
- **Provide differentiated mentors (i.e., teachers/tutors who use different approaches to motivate, guide, feedback or inform)**
- **Provide scaffolds that can be gradually released with increasing independence and skills (e.g., embedded into digital reading and writing software)**
- **Provide differentiated feedback (e.g., feedback that is accessible because it can be customized to individual learners)**
- **Provide multiple examples of novel solutions to authentic problems**

Guideline 6: Provide options for Executive Functions

At the highest level of the human capacity to act skillfully are the so-called “executive functions.” Associated with networks that include the prefrontal cortex, these capabilities allow humans to overcome impulsive, short-term reactions to their environment and instead to set long-term goals, plan effective strategies for reaching those goals, monitor their progress, and modify strategies as needed. In short, they allow learners to take advantage of their environment. Of critical importance to educators is the fact that executive functions have very limited capacity due to working memory. This is true because executive capacity is sharply reduced when: 1) executive functioning capacity must be devoted to managing “lower level” skills and responses which are not automatic or fluent thus the capacity for “higher level” functions is taken; and 2) executive capacity itself is reduced due to some sort of higher level disability or to lack of fluency with executive strategies. The UDL framework typically involves efforts to expand executive capacity in two ways: 1) by scaffolding lower level skills so that they require less executive processing; and 2) by scaffolding higher level executive skills and strategies so that they are more effective and developed. Previous guidelines have addressed lower level scaffolding, this guideline addresses ways to provide scaffolding for executive functions themselves.

17.1 Guide appropriate goal-setting (6.1)

It cannot be assumed that learners will set appropriate goals to guide their work, but the answer should not be to provide goals for students. Such a short-term remedy does little to develop new skills or strategies in any learner. It is therefore important that learners develop the skill of effective goal setting. The UDL framework embeds graduated scaffolds for learning to set personal goals that are both challenging and realistic.

Provide prompts and scaffolds to estimate effort, resources, and difficulty

Provide models or examples of the process and product of goal-setting

Provide guides and checklists for scaffolding goal-setting

Post goals, objectives, and schedules in an obvious place

17.2 Support planning and strategy development (6.2)

Once a goal is set, effective learners and problem-solvers plan a strategy, including the tools they will use, for reaching that goal. For young children in any domain, older learners in a new domain, or any learner with one of the disabilities that compromise executive functions (e.g., intellectual disabilities), the strategic planning step is often omitted, and trial and error attempts take its place. To help learners become more plan-full and strategic a variety of options are needed, such as cognitive “speed bumps” that prompt them to “stop and think;” graduated scaffolds that help them actually implement strategies; or engagement in decision-making with competent mentors.

Embed prompts to “stop and think” before acting as well as adequate space

Embed prompts to “show and explain your work” (e.g., portfolio review, art critiques)

Provide checklists and project planning templates for understanding the problem, setting up prioritization, sequences, and schedules of steps

Embed coaches or mentors that model think-alouds of the process
Provide guides for breaking long-term goals into reachable short-term objectives

17.3 Facilitate managing information and resources

One of the limits of executive function is that imposed by the limitations of so-called working memory. This “scratch pad” for maintaining chunks of information where they can be accessed as part of comprehension and problem-solving is very limited for any learner and even more severely limited for many learners with learning and cognitive disabilities. As a result, many such learners seem disorganized, forgetful, and unprepared. Wherever working memory capacity is not construct-relevant in a lesson, it is important to provide a variety of internal scaffolds and external organizational aids—exactly those kinds that executives use—to keep information organized and “in mind.”

Provide graphic organizers and templates for data collection and organizing information
Embed prompts for categorizing and systematizing
Provide checklists and guides for note-taking

17.4 Enhance capacity for monitoring progress (6.4)

Learning cannot happen without feedback, and that means learners need a clear picture of the progress that are (or are not) making. When assessments and feedback do not inform instruction or when they are not given to the students in a timely manner, learning cannot change because students do not know what to do differently. This lack of knowledge about what to improve can make some learners seem “perseverative,” careless, or unmotivated. For these learners all of the time, and for most learners some of the time, it is important to ensure that options can be customized to provide feedback that is more explicit, timely, informative, and accessible. Especially important is providing “formative” feedback that allows learners to monitor their own progress effectively and to use that information to guide their own effort and practice.

Ask questions to guide self-monitoring and reflection
Show representations of progress (e.g., before and after photos, graphs and charts showing progress over time, process portfolios)
Prompt learners to identify the type of feedback or advice that they are seeking
Use templates that guide self-reflection on quality and completeness
Provide differentiated models of self-assessment strategies (e.g., role-playing, video reviews, peer feedback)
Use of assessment checklists, scoring rubrics, and multiple examples of annotated student work/performance examples

UDL PRINCIPLE- PROVIDE MULTIPLE MEANS OF ENGAGEMENT

Affect represents a crucial element to learning, and **learners differ markedly in the ways in which they can be engaged or motivated to learn.** There are a variety of sources that can influence individual variation in affect including neurology, culture, personal relevance, subjectivity, and background knowledge, along with a variety of other factors. Some learners are highly engaged by spontaneity and novelty while others are disengaged, even frightened, by those aspects, preferring strict routine. Some learners might like to work alone, while others prefer to work with their peers. In reality, **there is**

not one means of engagement that will be optimal for all learners in all contexts; providing multiple options for engagement is essential.

GUIDELINE 7: PROVIDE OPTIONS FOR RECRUITING INTEREST

Information that is not attended to, that does not engage learners' cognition, is in fact inaccessible. It is inaccessible both in the moment and in the future, because relevant information goes unnoticed and unprocessed. As a result, teachers devote considerable effort to recruiting learner attention and engagement. But learners differ significantly in what attracts their attention and engages their interest. Even the same learner will differ over time and circumstance; their "interests" change as they develop and gain new knowledge and skills, as their biological environments change, and as they develop into self-determined adolescents and adults. It is, therefore, important to have alternative ways to recruit learner interest, ways that reflect the important inter- and intra-individual differences amongst learners.

18.1 Optimize individual choice and autonomy (7.1)

In an instructional setting, it is often inappropriate to provide choice of the learning objective itself, but it is often appropriate to offer choices in how that objective can be reached, in the context for achieving the objective, in the tools or supports available, and so forth. Offering learners choices can develop self-determination, pride in accomplishment, and increase the degree to which they feel connected to their learning. However, it is important to note that individuals differ in how much and what kind of choices they prefer to have. It is therefore not enough to simply provide choice. The right kind of choice and level of independence must be optimized to ensure engagement.

Provide learners with as much discretion and autonomy as possible by providing choices in such things as:

- The level of perceived challenge
- The type of rewards or recognition available
- The context or content used for practicing and assessing skills
- The tools used for information gathering or production
- The color, design, or graphics of layouts, etc.
- The sequence or timing for completion of subcomponents of tasks

Allow learners to participate in the design of classroom activities and academic tasks

Involve learners, where and whenever possible, in setting their own personal academic and behavioral goals

18.2 Optimize relevance, value, and authenticity

Individuals are engaged by information and activities that are relevant and valuable to their interests and goals. This does not necessarily mean that the situation has to be equivalent to real life, as fiction can be just as engaging to learners as non-fiction, but it does have to be relevant and authentic to learners' individual goals and the instructional goals. Individuals are rarely interested in information and activities that have no relevance or value. In an educational setting, one of the most important ways that teachers recruit

interest is to highlight the utility and relevance, of learning and to demonstrate that relevance through authentic, meaningful activities. It is a mistake, of course, to assume that all learners will find the same activities or information equally relevant or valuable to their goals. To recruit all learners equally, it is critical to provide options that optimize what is relevant, valuable, and meaningful to the learner.

Vary activities and sources of information so that they can be:

- Personalized and contextualized to learners' lives
- Culturally relevant and responsive
- Socially relevant
- Age and ability appropriate
- Appropriate for different racial, cultural, ethnic, and gender groups

Design activities so that learning outcomes are authentic, communicate to real audiences, and reflect a purpose that is clear to the participants

Provide tasks that allow for active participation, exploration and experimentation

Invite personal response, evaluation and self-reflection to content and activities

Include activities that foster the use of imagination to solve novel and relevant problems, or make sense of complex ideas in creative ways

18.3 Minimize threats and distractions

One of the most important things a teacher can do is to create a safe space for learners. To do this, teachers need to reduce potential threats and distractions in the learning environment. When learners have to focus their attention on having basic needs met or avoiding a negative experience they cannot concentrate on the learning process. While the physical safety of a learning environment is of course necessary, subtler types of threats and distractions must be attended to as well; what is threatening or potentially distracting depends on learners' individual needs and background. An English Language Learner might find language experimentation threatening, while some learners might find too much sensory stimulation distracting. The optimal instructional environment offers options that reduce threats and negative distractions for everyone to create a safe space in which learning can occur.

Create an accepting and supportive classroom climate

Vary the level of novelty or risk

- Charts, calendars, schedules, visible timers, cues, etc. that can increase the predictability of daily activities and transitions
- Creation of class routines
- Alerts and previews that can help learners anticipate and prepare for changes in activities, schedules, and novel events
- Options that can, in contrast to the above, maximize the unexpected, surprising, or novel in highly routinized activities

Vary the level of sensory stimulation

- Variation in the presence of background noise or visual stimulation, noise buffers, number of features or items presented at a time
- Variation in pace of work, length of work sessions, availability of breaks or time-outs, or timing or sequence of activities

Vary the social demands required for learning or performance, the perceived level of support and protection and the requirements for public display and evaluation
Involve all participants in whole class discussions

Guideline 8- Provide options for Sustaining Effort & Persistence

Many kinds of learning, particularly the learning of skills and strategies, require sustained attention and effort. *When motivated to do so, many learners can regulate their attention and affect in order to sustain the effort and concentration that such learning will require. However, learners differ considerably in their ability to self-regulate in this way.* Their differences reflect disparities in their initial motivation, their capacity and skills for self-regulation, their susceptibility to contextual interference, and so forth. A key instructional goal is to build the individual skills in self-regulation and self-determination that will equalize such learning opportunities. In the meantime, the external environment must provide options that can equalize accessibility by supporting learners who differ in initial motivation, self-regulation skills, etc.

Checkpoints

19.1 Heighten salience of goals and objectives

Over the course of any sustained project or systematic practice, there are many sources of interest and engagement that compete for attention and effort. For some learners, they need support to remember the initial goal or to maintain a consistent vision of the rewards of reaching that goal. For those learners, it is important to build in periodic or persistent “reminders” of both the goal and its value in order for them to sustain effort and concentration in the face of distracters.

Prompt or require learners to explicitly formulate or restate goal

Display the goal in multiple ways

Encourage division of long-term goals into short-term objectives

Demonstrate the use of hand-held or computer-based scheduling tools

Use prompts or scaffolds for visualizing desired outcome

Engage learners in assessment discussions of what constitutes excellence and generate relevant examples that connect to their cultural background and interests

19.2 Vary demands and resources to optimize challenge

Learners vary not only in their skills and abilities, but also in the kinds of challenges that motivate them to do their best work. All learners need to be challenged, but not always in the same way. In addition to providing appropriately varied levels and types of demands, learners also need to be provided with the right kinds of resources necessary for successful completion of the task. Learners cannot meet a demand without appropriate, and flexible, resources. Providing a range of demands, and a range of possible resources, allows all learners to find challenges that are optimally motivating. Balancing the resources available to meet the challenge is vital.

- Differentiate the degree of difficulty or complexity within which core activities can be completed
- Provide alternatives in the permissible tools and scaffolds
- Vary the degrees of freedom for acceptable performance
- Emphasize process, effort, improvement in meeting standards as alternatives to external evaluation and competition

19.3 Foster collaboration and community

In the 21st century, all learners must be able to communicate and collaborate effectively within a community of learners. This is easier for some than others, but remains a goal for all learners. The distribution of mentoring through peers can greatly increase the opportunities for one-on-one support. When carefully structured, such peer cooperation can significantly increase the available support for sustained engagement. Flexible rather than fixed grouping allows better differentiation and multiple roles, as well as providing opportunities to learn how to work most effectively with others. Options should be provided in how learners build and utilize these important skills.

- Create cooperative learning groups with clear goals, roles, and responsibilities
- Create school-wide programs of positive behavior support with differentiated objectives and supports
- Provide prompts that guide learners in when and how to ask peers and/or teachers for help
- Encourage and support opportunities for peer interactions and supports (e.g., peer-tutors)
- Construct communities of learners engaged in common interests or activities
- Create expectations for group work (e.g., rubrics, norms, etc.)

19.4 Increase mastery-oriented feedback (8.4)

Assessment is most productive for sustaining engagement when the feedback is relevant, constructive, accessible, consequential, and timely. But the type of feedback is also critical in helping learners to sustain the motivation and effort essential to learning. Mastery-oriented feedback is the type of feedback that guides learners toward mastery rather than a fixed notion of performance or compliance. It also emphasizes the role of effort and practice rather than “intelligence” or inherent “ability” as an important factor in guiding learners toward successful long-term habits and learning practices. These distinctions may be particularly important for learners whose disabilities have been interpreted, by either themselves or their caregivers, as permanently constraining and fixed.

- Provide feedback that encourages perseverance, focuses on development of efficacy and self-awareness, and encourages the use of specific supports and strategies in the face of challenge
- Provide feedback that emphasizes effort, improvement, and achieving a standard rather than on relative performance
- Provide feedback that is frequent, timely, and specific
- Provide feedback that is substantive and informative rather than comparative or competitive
- Provide feedback that models how to incorporate evaluation, including identifying patterns of errors and wrong answers, into positive strategies for future success

Guideline-9: Provide options for Self

While it is important to design the extrinsic environment so that it can support motivation and engagement (see [Recruiting Interest](#) and [Sustaining Effort & Persistence](#)), it is also important to develop learners' intrinsic abilities to regulate their own emotions and motivations. *The ability to self-regulate—to strategically modulate one's emotional reactions or states in order to be more effective at coping and engaging with the environment—is a critical aspect of human development.* While many individuals develop self-regulatory skills on their own, either by trial and error or by observing successful adults, many others have significant difficulties in developing these skills. Unfortunately some classrooms do not address these skills explicitly, leaving them as part of the “implicit” curriculum that is often inaccessible or invisible to many. *Those teachers and settings that address self-regulation explicitly will be most successful in applying the UDL principles through modeling and prompting in a variety of methods.* As in other kinds of learning, individual differences are more likely than uniformity. A successful approach requires providing sufficient alternatives to support learners with very different aptitudes and prior experience to effectively manage their own engagement and affect.

20.1 Promote expectations and beliefs that optimize motivation

One important aspect of self-regulation is the personal knowledge each learner has about what he or she finds motivating, be it intrinsic or extrinsic. To accomplish this, learners need to be able to set personal goals that can be realistically reached, as well as fostering positive beliefs that their goals can be met. However, learners also need to be able to deal with frustration and avoid anxiety when they are in the process of meeting their goals. Multiple options need to be given to learners to help them stay motivated.

Provide prompts, reminders, guides, rubrics, checklists that focus on:

- Self-regulatory goals like reducing the frequency of aggressive outbursts in response to frustration
- Increasing the length of on-task orientation in the face of distractions
- Elevating the frequency of self-reflection and self-reinforcements

Provide coaches, mentors, or agents that model the process of setting personally appropriate goals that take into account both strengths and weaknesses

Support activities that encourage self-reflection and identification of personal goals

20.2 Facilitate personal coping skills and strategies

20.3 Develop self-assessment and reflection