



Current State of the Art in the Area of Inclusive Higher Education Teaching

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1 Concise history of inclusive education

1.1 International

Inclusive education could not be interpreted without introducing an interpretation of the process of inclusion in and through education. There are many definitions of inclusion in the scientific and popular literature that taxonomize it as:

- social (Walker and Walker 1997; Gerschel, 2005),
- educational (Wolger, 2002; Tilstone and Rose, 2003),
- in terms of values or as an approach covering measures based on values (O'Brien, 2001).

Inclusion is not life through and thanks to others, which impose a certain model of social determination, which is personalized. Inclusion determines equal human rights in life with differences and paradoxes and postulates a quality standard and independent lifestyle. Inclusion is a way of life with others and free self-determination. It is a flexible and dynamic process that is constantly evolving depending on the culture, people's psychology and the context of public life. Inclusion helps educational structures, systems and methodologies to meet the needs of all learners.

Inclusion in education is not another new complex concept, it is not a new "program" or another "reform". Inclusion in education is life itself in its most humane dimensions, and it is not always easy to achieve because of diversity, but it is necessary for everyone and for everyone's rights. In the process of realization of inclusion, which refers to all differences in people, labels such as "included child / included student / included person" are not allowed. All people have a need for social and educational inclusion, but at different levels according to their physical, mental and social status and potential.

The world community seeks to create the necessary conditions for the real realization of fundamental rights and human freedoms, for inclusion and for inclusive education. These predictors are presented in various documents from important international forums and extremely important definitions, clarifications and analyses by scientists and practitioners. In chronological order, among them can be noted:

- **The Universal Declaration of Human Rights** (adopted on 10 December 1948) states: **"Everyone has the right to education."** Inclusion in education is marked by significant synergies with justice as one of the fundamental human rights in the Declaration of Human Rights (1948).
- **UNESCO Convention against Discrimination in Education** (adopted on 14 December 1960 and ratified on 17 November 1962).
- The European Convention on Human Rights of 1950.
- International Covenant on Economic, Social and Cultural Rights, 1976.
- **The UN Convention on the Rights of the Child** (1989), which establishes four basic principles for the elimination of discrimination:
 - Article 2 with explicit mention of children with disabilities.
 - Article 3 consideration of the best interests of the child.
 - Article 6 right to survival and development.
 - Article 12 respect for the views of the child.
- **The World Declaration on Education for All**, adopted at the UN World Conference (March 1990) in Jomtien, Thailand. The declaration postulates the satisfaction of basic educational needs and universal education.



- **The UNESCO Convention on Technical and Vocational Education** (adopted in 1989), in force since 1991. It proclaims universal access to technical and vocational education, as well as access to higher education on a non-discriminatory basis.
- **The World Conference on Human Rights** (1993) proclaimed human rights education as "essential for the promotion and achievement of stable and harmonious relations among communities and for the promotion of mutual understanding, tolerance and freedom".
- The UN General Assembly (1994) designates the period 1995-2004 as the **UN Decade for Human Rights Education**. All UN member states are called upon to promote "the dissemination of training and information aimed at building a universal culture of human rights." Above all, state educational programs promote fundamental human rights as a motivating tool for peace, democracy and social order.
- **The United Nations Standard Rules on Equality and Equal Opportunities for People with Disabilities** (1993), which make a moral and political commitment to ensure that people with disabilities have equal rights with other citizens, and their education is an integral part of the education system.
- The Declaration adopted at the **World Conference on Special Education in Salamanca** (1994), which accepted inclusive education as a factor in building an inclusive society and enriching the theory and practice of education.
- Inclusive education is presented as an important and positive principle for schools involved in standards policy, which reflects the presumption that inclusive school is by definition a good school (Stainback and Stainback, 1996).
- **The "Four Pillars of Education"** and the Seven Key Points of Discrepancy Facing the World and Influencing Education in the 21st Century were adopted by the **UNESCO Commission** (1996).¹ The Four Pillars of Education include:
 1. **Coexistence training.** Emphasis is placed on education as a factor in accepting the independence of the individual from other people by respecting pluralism and differences, dealing with conflicts and taking an active part in society.
 2. **Developing knowledge habits.** The focus is on supporting the education of learners in acquiring knowledge tools, including communication and oral training, literacy, numeracy and problem solving; simultaneously gaining general and in-depth knowledge in several areas, understanding rights and responsibilities and, most importantly, learning how to learn.
 3. **Action training.** The supporting role of education to students in acquiring professional skills, social and professional competence, which will allow them to make informed decisions about different life situations, to act in social and work relationships, to participate in local and global markets, to use technological tools, to meet basic needs and to improve their own lives and the lives of others.
 4. **Personality development training.** It is emphasized that education contributes to individual development and allows people to act with greater autonomy, reason, critical thinking and personal responsibility.

The complementary roles of formal and non-formal education are also presented.

¹ https://www.see-educoop.net/education_in/pdf/15_62.pdf



These Four Pillars of Education will be able to resolve the Seven Key Points of Inconsistency facing the world and influencing education in the 21st century:

1. The discrepancy between the global and the local.
 2. The discrepancy between the universal and the individual.
 3. The discrepancy between tradition and modernism.
 4. The discrepancy between the spiritual and the material.
 5. The discrepancy between long-term and short-term tasks.
 6. The discrepancy between competition and equality of opportunity.
 7. The discrepancy between the extraordinary increase in knowledge and the capacity of human beings to assimilate it.
- It is believed that the definition of **inclusive education was adopted at the seminar in Agra (India, 1998)**. “The Agra seminar was an international seminar with a difference. It was a collaborative venture between a small number of international non-governmental organisations (NGOs) and the Enabling Education Network (EENET). The International Disability and Development Consortium (IDDC) has no headquarters, staff or budget of its own. The organisation of the seminar guide by IDDC's current chairperson and Save the Children Fund (SCF {UK})'s Disability Adviser, Ms Sue Stubbs; but responsibility for the various tasks was shared out between the organisations.”² Stubbs is the coordinator of the International Disability and Development Consortium and a former disability advisor at Save the Children - UK. A book is published after the seminar: “Gearing up for Inclusive Education” (2007). The preamble already outlines basic understandings of inclusive education: “An inclusive school is one that attempts to address the learning needs of each learner by reducing or eliminating barriers that are obstructing participation. An inclusive education system welcomes and educates ALL children regardless of their gender, abilities, economic situation, race, or religious beliefs.” Four key principles for inclusive education have been formulated:
 1. A belief that all children can learn.
 2. At the core of inclusive education is the right to education.
 3. Regular school systems should be able to educate all learners with appropriate support mechanisms.
 4. Schools must change in order to reach all learners-leading to quality improvement.

The process is on-going and must involve children, their families, teachers and other staff members, school communities as well as the local community. (Ray, R., 2007)³

Definitions of inclusive education by scholars, practitioners and industry organizations are emerging. As more significant can be noted:

- **Stubbs (2002)** expands the definition of inclusive education by noting that it is related to:
 - covering more activities from formal school education - it includes activities at home, community, informal and informal systems,
 - affirming the position that all children are trainable,

² <https://www.eenet.org.uk>

³ <http://14.139.60.153/bitstream/123456789/4082/1/Gearing%20Up%20for%20Inclusive%20Education%20SCERT.pdf>



- supporting educational structures, systems and methodologies to meet the needs of all children,
 - recognition and respect for differences between children related to age, gender, ethnicity, language, disability, etc.,
 - the dynamics of a process that is constantly evolving, regardless of culture and context,
 - the inclusion of inclusive education as a component of a more comprehensive strategy for building an inclusive society.
- **The National Association for Special Educational Needs in the UK:** “Inclusion is not just a concept limited to location issues. Its definition must cover broad notions of access to education and recognize the importance of meeting different needs. Increasing access for more and more people is an important goal. But this will not develop spontaneously and must be actively planned and encouraged.” (NASEN, 1998).
 - In the “**Index for inclusion**” (Booth, 2000), learning and inclusion are described as continuous processes that go hand in hand with the continuing improvement of the school. The Index for inclusion is a model for the implementation of inclusive education in the school environment with included methods and ways to collect, analyse and process information for inclusion. The Index for inclusion specifies inclusive education for learning and teaching styles, namely what is taught in school, how it is taught and how students' knowledge and skills are assessed. The Index for inclusion includes three main areas of indicators and issues: developing inclusive policies, introducing inclusive practices and creating inclusive cultures. (according to Booth & Ainscow, 2011). This algorithm creates new, constantly updated and useful information about the respective school. The Index for inclusion includes a Guide with ready-made questionnaires, with various activities to be carried out by each school and specific stages of inclusion for members of the school community.
 - The Framework for Action, popularly known as the **Dakar Framework (2000)**, adopted at the World Education Forum (WEF) in Dakar (Senegal), ensures the provision of basic education for all by 2015 and includes an emphasis on “four key elements”:
 - inclusion is a process.
 - inclusion is the discovery and removal of barriers.
 - inclusion is presence, participation and success for all learners.
 - Inclusion places particular emphasis on those groups of learners who are at risk of isolation, who are excluded from education or who do not perform well. (**Dakar Framework, 2000**)
 - **The Millennium Development Goals**, adopted by a UN General Assembly Declaration in 2000. The Millennium Development Goals are eight and focus on the health, social, economic and educational status of people, as well as on environmental sustainability by 2015. Goal 2 is about achieving primary education for all. Objective 3 goal to promote gender equality. The 2015 report states that despite the progress of the Millennium Development Goals, much remains to be done.⁴
 - **The UNESCO Universal Declaration on Cultural Diversity (2001)**, which recognizes the diversity of society and its culture and calls for a change in people's attitudes towards diversity and awareness of its value and significance. The synergy between diversity and pluralism is sought through the individual characteristics of a person placed in the focus of values and cultural diversity.

⁴ <https://www.un.org/millenniumgoals/pdf/MDG%20Report%202010%20En%20r15%20-low%20res%2020100615%20-.pdf>



- **Priority program “Education for All”**, which focuses on education for people with disabilities. The goal of the program is to "prioritize disability issues on the agenda of development programs (...) and (...) to promote inclusive education as a key approach to achieving education for all" (Stubbs, 2002). The program "Education for All" covers the period 2000-2015. The Program states that each country must invest at least 6% of its gross domestic product in education. The ten most important policies for quality education are outlined:
 1. Workplace safety.
 2. Training of future teachers.
 3. Social mobility of teachers.
 4. Individual work with children and students.
 5. Training of teachers who train students in pedagogical specialties.
 6. Good financing of the educational system and payment for teachers' work.
 7. Better governance for greater efficiency of the educational process.
 8. Creating a register of pedagogical staff.
 9. Support for innovation in education.
 10. Assessment as a pedagogical technique.
- Topping and Maloney (2005) introduce the issue of inclusion, stating that "Like learning, inclusion is a dynamic process, not a static condition - a journey, not a destination."
- **The UNESCO concept (2005)** is about the rights of every child, the rights of every person in favour of social acceptance and social justice. The concept is very humane and is an expression of concern for the well-being and happiness of every member of society. Inclusion and participation are essential for human dignity and need to be used for the exercise of human rights. In the field of education, this concept is reflected in the development of strategies to achieve real equalization of opportunities (UNESCO, 2005). Inclusive education is described as a “process with a view to preserving and making full use of culturally appropriate methods of communication and transmission of knowledge.” (UNESCO, 2006).
- **Charter on Education for Democratic Citizenship and Human Rights Education (2010)** of the Council of Europe. The Charter states that “education is increasingly seen as a defence against the rise of violence, racism, extremism, xenophobia, discrimination and intolerance.”⁵

The Committee of Ministers of the member states of the Charter of the Council of Europe on Education for Democratic Citizenship and Human Rights Education (Adopted by the Committee of Ministers on 11 May 2010 at its 120th session) in its Recommendation CM / Rec (2010)) 7 notes basic human rights: “education, training, awareness raising, information, practices and activities which aim, by equipping learners with knowledge, skills and understanding and developing their attitudes and behaviour, to empower them to exercise and defend their democratic rights and responsibilities in society, to value diversity and to play an active part in democratic life, with a view to the promotion and protection of democracy and the rule of law”.⁶

- **The European Disability Strategy** announced by the European Commission (COM (2010) 636), valid for the period 2010-2020. According to the adopted Strategy, measures have been taken for independent living and inclusive education for people with disabilities.⁷ The main barriers

⁵ <https://www.coe.int/en/web/edc/charter-on-education-for-democratic-citizenship-and-human-rights-education>

⁶ <https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=09000016803034e3> (Committee of Ministers Council of Europe Recommendation CM / Rec (2010) 7 on education for democratic citizenship and human rights education

⁷ <http://csdle.lex.unict.it/docs/labourweb/Commission-Staff-Working-Document-Accompanying-document-to-the-COM-2010-636-final-1680.aspx>



are: Accessibility, Employment, Inclusion - People are more at risk of poverty and social exclusion if they have problems finding work. The poverty rate for people with disabilities is 70% higher than average, Education - People with disabilities have fewer opportunities to participate fully in education. In the 16-19 age group, the rate of non-participation in education is 37% for considerably restricted people and 25% for those restricted to some extent, while for those not restricted, it is 17%. This is a significant disadvantage for personal development, social integration and job opportunities.⁸

- The “Transforming Our World: An Agenda 2030 for Sustainable Development” Program, adopted in 2015, at the UN Summit on Sustainable Development in New York (USA). The program includes 17 Sustainable Development Goals (SDGs). Objective 4 with seven sub-objectives is to ensure inclusive and equal quality education and to promote lifelong learning opportunities for all. Accordingly, the sub-objectives are:
 - 4.1 To ensure by 2030 that all girls and boys complete free, fair and quality primary and secondary education, leading to appropriate and effective learning outcomes.
 - 4.2 To ensure by 2030 that all girls and boys have access to quality development, care and pre-school education in early childhood to be ready for primary education.
 - 4.3 Ensure equal access for all women and men to affordable and quality, technical, vocational and higher education, including university education, by 2030.
 - 4.4 Ensure a significant increase in the number of young people and adults with appropriate skills, including technical and vocational skills for employment, decent work and entrepreneurship by 2030.
 - 4.5 Eliminate gender inequalities in education and ensure equal access to all levels of education and vocational training for vulnerable people, including people with disabilities, indigenous peoples and vulnerable children by 2030.
 - 4.6 Ensure that all young people and a significant proportion of the adult population, both men and women, acquire language and mathematical literacy by 2030.
 - 4.7 To ensure by 2030 that all learners acquire the knowledge and skills needed to promote sustainable development, including (inter alia) through the teaching sustainable development and lifestyles, human rights, gender equality, promoting a culture of peace and non-violence, global citizenship, understanding and valuing cultural diversity and the contribution of culture to sustainable development.

Human rights are inseparable from the UN Sustainable Development Goals. Goal 4 is dedicated to quality education. By 2030, it is required to ensure gender equality, primary education; to ensure equal access to all levels of education and vocational training for vulnerable people, including people with disabilities, indigenous peoples and vulnerable children; to form language and mathematical literacy of students; to ensure that all learners acquire the knowledge and skills needed to promote sustainable development. The following have a special connection with inclusive education in higher education institutions:

Goal 4.3 Ensure equal access for all women and men to affordable and quality, technical, vocational and higher education, including university education, by 2030.

⁸ http://csdle.lex.unict.it/Archive/LW/Press%20releases/RAPID%20press%20releases/20110620-105650_MEMO-10-578_ENpdf.pdf



4.a Construction and modernization of educational institutions, oriented and adapted for children, people with disabilities and persons vulnerable as a gender, which provide for all a safe, inclusive and beneficial learning environment without aggression and violence.

4.b Significant increase by 2020 in the number of global scholarships for students from developing countries, in particular the least developed countries, small island developing countries and African countries - for enrolment in higher education institutions in developed countries and in other developing countries, including in vocational training programs, information and communication technologies, technical, engineering and scientific specialties.

- **The World Education Forum (2015)**, held in Incheon, Korea, issued a Declaration “Towards Inclusive and equitable quality education and lifelong learning for all”. The Declaration of the World Education Forum (2015), held in Incheon, Korea, noted that “inclusion and justice in and through education are a cornerstone of the transformative education agenda, and we are therefore committed to opposing all forms of exclusion and marginalization, inconsistencies and inequalities in access, participation and learning outcomes. No educational goal should be considered achieved if it is not achieved by all.”

The very title of the Declaration is indicative of the value of inclusion and justice for the educational and life functioning of every person. In the declaration referred to, the reform of education in the direction of inclusion and justice is interpreted as:

- “Fundamental human right and a basis for guaranteeing the realization of other rights”.
- “Public good”.
- “Essential for peace, tolerance, human expression and sustainable development”.
- “Education equips people with the competencies to increase their income and escape poverty”.

The participants who signed the Incheon Declaration unequivocally stated their intentions for a "new vision for education" and a strategy for its implementation, as well as setting targets and timetables for monitoring inclusive and equitable education.

- RECOMMENDATION OF THE COUNCIL OF THE EUROPEAN UNION of 22 May 2018 on the promotion of common values, inclusive education and the European dimension in teaching (2018 / C 195/01). In the Recommendation of the Council of the European Union, point 5, it is noted that “education in all of its types and at all levels and from an early age plays a pivotal role in promoting common values. It helps to ensure social inclusion by providing every child with a fair chance and equal opportunities to succeed. It provides opportunities to become active and critically aware citizens, and increases understanding of the European identity.”⁹

Accordingly, item 16 states that “Ensuring effective equal access to quality inclusive education for all learners, including those of migrant origins, those from disadvantaged socioeconomic backgrounds, those with special needs and those with disabilities — in line with the Convention on the Rights of Persons with Disabilities — is indispensable for achieving more cohesive societies. In this endeavour, Member States could benefit from existing Union instruments, notably Erasmus+, the European

⁹ <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:C:2018:195:FULL>



Structural and Investment Funds, Creative Europe, Europe for Citizens, the Rights, Equality and Citizenship Programme, the European Solidarity Corps and Horizon 2020, as well as the guidance and expertise of the European Agency for Special Needs and Inclusive Education.”¹⁰ An explicit focus for the Member States of the European Union is placed on the provision of inclusive education by promoting it “for all learners”, in particular by:

- a) including all learners in quality education from early childhood and throughout life.
- b) providing the necessary support to all learners according to their particular needs, including those from disadvantaged socioeconomic backgrounds, those from a migrant background, those with special needs and the most talented learners.
- c) facilitating the transition between various educational pathways and levels and enabling the provision of adequate educational and career guidance.

Guidance is provided on “effective use of the European Agency for Special Needs and Inclusive Education, on a voluntary basis, to implement and monitor successful inclusive approaches in their education systems.”

1.1.1 Convention on the Rights of Persons with Disabilities (CRPD), Art 24.

The Convention on the Rights of Persons with Disabilities is an international convention adopted by the United Nations General Assembly on 13 December 2006 and opened for signature in March 2007. It came into force in May 2008 after being ratified by the 20th UN member state. As of December 2021, 184 countries and the European Union had signed the Convention (which ratified it on 23 December 2010) (UN Treaty Collection: parties to the Convention on the Rights of Persons with Disabilities: List of parties). The Convention is the first UN human rights treaty of the twenty-first century (General Assembly Adopts Groundbreaking Convention, Optional Protocol on Rights of Persons with Disabilities, 2006).

The Convention is monitored by The Committee on the Rights of Persons with Disabilities (CRPD). The committee is the body of independent experts which monitors implementation of the Convention by the States Parties. The UN General Assembly established The Office of the High Commissioner for Human Rights in December 1993 through its resolution 48/141 which also details its mandate.¹¹

All States parties are obliged to submit regular reports to the Committee on how the rights are being implemented. States must report initially within two years of accepting the Convention and thereafter every four years. The Committee examines each report and shall make such suggestions and general recommendations on the report as it may consider appropriate and shall forward these to the State Party concerned. The Convention is published on the website of The Committee on the Rights of Persons with Disabilities.¹² The annual conferences of the States Parties on The Committee on the Rights of Persons with Disabilities (CRPD) set guidelines since 2008.

The states that have signed the Convention have to “promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity”. The Convention serves as a major catalyst in the global movement for the rights of persons with disabilities, allowing a shift from treating persons with

¹⁰ <https://eur-lex.europa.eu/legal-content/BG/TXT/HTML/?uri=OJ:C:2018:195:FULL>

¹¹ <https://www.ohchr.org/EN/AboutUs/Pages/WhoWeAre.aspx>

¹² <https://www.ohchr.org/EN/HRBodies/CRPD/Pages/ConventionRightsPersonsWithDisabilities.aspx>



disabilities as objects of charity, medical treatment and social protection to being seen as full and equal members of human rights society (The UN Convention on the Rights of Persons with Disabilities, a commentary. Bantekas, Ilias, Stein, Michael Ashley, Anastasiou, Dēmētrēs (First ed.). Oxford, United Kingdom. 20 September 2018. ISBN 978-0-19-881066-7. OCLC 1041925625)

Article 24 is dedicated to the education of people with disabilities. The article notes:

1. States Parties recognize the right of persons with disabilities to education. With a view to realizing this right without discrimination and on the basis of equal opportunity, States Parties shall ensure an inclusive education system at all levels and lifelong learning directed to:
 - (a) The full development of human potential and sense of dignity and self-worth, and the strengthening of respect for human rights, fundamental freedoms and human diversity.
 - (b) The development by persons with disabilities of their personality, talents and creativity, as well as their mental and physical abilities, to their fullest potential.
 - (c) Enabling persons with disabilities to participate effectively in a free society.
2. In realizing this right, States Parties shall ensure that:
 - (a) Persons with disabilities are not excluded from the general education system on the basis of disability, and that children with disabilities are not excluded from free and compulsory primary education, or from secondary education, on the basis of disability.
 - (b) Persons with disabilities can access an inclusive, quality and free primary education and secondary education on an equal basis with others in the communities in which they live.
 - (c) Reasonable accommodation of the individual's requirements is provided.
 - (d) Persons with disabilities receive the support required, within the general education system, to facilitate their effective education.
 - (e) Effective individualized support measures are provided in environments that maximize academic and social development, consistent with the goal of full inclusion.
3. States Parties shall enable persons with disabilities to learn life and social development skills to facilitate their full and equal participation in education and as members of the community. To this end, States Parties shall take appropriate measures, including:
 - (a) 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.
 - (b) Facilitating the learning of sign language and the promotion of the linguistic identity of the deaf community.
 - (c) Ensuring that the education of persons, and in particular children, who are blind, deaf or deafblind, 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.
4. In order to help ensure the realization of this right, States Parties shall take appropriate measures to employ teachers, including teachers with disabilities, who are qualified in sign language and/or Braille, and to train professionals and staff who work at all levels of education. Such training shall incorporate disability awareness and the use of appropriate augmentative and alternative modes, means and formats of communication, educational techniques and materials to support persons with disabilities.
5. States Parties shall ensure that persons with disabilities are able to access general tertiary education, vocational training, adult education and lifelong learning without discrimination and on an equal basis with others. To this end, States Parties shall ensure that reasonable



accommodation is provided to persons with disabilities. (Convention on the Right of Persons with Disabilities; 2017)¹³

¹³ https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/61/106



1.2 Concise History of Inclusive education in India

Inclusive education is a process of educating all the children in the same and safe environment of the schools. It emphasizes all the children (including different disabilities) to play and communicate among each other. Disability should not be any kind of barrier in the education system among the children. Every child is entitled to a high-quality education and learning experience. Few studies shows that the children with learning disabilities are often ignored in decision making and also limiting themselves not to go for higher education and not participating in any of the political or social activities (Singal, N, 2006).

Over the last five decades, the Indian government has worked hard to provide a broad range of services for the education of children with disabilities. In 1883, Bombay established the first school for the deaf, and Amritsar established the first school for the blind in 1887 (Singh, J. D., 2016) The government sponsored scheme for Integrated Education for Disabled Children was established in 1974 to offer children with special needs with equal chances in mainstream schools and to aid their retention. With the help from government sponsored scheme, number of schools for have increased in a good number, such as 32 for blind children, 30 for deaf and 3 for intellectually disabled (Sanjeev, K., & Kumar, K, 2007).

The Rehabilitation Council of India Act of 1992 established a training programme for professionals to cater to the needs of disabled students. The National Policy for Persons with Disabilities, published in 2006, aims to establish the framework within which the government, public society, and private sector must function in order to promote a decent standard of living for disabled people and support for their attendants.

1.2.1 Legislation and Policy

The Preamble of the Indian Constitution (26 November 1949) declares unequivocally that everyone has the right to equality of position and opportunity. In certain circumstances, such as disability, Article 41 of the Indian Constitution's Directive Principles supports the right to work, education, and public aid. Later, the article 45 binds to the establishment of essential and free education to all children up to the age of 14 years. Programme of Action (1992) and National Policy on Education (NPE, 1986), focused on integrating disability children with the regular children and highlighted that it is very much essential for the better communication among them. Thus, on 28 November 2001 constitution of India mentioned that all the children (including disabilities) of the age group 6 to 14 years must have free education.

In 1974, Government of India has launched a scheme called Integrated Education for Disabled Children (IEDC) and which offers various educational openings to the disabled children. This scheme offers completely free to set up various academic labs and conducting special trainings for the benefit of disabled children and also provides free materials, uniforms and transport etc.

In 1987, Ministry of Human Resources Development (MHRD) in association with United Nations Children's Fund (UNICEF) started Project Integrated Education for the Disabled (PIED) (Singal, N, 2006). The project's main purpose was to get as many impaired children as possible into regular classrooms. The major challenges of PIED are:

- To develop the general educational system in demonstration sites in order to meet the goal of providing education to all children, including those with disabilities.



- To foster a positive attitude toward students with unique needs in the classroom.
- To raise children's academic achievement Children with specific needs will be included in the demonstration sites.

PIED was implemented in several states of India especially Delhi Municipal Corporation, Baroda Municipal Corporation, Haryana, Tamil Nadu, Madhya Pradesh, Mizoram, Maharashtra, Nagaland, Orissa, Rajasthan (Sanjeev, K., & Kumar, K, 2007). PIED has come with a very good impact on the attitudes of students, teachers, school administrators, parents, and the general public. In addition, the relationship between impaired and non-disabled children is positive.

During 1990's, a new approach termed as District Primary Education Programme (DPEP), where it mainly examined key curriculum concerns, such as what reasons limit certain children's access to education. The DPEP paved the way for children with special needs to get learning opportunities that were adapted to their specific needs (Rao, D. B, 1998). Initially DPEP was implemented in few states with a small number and has got popular, from 1998 to 2014, DPEP has been successfully implemented in 18 states.

1.2.2 Inclusive Education in Sarva Shiksha Abhiyan

Sarva Shiksha Abhiyan (SSA) is an Indian government initiative intended at ensuring that all children receive basic elementary education in a timely way (Ward, M, 2011). Constitution of India proposed in the 86th amendment that education should be made available free for all the children from the ages to 6 to 14. In 2011-12, the government of India has assigned a budget of 21 crores. SSA grants up to Rs.1200/- per kid each year for impaired children's integration, based on particular suggestions.

On February 7, 1996, the Persons with Disabilities (Equal Opportunities, Protection of Rights, and Full Participation) Act of 1995 went into effect. This policy is a major turning point in the fight to ensure equitable opportunities for individuals with disabilities and their full participation in the nation-building process. At present, Government of India is providing free education for all the children in all the states.

The Government of India had proposed several acts and schemes are listed below:¹⁴

- 1987 The Mental Health Act
- 1992 The Rehabilitation Council of India
- 1995 The Person with Disabilities Act
- 1999 The National Trust for Welfare of Persons with Autism, Cerebral Palsy, Mental Retardation, and Multiple Disabilities Act

List of major institutes that offer education to all the children are given below:

- National Institute for the Empowerment of Persons with Intellectual Disabilities
- Centre for Disability Studies and Action
- Sanskriti University
- Kalasalingam University
- Netaji Subhash Open University

¹⁴ <https://vikaspedia.in/education/parents-corner/guidelines-for-parents-of-children-with-disabilities/legal-rights-of-the-disabled-in-india>



- Durgabai Deshmukh College of Special Education
- Banaras Hindu University
- Ashtavakra Institute of Rehabilitation Science and Research
- Kalasalingam University
- Amity University

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- http://www.rehabcouncil.nic.in/writereaddata/approved_inst.pdf



1.3 Concise History of Inclusive Education in Bangladesh

1.3.1 Inclusive Education and the Bangladesh Context

Bangladesh is a small Asian country that is progressively implementing inclusive education. Inclusive education means having an equal education provided to disabled children in every institution in Bangladesh. For whatever reason, no organization can exclude the enrolment of any disabled student (ILO, 2013). According to the 2012 Pre-Primary Education Expansion Project, inclusive education involves having an acceptable education program that recognizes and promotes the diversity of children (DPE, 2012). Although there have been overall advances in education achievement worldwide, disabled children are still among the most excluded groups. They would be less likely to be involved in and pursue their education relative to their counterparts without impairments (WHO, 2011). Bangladesh is entitled to about 40 million heterogeneous learners, who are provided with a huge and intricate education system (ADB, 2018). Education resources remain accessible through traditional and experiential learning modes offered and complemented by the government as well as non-profit communities. In a region where the prevalence of disability is 9.1 percent, social inclusion and equality for disabled children are becoming increasingly important in academic planning and strategies (UNESCAP, 2019). Due to active groups and a robust development structure, the government's views and practices on disability inclusion in services such as education are transforming. Current legislation and rules include significant measures to support Bangladesh's initiatives to maintain that disabled students are educated in inclusive environments. This article aims to provide a comprehensive summary of Bangladesh's inclusive education policies and practices.

1.3.2 Policy and Regulatory Guidelines

The government has developed a regulatory environment that promotes individuals with disabilities to engage fully in society. Bangladesh doesn't truly have a foundation for inclusive education. Existing legislation, regulations, and obligations to the CRPD and the Convention on the Rights of the Child, on the other hand, ensure that all children receive an equal education. Bangladesh has been authorized through its 1972 Constitution to get such a "uniform, mass-oriented and universal system of education and extend free and compulsory education to all children" (Article 17) and protect its people against discrimination on the grounds of "religion, race, caste, sex or place of birth" in attempting to access or "admission to any educational institution" (Article 28) (Constituteproject.org, 1972). The Primary Education legislation of 1990 granted all children in either form of academic organization access to compulsory primary education (MoPME, 1990). In 1995, the first National Disability Policy was enacted, establishing standards to guarantee that disabled people obtain accurate diagnosis, education, treatment, and employment, along with several other basic rights (CLCBD, 1995). In 1996, a framework to implement this policy was adopted. Bangladesh established a novel educational policy in the year 2000, which recognized the principle of incorporating special-needs children into conventional education (NFD, 2000). The Bangladeshi Parliament passed "The Bangladesh Persons with Disability Welfare Act (2001)", which is a substantial disability regulation (ILO, 2001). A National Coordination Committee on the Rights and Protection of Persons with Disabilities (charged with organizing all government of Bangladesh impairment efforts) then established the National Disability Initiative on Disability in 2006 (BLAST, 2015). The UN Convention on the Rights of Persons with Disabilities (CRPD) was enacted by Bangladesh on November 30, 2007, and the objective of this report is to analyse the facts and circumstances of disabled people in Bangladesh, to address the aforementioned civil rights issues, as well as provide recommendations to the Bangladeshi government on how to ensure that initiatives to strengthen the rights of disabled people are successful



(BLAST, 2019). Under the National Education Policy 2010, equitable prospects have been provided for all forms of disabled and impoverished students and decreased distinctions among diverse socio-economic, ethnic, and socially disadvantaged children (Malak et al., 2013). Whereas the Rights and Protection of Persons with Disabilities Act of 2013 guaranteed equality and the right to education for people with impairments, it established a relatively restricted concept of inclusive education as schooling offered solely to children with special needs (ILO, 2013). The prospective National Education Act of 2016 is intended to include regulations aimed at improving educational standards by ensuring that all children attend school (MoEDU, 2016). Despite the existence of key legal provisions that favour inclusion, there are requirements that directly or indirectly promote segregation. In the year 2019, an Integrated Special Education Policy comes into place. Disability-inclusive education has reached a number of significant breakthroughs.

Social laws, policies and programs	Adoption
Primary education (compulsory) act	1990
Constituted a national coordination council on disability under the ministry of social welfare	1993
National policy on disability	1995
Adopted Action plan on disability strategy for the execution of the national policy	1996
Established national organization for the improvement of disabled persons	2000
Welfare Act for People with Disabilities	2001
Approved national plan of action-II	2006
Bangladesh's government adopted the UN convention on disabled persons	2007
Formed a disability rights monitoring committee and a nationwide council of law and legislative groups	2009
National education policy	2010
Rights and protection of persons with disabilities act	2013
Neurodevelopmental trust act	2013
Children act	2013
National education act	2016 (draft)
Fourth primary education development program	2018 (ongoing)
Integrated special education policy	2019

Table 1: Important disability and education legislation, plans, and practices.

Source: Islam & Juhara, 2021a; UNICEF, 2021.

According to the Seventh Five Year Plan (FY2016–FY2020), students with impairments and specific needs have received insufficient assistance. Inclusionary education initiatives are confined to children with moderate physical impairments, excluding those with more severe physical disabilities from school. Within the next five years, the government of Bangladesh intends to enhance funding for inclusive education (Seventh Five Year Plan FY2016–FY2020, 2015). One of the goals of the next 8th Five-year plan (2021–2025), which provides incentives to improve access to the educational system and other activities for disabled children, is to increase the number of “primary schools with accessible architecture and materials” for disabled children from 34% to 80% by 2025 (Eighth Five Year Plan (2021–2025), Dhaka, 2020).

1.3.3 Implementation of Inclusive Education on an Actual Basis

Bangladesh has successfully adopted inclusive education throughout primary level according to the Primary Education Development Scheme (PEDP II scheme) since 2002. Its ultimate purpose would have been to initiate basic and quality education available to all primary school-aged children (UNESCO,



2004). To accomplish the aims of the PEDP II, two key aspects were introduced: the PEDP II innovation incentive and a decentralization strategy.

Higher Education Institution	BA degree	MA degree	Doctorate
Bangladesh Institute of Special Education	✓	✓	
University of Dhaka	✓	✓	✓
University of Rajshahi	✓	✓	✓
University of Chittagong	✓	✓	
University of Khulna	✓	✓	
Jagannath University	✓	✓	
Noakhali Science and Technology University	✓		
National Institute for the Intellectually Disabled			
National Centre for Special Education	✓		

Table 2: Educational institutions providing academic programs in special education.

Source: Disability-Inclusive Education Practices in Bangladesh, 2021.

The PEDP II innovation incentives are designed to promote practical and creative approaches to raising the educational quality for impoverished students. The incentives were accessible from the PEDP II budget. Under PEDP II, the School-Level Improvement Plan (SLIP) and the Upazila Primary Education Plan (UPEP) promote decentralization. From its inception, SLIP served as a platform to reduce the marginalization of students who were underprivileged due to their gender, disabled children, ethnicity, or socioeconomic background. By involving community and government officials, UPEP was adopted. Now, the Fourth Primary Education Development Program 2018–2023 (PEDP4) supports the equality of opportunity for disabled students in education and aims to fulfil stated objectives set forth in the Sustainable Development Goals (SDGs), notably SDG 4 (Quality Education) and SDG 5 (Gender Equality) (UNESCO, 2018). In secondary education, the Teaching Quality Improvement (TQI)-SEP initiative has made significant strides to provide continual training assistance to secondary school teachers in order to keep them up to pace with modern educational advances, such as inclusive education (ADB, 2010).

In Bangladesh, NGOs are engaging in inclusive education-related projects. For example, Action in Development assesses the demands of different disabled children through regular visits and, if necessary, refers them towards other organizations that may offer suitable remediation. UNESCO Dhaka has indeed been working to create awareness about inclusive education and has published a number of publications to support the concept. Since 1998, the Bangladesh Protibandhi Foundation has been operating inclusive education approaches in a variety of schools. Bangladesh Rural Advancement Committee (BRAC) offers inclusive physical and behavioural training for instructors and actively promotes CWD to attend their non-formal schools by boosting community awareness. The University of Dhaka's Institute of Education and Research (IER) is also focusing on inclusive education concerns by carrying out research, creating human resources, and launching awareness-raising initiatives.

1.3.4 Key Achievements and Challenges for the Implementation of Inclusive Education Policies

Bangladesh has experienced tremendous growth in establishing gender equality in registration at both primary and secondary institutions during the last decade. It has also been successful in increasing primary attendance rates to 90% in 2019 (MOPME, 2019). According to Secondary School Certificate (SSC) result statistics, secondary teachers' engagement in TQI-SEP professional development programs seems to have had a great impact on students' achievement. Acknowledging all children's educational



rights and emphasizing policy and public initiatives on out-of-school children were appropriate beginning steps for Bangladesh's progress toward inclusive education. The innovation grant initiative was also a watershed moment for public-private collaborations in advancing inclusive education.

Research findings (Ahsan & Burnip, 2020; Islam & Juhara, 2021) from Bangladesh reflect that misleading perceptions about impairments; harsh realities of relatives, educators, caregivers, and friends towards disabled students; shortage of affordable amenities; insufficient trained educators; limitations of curriculum alteration and rationalization; non-availability of unconventional pedagogical practices; a conventional evaluation process; insufficient educational tools; lack of disability inspection and assessment methods; poor government infrastructure programs; and above all, inadequacy of government grants entail obstacles to standard education for the disabled children. Therefore, significant investments are required in emerging economies like Bangladesh to accomplish inclusive educational objectives.

1.3.5 Implementation of ICT for Solving the Current Inclusive Education Challenges

The inclusiveness and accessibility of students with impairments in service delivery processes is a priority for the Bangladesh government's ICT strategy. Ongoing projects are developed for the convenience of students with special needs:

a. MuktoPaath e-learning platform: (a2i, 2020)

Many learners, including those with disabilities, now have access to general, vocational, and lifelong education through MuktoPaath. On MuktoPaath, disadvantaged and marginalized people can acquire vocational education that is relevant to and advantageous to self-employment. MuktoPaath can be used by instructors, students, adolescents, working people, migrant workers, or families, for example. MuktoPaath currently has 1.1 million active users and serves over 187 courses.

b. Emporia web platform and mobile application: (EMPORIA, 2021)

The Emporia app is available on both a web platform and as a mobile app. The online portal allows users access to an e-learning platform as well as an employment site, particularly developed for individuals with impairments. Users have to install the mobile application on an Android mobile device. Emporia incorporates ICT classes as well as a "dynamic exam" system. The employment site provides individuals with disabilities with improved opportunities for employment and a better method to qualify for vacancies.

The app includes:

- i. Dynamic reactions depend on the nature of disability.
- ii. Users can pursue their e-learning course either online or offline.
- iii. Learners can track their progress, retake tests, and report on or rate specific courses. and
- iv. Users can create a CV and browse for and apply for jobs.

c. Empowerment of Persons with Disabilities including Neurodevelopmental Disabilities [NDD] through ICT: (EPWDICT, 2020)

This initiative intends to assist people with disabilities in developing ICT skills that will enable them to find work and contribute to a Digital Bangladesh.



The specific goals are:

- i. i. To create specialized audio and video tutorials on ICT training with voice and sign language assistance.
- ii. Developing a specialized, interactive, and accessible national e-learning platform (web portal) for people with disabilities; and (2) establishing a specialized ICT Resource Centre for people with disabilities (EMPORIA, 2021).

The Bangladesh Business Disability Network (BBDN) and the Bangladesh Association of Software and Information Services (BASIS) have teamed up to help physically challenged people gain access to information and communication technology in the future. The goal of this partnership is to increase the number of BASIS organizational members who are actively working to become disability-inclusive by increasing their awareness. BASIS can play a critical role in creating legislation with its members, the wider business group, and the government in order to provide a window of opportunity for job creation and set criteria for providing appropriate work settings for individuals with disabilities. BBDN could be a strategic partner for BASIS in dealing with disability inclusion issues and assisting BASIS members in taking advantage of the benefits of becoming an inclusive organization (The Business Standard, 2021).

1.3.6 Conclusion

To strengthen inclusive education in Bangladesh, new initiatives based on the experiences of developed nations must be implemented. Bangladesh may deliberately build connection programs between mainstream education and special institutions to attain the purpose of inclusive education by increasing the inclusion of students in ordinary schools. Bangladesh has also established specific sections for students with visual impairments, which might be expanded to include students with other forms of disabilities. It has established certain education resource centres underneath the District Education department, but such departments need not meet the standards for enrolling children with disabilities in educational programs (CSID, 2020). Further research into the effects and implications of such policy statements and activities in so many aspects of the learning culture (e.g., teacher training programs, school management, and curricular changes) might help to clarify Bangladesh's present inclusive scenario.

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2 Inclusive management of HEIs

Inclusive higher education has never been more important than it is today. Looking back at history, there has never been a greater demand for higher education, and these numbers will only continue to grow (ICEF Monitor, 2018). Higher education has become more accessible and is largely associated with better job and growth opportunities (Quality Education, 2017). Statistics show that more and more students with special needs are starting their studies at the university, which also includes learning disabilities (Mariaud, 2018).

Inclusive education is based on the idea of an adaptive educational institution that takes into account the needs of each individual (Grynova, Kalinichenko, 2018). The right of everyone to higher education, in accordance with their abilities, is enshrined in the UN Universal Declaration of Human Rights (1948). The UN Sustainable Development Goals for 2030 continue to highlight the importance of inclusive higher education, promoting inclusive education systems, including at higher education level. It is stated that much has been achieved so far in the context of inclusive and equitable education, but that there is still room for growth and development (Sustainable Development Goals, 2015). According to Helen Towle, international documents define what they should be like, but do not provide clear guidelines and recommendations on how to implement inclusive education (Towle, 2015). More specific steps on how to implement inclusive education and what support measures can be adapted to different situations can be found in national legislation. According to the European Agency for Special and Inclusive Education (EASNIE), this system varies from country to country due to its historical development and current capabilities, but all European Union countries are moving towards more inclusive education at all levels (EASNIE, n.d.).

The fact that inclusive higher education is extremely important for a person's ability to develop as a person and professionally is evidenced by a number of factors. Adults with learning disabilities generally have lower income and education levels, greater difficulty in finding work, resulting in difficulties in self-sufficiency (Towle, 2015). A 2012 survey by Statistics Canada of people with learning disabilities (15 years and older) found that these people were more likely not to complete high school than their peers. Persons with learning disabilities also obtained significantly less qualifications after completing secondary school. Almost all respondents indicated that their learning experience had been affected by their learning disabilities. The most frequently mentioned influencing factors were longer time to achieve one's goals in education, fewer course attendance and a change of course or career. Many have also experienced violence and mobbing at school. 47.2% indicated that they had attended a special education class in a regular school, which is a form of segregation (Learning disabilities among Canadians aged 15 years and older, 2012, 2015).

Liisa Laitinen explains that two decades ago, a university degree for a person with special needs meant the opportunity to find a job successfully, but now the situation is no longer so simple. It is more difficult to find a job, despite the fact that the responsible institutions are ready to help. A university degree no longer guarantees employment for these people, but higher education expands their opportunities (Laitinen, 2018).

Not only the need for inclusive education at all levels is highlighted, but also changes in the organization of the study process are encouraged. It is emphasized that teachers in universities should also be made aware of the different needs of students and how to work with them. Universities are encouraged to use universal design in their teaching (Advisory Board on English Education, 2006). The above-mentioned UN Sustainable Development Goals 2030 also state that educational institutions



need to think about how to provide an inclusive and effective learning environment for all involved (Sustainable Development Goals, 2015). German Rectors' Conference on November 8, 2016, focuses on the need to make part-time studies more accessible. Students with learning disabilities tend to choose part-time studies because it provides an opportunity to reduce the study load in the semester. However, the possibility of studying part-time usually means halving the study load per semester and doubling the duration of studies, but these adjustments do not meet the needs of students, which would be the possibility to study at a different pace within a course of study; individually structured study programs, an individual examination schedule and a course assignment schedule (German Rectors' Conference, 2016).

The example of Ireland has been used to better illustrate the increase in the number of people with learning disabilities in higher education. Ireland 2017/2018 in the academic year 38.9% of the total number of students with various types of disabilities were directly with learning disabilities. Over the last 10 years, Ireland has seen an increase in the number of students with a range of disabilities and a variety of recognized disabilities, such as the focus on students with Attention Deficit Hyperactivity Disorder (ADHD) or Students with Attention Deficit Syndrome (UDS) since 2009 (AHEAD, 2018). According to 2014 data, there are about 10 thousand students with various disabilities in Ireland, which is about 5% of the total number of students in higher education (Ryder, 2014). The example of Ireland shows perfectly well that the increase in the number of students could be explained by a more accurate diagnosis.

EASNIE acted as the main European organization for the exchange of knowledge on special needs education. This agency explains inclusive education in its perfect state as a system that provides meaningful, high-quality educational opportunities for everyone who wants to learn in the local community, side by side with his or her friends and peers. Legislation should regulate education systems, emphasizing the right of everyone to learn to inclusive and equal education. EASNIE encourages the development of inclusive education systems, enabling everyone to use their strengths to grow and succeed, to value diversity and to promote an individual approach to everyone, fostering their interest and active participation. The Agency emphasizes the importance of raising the overall level of achievement, thus raising the overall quality of education for all (EASNIE, n.d.).

2.1 Students with learning disabilities in higher education

Lois MacCullagh, studying students with dyslexia, indicates that about 5 to 12% of the entire human population has dyslexia (not necessarily diagnosed). In his studies of the situation in the United Kingdom and Greece, the percentage of students who have identified themselves as dyslexics is less than 0.5%. Students with dyslexia are more likely to drop out after the first or second year of study. One of the reasons for the low percentage of dyslexics is the choice not to disclose their diagnosis to the institution (MacCullagh, 2014).

Analysing the statistics on students with learning or other disabilities in higher education, it can be concluded that the number of such students is growing year by year and the question of how to include and provide the necessary support for people with learning disabilities in higher education is relevant. In her article, Anabel Moriña points out that the need for inclusive higher education is growing as more and more students with learning disabilities graduate successfully, and she emphasizes inclusive education as a basis for a fair and equal society (Moriña, 2017). She believes that changes are gradually being made in higher education to make it more inclusive, but she believes that there is still a long way to go before it can be considered fully inclusive, not only in the context of learning disabilities but also by people from different backgrounds socio-economic, cultural and age groups.



Susie Russak and Ariella Daniel Hellwing (2019) conducted a study analysing how students define achievement and success and what factors influenced their growth. Research sample was university students with learning disabilities who have obtained a bachelor's degree or the right to work in interest education, without obtaining a bachelor's degree. The authors' approach stood out in that they allowed students (already graduates during the interviews) to explain for themselves how they understood success. The researchers acknowledged that explanation could not always be distinguished from success factors, but these definitions provided insights into the views and values of the interviewees in a broader sense (Russak, Hellwing, 2019). This research reveals that success is explained by the interviewees as a set of internal or external factors. The combination of external factors is receiving positive feedback from others and measurable achievements (Russak, Hellwing, 2019).

Russak, Hellwing in another research (2015) wanted to find out what factors have helped students with different types of learning disabilities. The study involved students who graduated from Israeli universities (graduated in 1998-2008), five years after graduation, who had received support measures during their studies. In order to use the support mechanisms at the university, students had to submit documents proving their disability. Students commented on the factors that helped in the study process. The university (name not mentioned) is required by law to provide support for students with different needs, including learning disabilities, but in reality, these measures vary depending on the institution's funding, policy, staff and common position. The researched university offers students academic and personal support. Academic support includes individual and peer mentoring, assistive technology support, workshops on topics such as time management, taking notes, taking tests, academic reading and writing, preparing for a session such as languages or statistics, and issues that appear while studying. Personal support includes workshops on coaching, motivation, and self-confidence, as well as one-on-one counselling. These support mechanisms were designed to address the difficulties faced by students with learning disabilities in higher education, such as poor reading speeds, difficulties in writing statistics, difficulties in analysing statistics, difficulties in attending attention, difficulties in meeting foreign language requirements and planning skills (Russak, Hellwing, 2015).

Russak, Hellwing concluded that students with learning disabilities were able to complete their studies in the optimal time allotted to them - in four years. Students with learning disabilities choose a field of study with a good awareness of their strengths and weaknesses, as well as being able to use their personal experience in their professional life. Some of the students continued their studies after obtaining a bachelor's degree. Students most often used academic support mechanisms, most often for academic writing, reading and editing. (Russak, Hellwing, 2015). MacCullagh explains that the development of knowledge in higher education is largely based on reading and writing, which is one of the most difficult skills for students with learning disabilities. In his research, students with dyslexia are more likely to have difficulty taking notes, expressing ideas in writing, writing essays, and experiencing stress and distrust of university staff, thinking that they do not understand students' needs and / or experiencing negative attitudes towards students with learning disabilities (MacCullagh, 2014).

Russak and Hellwing (2015) found out that the second most frequently mentioned category of students is support in the field of time and organization, helping to structure study materials, keep track of deadlines, work on several tasks in parallel, etc. In the personal support category, students rated personality development and self-improvement workshops, for example, by discovering their strengths or learning to accept their disorder. The second area of support mentioned was interpersonal



relationships, enabling these students to feel supported and understood. Russak and Hellwing concluded that, in general, students with learning disabilities are very empathetic in a variety of situations, as they have experienced many. When studying the effects of learning disabilities on personal life, the researchers found that attitudes towards them were changing. The interviewees see it as a motivator, the achieved goals prove their ability. According to the authors, the importance and impact of support measures is also demonstrated by the fact that five years after graduation, students still remembered them (Russak, Hellwing, 2015).

Just like success, the reasons for growth are divided into internal and external, according to Russak and Hellwing (2019). Internal motivators for growth are setting realistic goals, purposefulness and relentlessness, belief in oneself and one's abilities, learning disabilities as a motivating factor, the use of strategies, and the desire to assert oneself and others. It seems particularly significant that these interviewees emphasized their disruption as a factor in growth. They explain that this has made them much more aware of their strengths and weaknesses. As external factors for growth, interviewees mention the courage to adapt the environment to their needs and the people who have been around and supported: friends and family. One of the main conclusions of the authors is that in order to set realistic goals for oneself, a person must be aware of his / her strengths and weaknesses (Russak, Hellwing, 2019).

In order to be able to talk about successful students with learning disabilities, Moriña believes that it is necessary to include the principles of inclusive education in higher education, as well as to base the teaching approach on the social model. Barriers to success take the form of discrimination and oppression, and universities should avoid using diagnoses to identify students with learning disabilities, avoiding stigma and stereotyping. Moriña explains that in the medical model, learning disabilities are perceived as an individual problem (Moriña, 2017) and therefore she suggests using social model.

Susan Grimes, Erica Southgate, Jill Scevak, and Rachel Buchanan studied why some university students choose not to identify that they have a learning or other disability. This group of researchers conducted a survey of Australian students using both closed-ended and open-ended questions. People who choose not to disclose their disorders to the institution are an unconscious part of the population and therefore little studied (Grimes, Southgate, Scevak, Buchanan, 2018). During their study, they reformulated disability as a learning challenge, thus trying to avoid stereotypical and deficient language. Second, most institutions require formal confirmation that a student has a disability, but in their survey, researchers chose to allow students to rate themselves according to the Higher Education Statistics Agency's British classification system for the type of disorder they have (Grimes et. al, 2018). Data analysis revealed that students with invisible disabilities (learning disabilities or mental health problems) most often choose not to disclose their diagnosis to the university. Studying at a university provides an opportunity to form a different image of oneself that is not based on a person's disorder, as well as feared a change in attitude. Students with learning disabilities most often mentioned that they had developed learning strategies because they had already received support at previous levels of education. General support is available to students, so they do not feel the need to seek further help. However, just over 30% said they did not know where to get support, and just as many did not consider the help offered to be useful. Students also chose not to disclose their disabilities to the university because they were afraid of changing their attitudes. Younger students (under 25) more often chose not to ask for help from the institution (Grimes et. al, 2018).



Moriña highlights three key themes in existing research on inclusive higher education from a student perspective: barriers to learning for students with disabilities, the transition from secondary to higher education, and students' doubts, or revealing their disabilities if they are invisible. On the other hand, on the part of the university: the attitude of the staff towards students with various disabilities, the need for the university staff to be better prepared and the application of a universal learning design in the study process. Analysing the research, Moriña concludes that the main obstacle for students is the negative attitude of university staff towards people with various disabilities, for example, professors question the authenticity of students' disabilities or the inflexibility of exam schedules. Although many of these barriers are also mentioned by students without any kind of disability, these problems are even more complex for people with different types of disabilities (Moriña, 2017).

Researching why some students choose not to share information about their disabilities at university, it is concluded that young people perceive learning as an individual responsibility. Asking for help could, in their view, diminish the strength and / or importance of the degree obtained. Some students chose to reveal their problems to only a few teachers if they saw the need and trusted the person. Students chose not to disclose their disruption to the university for fear of correct data processing and possible transfer of information to a future employer. Fear of prejudice and stigma also dominated the answers to open-ended questions. Students did not want to look less competent than others, and by not revealing their disorders, they avoided the negative reactions they had experienced before. The cost of diagnostics also deterred some students from informing the university, and some felt that some students considered their disabilities to be insufficient to seek help. In general, the reasons for not disclosing one's special needs to the university are based on sound arguments, taking into account the positive and negative consequences. As concluded by Grimes et. al, it is up to each student to choose whether or not to reveal their difficulties and disabilities to the university, but thus students risk their academic growth when trying to build a new identity. Although some students choose not to reveal their disorders when trying to be a normal student, this requires a review of what is considered normal and how to reduce the desire to aspire to certain norms. Researchers believe that universities should accept that students may or may not choose to disclose their disabilities. They should be prepared to act if a student informs individual university staff about their problems. It is important to inform students about the possibilities of receiving support and to continue educating university staff about various disorders, how to react when a student trusts, and to reduce stigma (Grimes et. al, 2018).

Less often, research focuses on the transition from high school to university. This transformation can be difficult for any student, but it can be particularly difficult for people with different disabilities, as the university environment requires academic and social adaptation. Also, students do not always know where to seek help and what their legal rights are. Special support is needed during the first weeks of the study year. Universities that focus on engaging students with learning disabilities, providing support, mentoring new students are seeing positive results and fewer drop-outs than before the introduction of these measures (Moriña, 2017).

On the part of the university, especially the lecturers, an international study by Allison Lombardi, Boris Vukovic and Ingrid Sala-Bars in Spain, Canada and the United States found that US lecturers were most active in supporting inclusive education in lectures. and the need to provide appropriate learning materials for each student. Canadian teachers demonstrated the best knowledge of inclusive education in terms of legislation. Like colleagues in the United States, they expressed the need for environmental accessibility. The Spanish colleagues showed the lowest results in all the categories analysed. In practice, US teachers were best placed to make inclusive assessments and make course modifications. Spanish colleagues created more accessible course materials, which were also high in



Canada, and used inclusive strategies in lectures. Canada had the best environmental accessibility (Lombardi, Vukovic, Sala-Bars, 2015). It can be concluded that ideologically universities support inclusive education, but teachers are not always ready to implement it.

Lombardi, Vukovic and Sala-Bars also emphasized the implementation of universal design in the university curriculum, which would help not only students with various disabilities, but also those groups of students who are at risk due to historical development. The systematic use of universal design would also reduce the two most requested support measures (more time in the exam and support for taking notes) among students with learning disabilities. However, a national survey in the United States reveals that there are insufficient resources and lack of interest from teachers to implement such a design (Lombardi et. al., 2015).

Despite the barriers, students with all kinds of disabilities believe that as many young people as possible should have access to higher education, as this opens up employment opportunities. Those involved in the study process benefit from diversity.

Moriña's **recommendations for higher education administration**: ensuring that the physical environment is accessible to all, recognizing that the transition to higher education is a particularly sensitive process for students with various disabilities, and that it is important to train teachers to work with students with different needs (Moriña, 2017). The research covers four main topics: the experience of students with learning disabilities (or disabilities in general) in higher education, the attitudes and activities of teachers in working with students with learning disabilities, the importance of university support measures, and the student dilemma of whether or not to disclose their problem. Most of the studies analysed highlight that there is no clear picture of how many students have different types of disabilities. The least information is available for students with invisible disabilities. Students with invisible disabilities, including learning disabilities, are afraid to reveal their problem to the university, worrying about stigma, a change in attitudes from teachers, and a decline in the importance of the degree obtained.

The university is a place where students can create a new image of themselves, as most of the people around them are unfamiliar. The analysed articles show that some students choose not to disclose their disorder to the university, because their authenticity is questioned, as well as the submission of official documents causes great discomfort. Students choose to disclose their challenges to those closest to them or, if necessary, to some advantage, such as tuition fees.

Given that the study process is largely based on the reading of academic literature and the creation of various types of written work, support at university for students with reading and writing disabilities is particularly important. Researchers mention the use of universal design in the learning process, which would help not only students with learning disabilities, but also students in other risk groups. For students with learning disabilities, this would help reduce the need for the most common support measures (taking notes and taking longer in exams). Although at the ideal level, universities support the introduction of universal design as a step towards inclusive higher education, in reality teachers do not have the desire or time to do so (Raue, Lewis, 2011). The introduction of universal design is also hampered by the financial capacity of each institution.



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3 Inclusive Teaching Pedagogies

3.1 Inclusion, equality, and access for students with disabilities in higher education

The existing normative documents at the global, European, and national levels presuppose the implementation of the process of inclusive education, but the noted normative constructs are only a predictor of inclusive activities in which accessibility and equality for people with disabilities are realized, incl. and for students with disabilities at HEIs.

As Parrilla (2002) states “inclusive education does not signal a new approach to education, nor is it limited to the sphere of education; rather it stresses equality above difference and embodies new ethics and cultural and educational enrichment throughout the entire educational system. However, educational inclusion is described as an open, dynamic process under constant construction and analysis, so the time dimension sometimes poses the complex dilemma of the right to inclusion contrasted with the conditions under which this inclusion takes place.” It depends on the educational organizations, the people inside and outside them, how the inclusive policies, reflected in regulations, laws and other normative acts, will be implemented for the students with disabilities in the higher educational institutions. Higher educational institutions are the ones that can and do provide access, and access means equality in the communication, rights, education and social functioning of every student, regardless of the neurodiversity of which he or she is a carrier.

The very concept of “accessibility” is most often defined as “the ability of a particular system, space, materials, products without the need for any changes in them to be used by all people completely independently.” In this definition, accessibility approaches the universal design of architecture and interior design, initially developed by Mace (1985).

Accessibility should not be confused with usability, which is “the degree to which a product (such as a device, service or environment) can be used by certain users to achieve certain goals with efficiency, effectiveness, satisfaction with convenience in a particular context of use” (Li et al., 2018; Web Accessibility Initiative. Retrieved 2020). “Accessibility” is a multi-dimensional construct, so it meets multi-layered definition, differentiation, and application in all spheres of life. Most often, accessibility is debated about people with disabilities, but accessibility applies to all people.

DIRECTIVE (EU) 2019/882 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 April 2019 on accessibility requirements for products and services uses the term “persons with functional limitations”, which refers to “persons who have any physical, mental, intellectual or sensory impairments, age-related impairments, or other human body performance related causes, permanent or temporary, which, in interaction with various barriers, result in their reduced access to products and services, leading to a situation that requires those products and services to be adapted to their particular needs”.

Article 13 states that “CRPD requires its Parties to take appropriate measures to ensure that persons with disabilities have access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas.” The United Nations Committee on the Rights of Persons with Disabilities has identified the need to create a legislative framework with concrete, enforceable and time-bound benchmarks for monitoring the gradual implementation of accessibility.



According to Article 14 the UN CRPD calls on its Parties to undertake or promote research and development of, and to promote the availability and use of, new technologies, including information and communications technologies, mobility aids, devices and assistive technologies, suitable for persons with disabilities. The UN CRPD also calls for priority to be given to affordable technologies.¹⁵

In the Council Resolution on a strategic framework for European cooperation in education and training towards the European Education Area and beyond (2021-2030) (2021 / C 66/01) as a strategic first goal for creating a European Education Area by 2025 is noted: Improving quality, equity, inclusion and success in favour of fair and equal access to the education system for all. Special attention is paid to ensuring “a truly inclusive education and equal opportunities for all learners at all levels and types of education and training, academic attainment and achievement should be dissociated from social, economic and cultural status, or from other personal circumstances”, as well as for “All other actions towards broader inclusion are to be encouraged, such as supporting access to inclusive quality education for persons with disabilities.”

Inclusion seems therefore to be the correct path to be followed in order to reduce the distance between people and prevent phenomena of exclusion, even though sometimes the research of inclusion creates itself events of macro/micro-exclusion (D’Alessio, 2013)

Special focus in the present study is placed on access as a key to equality for students with disabilities from Higher educational institutions.

Disabilities are a social construct and are most often defined according to norms and criteria. Often these norms and criteria lead to exclusivity (Mercer & Mercer, 1985). Twice exclusivity or twice-exposes both disability and talent/genius. Thus, double exclusivity brings talent/genius to the level of social acceptance, and disability is alleviated and even forgotten. Logically, the question arises: What happens to undiscovered gifts, opportunities, potential in case of disability due to lack of access? Due to the social weight of “disabilities”, despite their diversity, they cannot be synonymous only with bad, only with evil, only with the wrong. Such interpretations lead to strong discrimination. The social acceptance of the concept of “disability” is associated mainly with lack, insufficiency, destruction, or dysfunction and introduces a social categorization. Social categories derive social perception and social groups. In the academic space, there are various social groups with different levels of social acceptance. Hence, accessibility is specified as social accessibility (according to Goffman, 2009; Shinohara & Wobbrock, 2011; Li et al, 2018).

Jaeger and Bowman (2005) remark, access debates concerning disability have not been limited to physical access (access to objects and places), but also include intellectual access (access to ideas, which in turn includes access to education, for instance); it is “a multifaceted concept with impacts on every part of daily life.” A similar view of access in the context of its application and influence in its daily functioning is shared by Carpentier (2015): “as a concept, access is very much part of everyday language, which makes clear definitions rather rare” which access is inherently inherent, noting that “access is utilized conceptually in a wide variety of (academic) fields, which we can use to deepen our understanding of this concept.” Carpentier (2015) considers access through the prism of the synergy of access with participation and interaction. As he notes: “From this perspective, the conflation of

¹⁵ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0882>



access, interaction and participation is part of the struggle between the minimalist and maximalist articulations of participation” (Carpentier, 2015).

The main focus of accessibility as a key tool for achieving the goals of “full participation” and “equality” was placed back in 1982 in the Program of Action for People with Disabilities (A/RES/37/52).¹⁶

Without providing a historical overview of the concept of accessibility, it can be noted that the Convention for the Protection of the Rights of Persons with Disabilities,¹⁷ still in the Preamble,

(v) noted the "importance of ensuring access to the physical, social, economic and cultural environment, to health and education, to information and communication, to enable people with disabilities to enjoy their full rights and fundamental freedoms."

Also, the General Principles of the Convention refer to the principles:

(d) equal opportunities and

(e) accessibility.

Art. 9 is entirely dedicated to accessibility. Accessibility is defined in the Convention as a cross-cutting issue, which allows people with disabilities to live independently and to participate fully in all aspects of life. In the synergetic aspect, Art. Article 19 deals with independent living and inclusion in the community, Article 20 deals with personal mobility, and Article 21 deals with freedom of expression and access to information.

According to Suleymanov (2015), the existence of a clearly declared agreement in the world that all students have the right to education, expressed in universally important documents, as well as the presence of many good practices for teaching and learning, theoretical and practical experience of schools indicate that the results of inclusive education are obtained after serious and energetic social reforms and innovations.

Accessibility is not a consequence of the overall educational process, but it is necessary to anticipate, plan and include in the design of the physical, digital and educational environment.

Accessibility can be ensured in different ways, but there should be a holistic approach to ensuring it. Cooper (2006) shares this view, noting that “accessibility must include all aspects of student-educational interaction.” Inclusion is a dichotomous process. overcoming barriers - on the one hand, educational institutions need to change by introducing ever-inclusive models of learning and social interactions, and on the other hand, students with disabilities also need to change by striving to maximize their potential you are.

Inclusive education ensures equality, access and quality in and from the educational institution for all actors on its stage.

¹⁶ <https://www.un.org/development/desa/disabilities/resources/world-programme-of-action-concerning-disabled-persons.html>

¹⁷ <https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf>



According to McGovan (2015) “Equity is, however, close in meaning to ‘equality of opportunity’, and just as a subject to ambiguity and diversity of interpretation.” He derives three principles for understanding equity of access: accessibility, accessibility and horizontality. McGovan determines the availability in relation to the total number of vacancies and the availability of appropriate facilities, teaching staff, etc. He Examines horizontal systems in two aspects of systemicity: from the standpoint of highly specialized forms of education, which are not limited in their capabilities by previous trainings with socio-economic privileges, and from the standpoint of illegitimate limitation of valuable opportunities for the few based on perceived needs. society only by a small proportion of high-ranking workers. He argues that having access to higher education is important primarily because of the enhancement of the lives of those engaging with it - and if it is indeed an intrinsically and instrumentally valuable experience, then it should be made available to as wide a proportion of the population as possible.

3.1.1 Types of the accessible environment

The accessible physical environment and the learning process provide the most effective start to the design of a supportive and inclusive environment. Access to the physical environment is most often associated with personal mobility, and independent living in different changing spaces, in different buildings, and when using different products and materials in everyday and educational contexts.

An interesting interpretation of disability and accessibility of the learning environment is given by Cooper (2006) - “disability is ... an artifact of the relationship between the learner and the learning environment or the way it provides learning. Accessibility, redefined in this sense, is the potential of the learning environment to adapt to the needs of all learners. It is determined by the flexibility of the virtual system (in terms of presentation, control methods, ways of accessing and assisting the learner)”, (Cooper, 2006). In this discourse, the learning environment in universities becomes an accessible learning and self-learning environment in terms of the needs of students with disabilities and the inclusion of all students.

The accessibility of the learning environment would increase if the following are applied in the learning process:

- the principles of universal training design,
- training models related to neuro-education and neuro-pedagogy,
- personalized training,
- digital technologies, including mobile applications,
- adaptive technologies for students with SEN,
- assistive technologies,
- innovative learning models with innovative technological solutions,
- and other.

In the application of the targeted educational designs, accessible educational content is designed for each student *with and without disabilities*, the commitment of each student increases, and the learning experiences are positive. The investment is worth it because the prosperity of each student and his general academic well-being is visible.

Accessibility is about **equality** and **overcoming negative stereotypes**. When commenting on accessibility, the first association is with inclusive pedagogy in the context of students with disabilities.



The question remains about the dichotomous inclusion or how non-disabled students and professors are included in a learning environment in which there are students with disabilities by overcoming negative attitudes and negative stereotypes without showing leniency and regret but supporting students with disabilities. According to generally accepted norms, “people who depend on us must be helped” and this norm is defined as “the norm of prescribed reciprocity” (Coleman, 1998; Cialdini, 2001, Eisenberger et al 2004).

Theories of identity, and especially the theory of social identity, are important for understanding the diversity of students and ensuring accessibility for them in higher education. Every negative stereotype, every negative stigma is a barrier to the formation of actual, virtual, and multi-captive identity. As Biane points out, actual identity is about everyone's beliefs about themselves, virtual identity is associated with the beliefs of the people with whom one communicates virtually and what they think of the other person. The discrepancies between actual and virtual identity lead to stigma in everyone.

But stigma can also have a positive effect. Stigmatized individuals often function as well as non-stigmatized individuals (Miller and Kaiser, 2001). According to Shih M. (2004), stigmatized individuals develop skills to compensate for the stigma. These skills help them build their goals and overcome the obstacles and inconveniences associated with stigma (Miller, Major, 2000). Shih M. (2004) sets out three strategies for overcoming the adverse effects of stigma and in this sense defines “positive stigma” or stigma that creates new conditions and motivation for success and efficiency. These strategies include self-defence strategies about stigma, compensation, strategic manipulation in the interpretation of the social environment to protect their world, the world of people with disabilities. As Shih points out, stigmatized individuals make selective comparisons. People with disabilities are compared to both people with disabilities and people with disabilities in their community.

Inclusive education is not an umbrella for public and social protection, which includes students with disabilities, it is not an activity carried out in a paternalistic form, it is not a type of charity. When all participants in the academic learning environment (students without and with disabilities, professors, administrators) accept disabilities as natural individual differences, then full inclusion is realized. The situation is specific in which there is internal institutional stigma despite the presence of inclusive practices. It is usually observed when groups are determined in the educational institution not by academic criteria, but by criteria related to physical and/or mental health, origin, etc. For example, defining a 'group of students with disabilities can be stigmatizing and hamper equality, access, and educational and social inclusion.

3.1.2 Digital accessibility

Another aspect of accessibility for students with disabilities in HEIs is related to digital accessibility, which is important to comply with the World Wide Web Consortium's (W3C) Basic Web Accessibility Guidelines (WCAG) 2.0 (2008).

Access to web presented content is based on four principles:

1. “Perceivable - Information and user interface components must be presentable to users in ways they can perceive.
 - This means that users must be able to perceive the information being presented (it cannot be invisible to all of their senses)
2. Operable - User interface components and navigation must be operable.



- This means that users must be able to operate the interface (the interface cannot require interaction that a user cannot perform)
3. Understandable - Information and the operation of the user interface must be understandable.
 - This means that users must be able to understand the information as well as the operation of the user interface (the content or operation cannot be beyond their understanding)
 4. Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.
 - This means that users must be able to access the content as technologies advance (as technologies and user agents evolve, the content should remain accessible)

If any of these are not true, users with disabilities will not be able to use the Web”.¹⁸ In the same document are derived models for accessibility to use Word documents, images non-text objects, data tables, links, images requiring long description, PDF files, slides of the presentations, video, audio, different types of online applications.

Digital accessibility should also be introduced in the used electronic learning platforms such as Moodle, Google Work for Education, Microsoft Teams, DSpace, Students Portals, Institutional Portals, Portbase 5, and many others.

Marked and other popular accessibility models make access ubiquitous. In this context, Jaeger (2011) notes “the ubiquitous nature of the Internet and accompanying services and technologies now makes equal access to and participation in the online environment a social necessity for education, employment, finance, and civic engagement.”

“The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect.”¹⁹ In the words of Tim Berners-Lee, W3C Director and inventor of the World Wide Web, the exceptional importance, importance, and influence that the Internet has on overcoming individual differences and the variety of opportunities and needs for each person is evident. On the same website, the W3C Web Accessibility Initiative (WAI) brings together people from the industry, disability organizations, government, and research labs from around the world to develop guidelines and resources to help make the Web accessible to people. with auditory, cognitive, neurological, physical, speech, and visual disabilities.

WAI's coverage of web accessibility includes:

- “web contents” - websites and web applications.
- authoring tools, such as content management systems (CMS) and blog software.
- browsers and other “user agents”.
- WAI-ARIA specification for accessible rich Internet applications.

Digital accessibility is related to Internet access and Internet connectivity. People with disabilities may also be restricted in their access to and use of the Internet by a wide range of factors, including

¹⁸ <https://www.w3.org/TR/UNDERSTANDING-WCAG20/intro.html#introduction-fourprincs-head>

¹⁹ <https://www.w3.org/standards/webdesign/accessibility/>



accessibility issues with Internet Service Providers (ISPs), the ability to afford hardware and web browsers that are not compatible with vital assistive technologies.” (Jaeger, 2012).

Gurstein (2000) mentions access to the carriage, devices, software tools, content/services, service/access provision, and literacy/social facilitate (skills).

According to Carpentier (2003), the core of the digital divide discourse is based on the articulation of three elements:

- 1) the importance of access to online computers,
- 2) whose use results in increased levels of information, knowledge, communication, or other types of socially valued benefits,
- 3) which in turn, are so vital that the absence of access and the resulting ‘digitize’ (or computer illiteracy) will eventually create or maintain a dichotomized society of haves and have-nots.

For students with mobility disabilities, Web accessibility is a predictor of equality in the learning process. They do not have to overcome physical, spatial, meteorological, transport, and time barriers to attend school. In synchronous online learning, the accessibility of the Web eliminates these barriers for students with disabilities. In asynchronous learning, students with sensory, cognitive, neurodevelopmental disorders can use its ubiquity and read learning materials, learning resources, and the study content in the respective discipline without the need for a personal/social assistant. With a combination of synchronous and asynchronous learning, professors and administrators have greater opportunities to provide personalization of learning. At the same time, online learning should not be favoured in either a synchronous or asynchronous model, because online learning does not create as good conditions for social contacts and social interactions and social-emotional learning as face-to-face learning. Undoubtedly, education in HEIs has changed under pandemic and epidemiological conditions. Not only lectures, seminars, but even practical and laboratory exercises can be realized in a virtual environment with remote access. Higher education for students with disabilities, inclusion, equality, and access allows as the most effective hybrid model of education according to their needs and potential. In this context, personalizing the organization and management of the academic process (learning, social and emotional interactions in student life, sports, arts, cultural activities, etc.) for students with disabilities is a new challenge for their inclusion.

Digital accessibility is inevitably linked to universal access in human-computer interaction (Zubair et al, 2021). As noted by Lindsay & Brown (2005): more often “there are accessibility recommendations that are specific to a context, but there are also important accessibility recommendations that meet the needs of target groups and remain valuable in several contexts.” Common barriers, note: “incompatibility between pages and screen readers, incorrect or non-existent labelling of links, form elements and frames, cluttered and complex page structure, ALT tags non-existent or unhelpful, confusing and disorienting navigation, inappropriate colours and poor contrast, unclear and confusing layout, graphics and text size too small, lack of alternative media for audio and complex language, complicated language/terminology” (Lindsay & Brown 2005).

Inclusion is essentially related to access. Universal access does not allow environments and spaces in which students are categorized according to physical and/or cognitive and/or social capabilities. Access is synonymous with equality, social justice, and humanity. Whether access is provided with or without technology provokes and is a foundation for equality and inclusion for students with diverse opportunities and possibly unique potential.



Undoubtedly, there are emerging circumstances regarding the development of access and equality in the digital environment, in the development and application of digital technologies and digital resources. These new circumstances can be positioned in the academic space, in the space of social interactions, in the space of self-reflection, and general in the space of everyday life. Among the new circumstances that are in focus can be noted the digitalization of accessibility in connection with the development of digital inclusive education. The latter can be interpreted as conducted in a digital environment and as using digital technologies. In both cases, access is required for all HEIs students.

Accessibility needs to follow the innovative application of technology or accessibility also needs to evolve in line with technological developments. For example, the EDUCAUSE Learning Initiative (ELI) as a strategic initiative of EDUCAUSE and a community of Higher educational institutions and organizations committed to the advancement of learning through the innovative application of technology, offers the following scheme for advancing learning through technology.²⁰

Van Dijk & Hacker (2003) derive a typology of digital inclusion. This typology includes mental access (related to motivation, confidence, and attractiveness to use the human-technology interface); material access (opportunity to use technological interfaces and connect to networks); skill access; and usage access (relating to the use of sophisticated information and communication processes as opposed to basic tasks, entertainment, etc.)

Thompson et al. (2014) comment on digital inclusion and digital exclusion, noting several areas of access (e.g., physical access), literacy (e.g., intellectual access), and cultural factors (e.g., social access). As Jaeger (2005) notes, advocating for accessibility, formulated as an issue of equality, human rights, and social justice, may offer a better way to promote tangible changes in attitudes and the implementation of online accessibility. He added that access to the Internet was “a matter of social justice”, noting that “Institutions of social justice, such as public schools and public libraries at the local level and the W3C (World Wide Web Consortium) at the international level, exist to ensure the necessary digital literacy to use the Internet and the necessary guidelines to design an inclusive online environment.”²¹

For students with disabilities, digital inclusion is a possible and affordable mission. According to the UNESCO Institute for Information Technology in Education, e-learning removes spatial barriers - physical classrooms become unnecessary in the traditional sense of the word and students can join courses in the virtual learning environment of their choice (UNESCO Institute for Information Technologies in education, 2006).

Inclusive education applies to every professor, administrator, and student in HEIs. Through the application of innovative learning models, through the introduction of the competence approach, through global learning, through digitalization, it is clear that education can be an education that values all differences, education for different learners that ensures equal rights, accessibility, and inclusion. Because each learner is unique and the education of the future will motivate learning, will bring personal development to all students according to their strengths and needs, and each professor will have more and more opportunities to develop their innovative and creative potential. Then

²⁰ <https://www.educause.edu/eli/initiatives/key-issues-in-teaching-and-learning/>

²¹ <https://journals.uic.edu/ojs/index.php/fm/article/download/6164/4898#p4>



inclusive higher education will be such a natural model of education that it will not even be noted as a feature, because humanity lives as an inclusive society.

3.2 Education 4.0, inclusive education in higher education in normal and crisis situations

In the conditions of the information society and the technological revolution 4.0, the wide inclusion of information and communication technologies in school education leads to a change in the organizational model of educational organizations. Organizational change is aimed at the development of the virtual school environment within traditional university organizations, through the construction of WEB sites, e-administration, e-libraries, virtual learning environment (VLE), electronic resources, cloud platforms, blogs, social media pages' networks, etc.

Thus, various elements of Education 4.0 can be successfully introduced in educational practice. In particular, these are:

- Flexible learning content and curricula - "phenomenon-based" learning (Mattila, Silander; 2015).
- Personalized learning - neuropedagogy and e-learning (Kohn; 2016).
- Blended learning and effective use of ICT in education, building a school in the cloud (Pengelley; 2017).
- Strengthens the practical orientation of education and determines in a new way the development of the curriculum and assessment procedures.
- Interdisciplinarity in learning - The integration of knowledge, skills, and attitudes from one subject area to another.
- Emphasis on the practical value and usefulness of knowledge - learning by doing, expanding practical training.
- Stimulates creativity, creativity, and innovation in the educational process.
- Problem-based learning - transfer to solve problems in various non-standard situations.
- Use of interactive teaching methods - project-based learning.
- Meaningful implementation of technologies in education - 1: 1 model, cloud technologies
- Collaborative training and teamwork of students.
- Development of an inclusive academic environment.
- Constant search for new forms and types of training (mobile devices, Internet of Things, artificial intelligence).
- Changing the system for organization of training - changing the classroom system with a system of group/team training, interdisciplinarity, learning anywhere at any time, self-organized training.
- Change in assessment - formative and authentic assessment, student's portfolio.

Other important features of Education 4.0 are:

- Education in which, through blended learning and flexibility in the use of technology, individualization of learning is achieved.
- They use mainly interactive teaching methods - quizzes, discussions, laboratory classes, and projects.
- Individual profiling and differentiation of educational content tailored to the needs of specific learners (Rollins; 2014).



- Lifelong learning.
- Development of skills such as critical thinking, social skills, creativity, crisis management skills, digital skills.
- The emphasis is not only on academic achievement but also on the development of character, well-being, and happiness of students.

The trainees are children of the new Alpha generation - children born after 2012. This generation is very different, has “huge control over their lives, based on the use of current information, have a fighting spirit, transforming, the generation of the digital-book” (McCrindle; 2010).

Thus, at the university, based on the application of the basic principles of Education 4.0, students develop their potential. This is facilitated by the specific academic, which is related to the following main characteristics:

1. A new pedagogical model of:
 - Training anywhere and anytime.
 - Collaborative training in pairs or small groups.
 - Learning by doing - project-based learning.
 - Formative assessment and digital portfolio of the student.
2. Architecture and interior:
 - Flexible educational environment.
 - use of all spaces in the building as a learning environment.
3. Involving the family and the community is an important part of a successful school of the future.
4. Educational leadership - focused on self-esteem and organizational development.
5. Teacher facilitator, coach, and activator Wide use of community mentors.
6. Development of an inclusive academic environment.

Thus, in the conditions of Education 4.0, the development of an inclusive academic environment is an important priority of the university organization. Inclusive learning environments support full participation in the learning process; offer equal opportunities and quality learning, as well as a sense of belonging to all learners, including students with disabilities (Moriña et al., 2013). The environment welcomes diversity and encourages learners to feel confident, capable, and accepted. In this way, they improve their overall learning experience (Ginsberg & Wlodkowski, 2009), which requires a learner-centred approach and requires teachers to adjust their pedagogical practices to improve learning for all students. decisions to build an adequate educational environment for all, including students with SEN.

The following components can be identified in the process of inclusive education:

- “Acceptance of all trainees and all staff are equally valuable and valuable.
- Increasing the level of participation of students from different cultures and reducing their isolation through curricula and communities in local schools.
- Reducing barriers to learning and the participation of all students, not just those with disabilities or those categorized as children with 'special educational needs.
- Learning from the experience already gained in overcoming barriers to access and participation of specific learners in order to achieve change for the benefit of all.



- Consider differences between students as resources to support learning, rather than as problems to be overcome.
- Promoting sustainable relationships between HEIs and communities.
- Strengthening the understanding that inclusion in education is one of the aspects of inclusion in society” (Booth, Ainscow, 2002)

In the very process of realization of “inclusion, which refers to all differences in people, labels such as ‘included child/student/person’ are not allowed. All people have a need for inclusion but at different levels accordingly physical, mental, economic, and social status. Inclusion is a life with others, a life with challenges in everyday life due to different personal/group/national identities, a life with free self-determination, a life with differences and paradoxes. Inclusion does not happen here and now, at the moment, it is related to values and attitudes, with conscious and accepting, but also demanding patterns of behaviour and sometimes it is not an easy process” (Levterova - Gadjalova, 2019).

Thus, an educational institution must be “involved for training people belonging to different ethnic groups and cultures, speaking different languages, having different physical, mental, social and economic status, with different abilities, interests, and goals of education. To this end, organizations should not be limited by a single curriculum and a single approach to the education of all children. Students have to master the general education program, but everyone achieves this at an individual pace and sometimes with different results” (Baeva, 2012)

For its part, the organization and management of inclusive education are seen as “diversity management and requires a change in the structure, culture, and procedures of the educational organization” (Zimba, 2011). The changes in the structure of the organization are related to decentralized management and co-management in the educational organization, promoting flexibility and risk-taking, forming teams of specialists, creating appropriate resources. Changes in organizational culture. relate to the recognition of diversity, overcoming barriers to learning in learners, creating rules and inclusive environment, creating consensus on inclusive values The main changes in procedures in the institution - organizational changes related to “creating material and technical resources, changing roles and procedures for involving different groups of students” (Zimba, 2011).

According to other publications, the organization of inclusive education, such as managing the diversity and differences in the school community, is associated with "building a model of strategic leadership", planning and resource provision in the educational organization. Management processes are related to “a form of inclusive leadership, implementation of effective change management, planning, and organization of personal development support teams, integration of policies to provide appropriate resources, creation of inclusive vocational learning communities and network support for personalized education for students, building tools for assessing an inclusive environment” (Rayner, 2007).

After March 2020, in a crisis situation and the closure of university buildings due to KOVID 19, the model of inclusive education in higher education changed. Thus, distance inclusive education sets out relatively specific learning strategies in pandemic crises:

- providing access to quality inclusive distance education,
- recognition of the value of each student,
- providing opportunities for everyone to participate in distance learning together with their fellow students, including providing access to the virtual hall for students with special educational needs,



- providing a supportive virtual environment for each learner,
- creating a positive virtual environment for everyone,
- structuring clear rules for attendance and participation in distance inclusive education,
- providing the possible components of resource support in the digital environment,
- adaptation of the curriculum for presentation in distance learning,
- adapting the learning content for students with special educational needs for virtual presentation,
- ensuring the active participation of all students, including different students in video conferencing, conversations and online discussions, and online chats,
- minimizing and removing barriers to the education, upbringing, and socialization of all students,
- participation in training for work with separate tools and applications of the Network,
- conducting training or giving instructions for distance learning to all students,
- selection of appropriate formats and models of distance learning according to the capabilities and potential of the trainees,
- creating student communities in accordance with the interests of students, to increase school achievement, to develop creative thinking and creative behaviour,
- promoting interactions and effective communication between objects and subjects in the educational system,
- creating and maintaining web-based learning and information resources, including in alternative formats for students with special educational needs and for all students,
- use of electronic resources and technological solutions and applications to create interdisciplinary links and relationships,
- creating high expectations for the achievements of all students in distance learning.

3.3 EdTech and hybrid inclusive education in normal and crisis situations at universities

In recent years, many of the modern educational systems, including the Bulgarian one, have undergone significant organizational change related to the introduction of virtual elements in university structures. It is related to the construction of the “hybrid university”, for the “symbiosis between virtual and physical”, for the functioning of real, “hybrid” and “virtual” classrooms. Thus, the hybrid university can be generally defined as a “hybrid model” of an academic organization, in which the virtual environment is a natural complement to the basic elements of traditional higher education.

The hybridization of the academic environment and the intensive development of the ICT sector and the global network over the last decade have supported the process of including and overcoming some of the learning difficulties of students with SEN and expanding their access to education (Kinash et al., 2004; Noguera et. al., 2018; Peytcheva-Forsyth et al., 2017; Peytcheva-Forsyth et al., 2019; Seale, 2013). Moreover, a number of researchers argue that e-learning and hybrid learning have the capacity to improve access to education, promote inclusive education for students with different types of disabilities, and ultimately promote social inclusion in general (Cinquin et al., 2016; Fichten et. al., 2009; Seale et al., 2015; UNESCO, 2016). Hybrid learning has the potential to make education more accessible and democratic for people with persistent physical, sensory, cognitive impairments, learning difficulties, multiple disabilities, etc., some of whom are considered to be socially isolated groups, by providing -good conditions for their training. It is no coincidence that it attracts more and more students with different types of disorders in a number of developed countries such as the United States, Canada, Australia, Britain, Russia, and others. According to many researchers, it opens up new opportunities for inclusive education of students with different types of disabilities in higher education



(Douce, 2015; Seale et al., 2015; UNESCO, 2016). They conclude that e-learning and hybrid learning should be seen as a tool to promote better interaction and inclusion of SEN students in the academic environment.

According to the Innosight Institute's blended learning models (Staker and Horn, 2012), “four separate combinations of hybrid learning forms are implemented. They are used in various educational organizations in the United States and other educational systems. The models reflect the transition from relatively intensive pedagogical interactions in the classroom to those that take place in the process of online teaching. In particular, they are:

3.3.1 Rotation model

In this model, learners' online engagement is cyclically combined with face-to-face learning. Students move to different jobs on a schedule, working online or in-person with the teacher. There are also variations in the rotation model in relation to various aspects, such as time, individual, or group rotation. Within a subject (for example, mathematics), learners rotate on a specific schedule or at the discretion of the teacher in different training centres, at least one of which is related to online learning. Other modules may include activities such as instruction in small groups or the whole class, group projects, individual lessons, and assignments.

3.3.2 Rotation by “centres” (stations) for learning activities

The model allows students to go through training stations (“centres”) on a schedule, where at least one of the “centres” is related to online learning. This model is most common in primary schools.

3.3.3 Individual rotation

The individual rotation model allows trainees to rotate through training centres, but on individual schedules set by a teacher or software algorithm. Unlike other models of rotation, students do not necessarily go to each centre - they rotate only to the activities provided in their individual schedules.

3.3.4 Inverted classroom

According to a number of researchers, this model of blended learning can increase the effectiveness of learning, motivation to learn, and encourage teamwork. This is because the inverted classroom supports learning in which the teacher presents to students before the class (through online texts, video tutorials, videos) highlights of the curriculum. The students get acquainted with the learning content at home, which allows the learning time in the classroom to be used for the active development of their learning skills through discussions and debates. Of particular importance is the constant formative feedback provided during the inverted classroom, which helps teachers assess student achievement.

3.3.5 Flexible model (Flex model)

In this model, students are engaged mainly online, but under the guidance of a teacher with whom they meet physically in the classroom. In it, the learning content and instructions are provided mainly via the Internet, students move on an individual floating schedule. The model provides face-to-face support on a flexible and adaptive basis, through activities (small group instruction, group projects, individual lessons), and they are represented to varying degrees by individual learners. Thus, although there are teachers in the classroom to provide on-site assistance if needed, the training is mostly based in an electronic environment and students learn independently and practice new concepts through



digital tools. In general, the flexible model allows students to move on current schedules among learning activities according to their needs.

3.3.6 Self-mixing model (A La Carte model)

In this model, learners choose different courses according to their interests. At the same time, face-to-face training is combined with online training. The model is especially popular in high schools. It enables trainees to study beyond what is already offered in their higher education as a compulsory curriculum. Although these students attend a traditional school environment, in addition, they choose to supplement their studies through online courses that are offered remotely. This method of blended learning can be successful if the students themselves are highly motivated and want to attend additional courses of interest. In addition, the fact that online work is done from home does not create the need to build additional e-infrastructure at the university.

3.3.7 Enriched virtual model

Online activities are periodically supplemented with agreed joint physical attendance training in higher education. In this model of blended learning, students work mostly remotely, and the materials are provided mainly through an online platform. Although there are face-to-face training days (some programs only require visits twice a week), students can usually talk to teachers online if they have any questions. This blended learning model is much better for students who need more flexibility and autonomy in their daily schedules. Thus, the students complete most of the course work online at home, but visit the university for the necessary face-to-face sessions with the teachers.

3.3.8 Advantages of hybrid inclusive education for students with SEN

- Hybrid learning develops critical thinking and creates habits for independent work, builds skills and competencies.
- hybrid learning is interactive, it provides an opportunity for academic communication, presentation of personal opinion and point of view, exchange of ideas.
- In hybrid learning, the individual psychological characteristics of the student are taken into account and the learning process is highly personalized.
- Hybrid learning is fully in line with and supports the ideas of a person-centered approach to learning.
- Opportunity to learn from home.
- Opportunity to study at a convenient time.
- Personalization of training according to the individual characteristics and preferences of students with SEN.
- Extended access to e-learning resources anywhere and anytime Opportunities to adapt the methods and forms of assessment of student achievement with SEN.
- Opportunities for expanding the forms of pedagogical communication” (Staker and Horn, 2012).

3.4 Pedagogical methods in inclusive education in an online environment in HEIs

Inclusive online education at HEIs requires the development of a program of methods to present both the application of existing effective methods and to develop new methods according to the digital transformation of education, ongoing inclusive processes and taking into account intergenerational differences of students, professors and administrators.



The term method has Greek origins and means a way of research, knowledge; a way to something, the way/means to achieve the goal, way of action... An active role in the subject-subject relations is of decisive importance for the differentiation of the approaches to their learning. In the traditional approach to learning, the professor plays an active role, while in the current approach to learning, the active role is the student of HEIs, and the professor enters the role of facilitator, coach, mentor ... In the modern approach to inclusive education online in Active interactive and innovative teaching methods are widely used in HEIs, and passive methods are increasingly minimizing their application. While interactive methods have found rapid application in digital inclusive education (perhaps because they are well exploited and familiar to the academic community from physical education), a number of innovative methods are still finding application in the digital dimensions of educational inclusion in HEIs. On the other hand, the digitalization of inclusive educational space in HEIs determines the use of electronic devices in two spaces: content consumption and content creation and sets new requirements for them. Among the current and innovative methods for the implementation of inclusive digital education can be noted methods:

3.4.1 Organization and implementation of the educational-cognitive activity

3.4.1.1 *Perceptual methods:*

Perceptual methods related to inclusive education in the online environment in HEIs are based on the model of perceptual learning. Perceptual learning is realized every second, based on the functioning of sensory systems / visual, auditory, proprioceptive, kinaesthetic, tactile, olfactory, gustatory, vestibular / and is based on improving sensory modalities to respond to environmental stimuli through experience. The initial presentation of the concept of perceptual learning is accepted belongs to Gibson (1955), redefined in 1963 as “a relatively permanent and consistent change in the perception of a stimulus array, following practice or experience with this array”. Perceptual learning is interpreted through the prism of cognitive penetration (Raftopoulos, 2001; Macpherson 2012; Connolly, 2017), the connection with machine learning (Connolly, 2017), synergy with specific computer technologies in addition to traditional learning and as the implementation of perceptually adapted learning (Shipley, & Kellman, 2001; Garrigan, Wickens, Hilger & Kellman, 2010; Kellman & Massey, 2013; Kellman, Garrigan & Erlikhman, 2013; Arterberry & Kellman, 2016; Standen et al, 2020; etc.)

To perceptual methods, Babanski & Potashnik (1988) include methods that relate to the source of transmission and perception of information. Accordingly, they include verbal methods (narration, talk, lecture), visual methods (illustrations, demonstrations), practical methods (experiments, exercises).

If the method is defined as a way/path of action towards the goal, then the most common styles of perceptual learning can be related to perceptual methods. The most popular are:

- VAK / visual, auditory, and kinetic learning style.
- VARK / visual, auditory, reading/writing and kinetic learning style.

according to which the individual student has a certain sensory preference for learning. These models are centered on learning styles and teaching styles. In order to effectively apply the perceptual methods to the perceptual preferences of the learners, models for structuring the sensory profiles of the learners have been developed (Dunn, 1999; Stapleton, 2003).

In this context, perceptual methods can be synergized with preferred perceptual styles and sensory preferences for teaching the student HEIs in preferred:



- visual (or spatial) learning styles - visual methods are used for teaching with the presentation of pictures, drawings, three-dimensional models, three-dimensional images, etc.
- acoustic (or musical, auditory) learning styles - the training uses visual methods with speech, music, rhythmic structures, etc.
- linguistic learning styles - verbal methods in the form of dialogic and monologue speech, lectures, oral and written, etc.
- kinetic learning styles - the training uses practical methods involving general and fine motor skills and proprioceptive sensations/sensations of body movements, hands, facial movements, touch, etc.
- logical and / or mathematical learning styles - the training uses verbal, visual and practical methods through which the student from HEIs uses logic, reasoning, systematization, categorization, mathematical operations, etc.
- social learning styles - in the process of individual or group learning verbal, visual and practical methods are used according to the preferences and interests of the student from HEIs.

For perceptual learning, it is effective to derive a sensory profile that reflects the sensory strengths of the student from HEIs and his sensory preferences to receive, understand, process and absorb new information. The sensory profile can be structured according to the preferred sensory system for information perception: sensory, auditory, visual, tactile, proprioceptive, olfactory, gustatory, kinaesthetic or according to the processing of sensory stimuli: observation, testimony, counselling, sensitivity (Dunn, 2014; Stapleton, 2008).

For example, Dunn (2014) derives a sensory profile with 38 items in the following areas: tactile sensitivity, taste-olfactory sensitivity, sensitivity to movement, lack of response or search for stimuli; filtering sound stimuli; apathy, low energy; visual/auditory sensitivity. When the specifics of the student's sensory profile are taken into account by HEIs and electronic technologies are used in accordance with them, inclusive processes are realized.

Knowledge of the student's sensory preferences, psycho-physiological preferences and interests can also determine his or her effective learning styles. When teaching methods are used in accordance with the sensory, intellectual, cognitive, and emotional preferences of the student, it increases the cognitive, emotional, and social commitment of the student and his motivation. Students' preferences and interests influence the sensory perception of information, its understanding, the internalization of experience, memory, the transfer of information from one scientific space to another scientific space and contribute to the development of creativity. Neuropsychological research demonstrates that different learning styles (teaching and learning) activate different brain areas. The more brain areas involved, the more effective the students' learning itself.

3.4.1.2 Logical methods

The logical methods are related to the presentation of valid and reliable conclusions from the set preliminary assumptions. Logical operations are used: conjunction, disjunction, negation, exclusionary disjunction, implication and equivalence. Logical methods are defined as such according to the derivation of the logic of teaching and the logic of learning or through analytical, synthetic comparative, inductive and deductive, abstracting and summarizing models of presentation and mastery of educational content (by Babanski & Potashnik, 1988). They find application for the systematic learning and derive operationalization and taxonomisation of problems and respectively solutions. The application of logical methods in teaching leads to the creation of algorithms,



procedures, and classification of information for easier perception, understanding, understanding, and learning of the learning content. Hence, the concept of “logical learning style” appears, which is characterized by orientation towards achieving goal(s); critical and abstract thinking; making connections (even unexpected and original) between hypotheses, evidence and counterarguments / counterexamples; preferences for visually presented materials; creating plans, maps, diagrams, charts, graphs, etc.

The implementation of the process of inclusive education online with the application of logical methods requires:

- introduction of visualization of the educational content through its attractive presentation with the inclusion of virtual simulations; educational games; algorithms, schemes and diagrams; QR codes; virtual augmented reality; inclusion of educational and informational videos from YouTube, Tik-Tok; use different types of Video File Formats, Codecs, and Containers,
- creating and presenting a plan and summary of the study content at the beginning and end of the lecture/exercise/ laboratory work,
- introduction of operationalization and classification of problems/respectively of solutions / in teaching and learning,
- providing opportunities for mapping web resources, including parts of the studied learning content,
- supporting active web browsing on learning content issues,
- provoking to make technology-based decisions with real-life applicability,
- inclusion of elements of problem-based learning or full implementation of problem-based learning by searching for problems and finding traditional and alternative solutions to them,
- creation of scenarios with technologies offered for learning resources by the learners,
- construction of learning resources by students,
- creating opportunities for mental representation and cognitive schemes in learners as a reference framework for learning all new learning content and consolidating previously learned learning content,
- use of interactive methods to create an original design of problem areas in the curriculum such as "brainstorming", the Delphi method, etc.,
- providing opportunities to distinguish relevant from irrelevant educational information,
- use of the functionalities of the electronic platforms for creating mind maps of the learning content in group or individual format; - providing opportunities for team student interactions in an online environment with the inclusion of logical learners in a team, as well as the formation of teams of learners with different learning styles,
- providing opportunities for digital presentation and discussion of structured plans, diagrams, charts, maps of learning content, which can increase the effectiveness of the learning process for all students.

3.4.1.3 *Gnostic methods*

Gnostic methods refer to the methods of cognitive activities and are related to the level of independent thinking in learners in the learning process. The very term "Gnostic" is etymologically derived from Greek and means "knowledge", "cognition". Babanski & Potashnik (1988) refers to gnostic methods:



- Re-creation methods are associated with traditional teaching methods, in which the academic professor is accepted as the only reliable provider of educational information, as unequivocal and indisputable authors in science. These methods are increasingly being used in inclusive online education at HEIs, but they are not obsolete. Re-creation methods can be informational, illustrative and explanatory. Undoubtedly, the parrot's re-creation of learning content provided in lectures has no added educational value and is not inclusive for either the academic lecturer or the HEIs student, both in physical and online learning. However, much of the learning content, which is reinforced in practical and laboratory exercises, requires demonstration, demonstration and re-creation to proper implementation and learning. The observation of virtual simulations, the use of different video formats with the concrete, accurate and precise implementation of the practical exercise on certain educational content requires specific, accurate and precise re-creation for learning and gaining practical experience. The Internet offers opportunities to work in virtual remote laboratories, monitor and conduct practical activities with remote access (for example, Google reference schools that work on the model 1: 1), (by Babanski & Potashnik, 1988).
- Research methods are of interest because they require learning through action and practice, provoke heuristic searches, creativity, creativity, and satisfaction in achieving results. In the process of using research methods not only the learning, the result is achieved, and the learning content is mastered imperceptibly, but contextual competencies such as research competencies are developed and the development of the key competence for initiative and entrepreneurship of students is supported (by Babanski & Potashnik, 1988). HEIs students have the opportunity to work both individually and, in a team, according to their individual preferences and interests. Teamwork forms key and soft competencies that are needed in various standard and non-standard situations / even without being saturated with learning content/in real life.

3.4.1.4 *Methods for learning management*

The management of the learning process is set the challenging goal of forming a learning community. In each educational activity, the management of the training is realized. Several groups of methods can be derived:

- Norm-determining methods - the creation and observance of academic rules for online inclusion, formulated by all students, including students with diversity without neglecting the behavioural reflection of many students with neuro-differences related to understanding and behavioural patterns such as: "The rules are not for students with neuro-differences and should not be followed." The rules in HEIs are in fact the basic social norms of society, which students master more imperceptibly in HEIs. On the other hand, when HEIs students set social norms for themselves, the group and HEIs, and when they follow them, they already form a civil democratic society within the school.
- Organizational and managerial methods for structuring a supportive inclusive environment by maintaining an electronic platform, writing rules for the online learning process, regulating the ratio of synchronous and asynchronous learning, forms of learning control, forms of assessment, maintaining a positive atmosphere and positive relationships in the virtual classroom. A positive atmosphere is created when you teach with enthusiasm and have a positive attitude towards all students.
- Methods for effective digital leadership through which the academic lecturer provides opportunities for each student to express their strengths in online learning. Success motivates



and encourages additional efforts for even greater success. Achievement brings pleasure, confidence and stimulates greater effort and greater success. The example of the academic lecturer often has a contagious effect. When encouragement and praise are not spared, even for students with low academic achievement but showing progress, intrinsic or controlled motivation increases. When the academic professor preserves the dignity and self-esteem of each student in the online learning process, then inclusive leadership is realized.

- Communicative methods that provide opportunities for effective communication in the learning process and intensive informal communication with students with diversity. Informal communication increases the trust between a student and an academic lecturer. In a digital environment, net etiquette and all requirements for digital accessibility should be observed, because they ensure the technological efficiency or the channel of the communication process and the feedback. For the communicator and the recipient in digital communication remain to follow the net etiquette and protocol of conduct, as well as the basic rules of communication.
- Stimulating methods for the formation of competencies related to the meaning and significance of learning activities - how and why students learn, what achievements they have, whether they are allowed to enter the role of formal leaders or receive delegated responsibility, whether they receive rewards and incentives, whether they have internal motivation to learn, or their motivation is external, etc. (Skehan, 1989).
- Methods for monitoring the conduct of the training or pedagogical methods.
- Methods for assessing the achievements of students, related to the formal and formative assessment of academic achievement.
- Methods for pedagogical reflection on online learning. Pedagogical reflection is a complex psychological construct related to the activity of the academic professor in relation to the subject - his subjective pedagogical activity. Through reflection, each learner can motivate themselves to learn. "Critical reflection encourages learners to be willing and able to ask questions, explore and critique ways of behaving and thinking while learning about their skills, competencies and knowledge" (Lucas, 2012). According to Eby (2000), reflexive practice is a synthesis of reflection, self-awareness, and critical thinking. Through reflection, the professor can change their positions in the learning process, to gain the ability to change their views according to the strengths and potential of students and thus achieve greater efficiency in the learning process both in attendance and in distance learning in an electronic environment and undoubtedly a fuller unity between consciousness and responsibility for the learning process and behaviour.

The use of modern interactive methods of education develops a competence approach in training and expands the possibility to develop the key competencies of the specialist. The key competencies are a set of basic knowledge, general (universal) skills, personal qualities that allow achieving positive results in professional and other areas of life. Key competencies, in our opinion, represent a high degree in the hierarchy of competencies, because they are not interdisciplinary in nature, they manifest themselves in different areas. The transition of the competence approach in the organization of the learning process provides for the widespread use of active and interactive forms in the learning process.

3.4.2 for stimulation and motivation of the educational-cognitive activity

Motivation for educational and cognitive activities includes focused thoughts and actions towards school success and inclusive education. It is usually accompanied by positive emotional experiences and usually leads to improved individual performance. HEIs students who are "highly motivated to



learn” are focused on acquiring knowledge, skills and improving learning strategies, setting higher goals and giving higher subjective value to learning. In this way, learning motivation has a significant impact on the student's personal development” (Soetjipto & Waluyo, 2013).

Motivation is related to the self-determination of students from HEIs and the professor needs to be able to distinguish in all students internal motivation, external motivation, learning motivation, autonomous motivation, controlled motivation. When, in an online learning environment, the HEIs professor distinguishes between the predominant type of student motivation or the emerging type of motivation at the current period of study, he or she can be much more successful in facilitating the process of inclusive online learning. To create and maintain motivation for learning and cognitive activities, methods from different fields and areas of activity can be applied:

- Pedagogical methods along with daily individual programming with included development of instructions, adaptation of the curriculum and the content, learning through practice / by doing /, learning with positive emotions; taking into account the preferences and interests of students with diversity from HEIs in academic and community contexts; creating conditions for active digital learning of HEIs students using learning models such as: project-based learning, discovery learning, research learning, practical learning, learning with positive emotions, learning according to sensory preferences and interests of students, reverse teaching, co-teaching, etc.; use of interactive methods in the learning process; clear identification of the goals of the educational content and its application in real life; creating a link between the learning content and the student's self-determination by HEIs in different contexts; solving learning tasks with surmountable challenges to one's own cognitive and emotional potential; receiving from the academic lecturer educational tasks for implementation, with which he / she can achieve brilliant or at least good performance in front of his / her fellow students, and raising the intra-group status which preserves self-respect; acceptance and high appreciation of the knowledge and style of teaching of the academic lecturer; satisfaction with the learning process and the assessment, which should be a formative assessment.
- Methods of psychological support and resilience - recognition of the efforts made by students with diversity to learn certain learning content / sometimes these efforts are much more than the efforts of other students and therefore have greater personal and educational added value /; creation and implementation of team interactions - understanding the individual roles in the team and mastering the implementation of different roles in the team, finding the role in the team that corresponds to their self-determination and capabilities, perform their tasks in the team to achieve a common goal; giving praise for the efforts made - the praise and positive assessments of progress build self-confidence. "Assessment can be enhanced by emphasizing the student's performance in relation to personal goals" (Palmer, 2007); highlighting the fair outcome of the HEIs' own efforts and "receiving recognition and/or recognition credit". (Williams & Williams, 2011); correspondence of cognitive engagement to emotional and social engagement in connectivist learning contexts (Corno & Mandinach, 2009; Rotgans & Schmidt, 2011; Wang, Chen & Anderson, 2014; Chi et al, 2018;); creating and expanding a social circle of contacts with fellow students and creating supportive social networks by fellow students; teaching styles correspond to the interests, sensory and intellectual preferences of HEIs students; opportunities for competitive nature in the presentation of the mastered educational content are provided; supports learning not for assessment but for knowledge that is needed in real life; limiting the unexpected and unpredictable external factors influencing learning and assessing the knowledge of HEIs students; establishing and



maintaining confidence that academic professors treat each student as a unique person; Convinced that academics are comfortable delegating trust in innovative teaching methods such as "inverted classroom", "learning by mistake", "learning with your own interpretations", etc.; availability of the greatest possible control over one's own education; conviction that the professor is a facilitator and moderator of knowledge, not a didactic and conservative professor, etc.

- Psychological methods for forming meta-cognitive strategies. Meta-cognitive strategies are problem-solving strategies. "Metacognition is a process of learning about cognitive operations and states in order to inform and regulate cognitive strategies" (Mezirow, 1990). It usually involves active participation and active control of learning by students. The development of metacognitive strategies in the online learning process can be carried out by searching for and discovering different approaches and solutions to a certain learning task or to a certain type of learning tasks; checking the understanding of the learning task and their solutions, as well as control of the selected solutions; mastering different ways of finding right, wrong and alternative solutions; evaluating and informing each HEIs student about his / her progress, not only with the quantitative assessment but also with the chronological descriptiveness of the achievements, analysis and comparisons of the achievements.
- Ontological methods for technologies - dynamic use of aids, adaptive and assistive technologies. Academics who are trained with innovative technologies and use innovative technologies in their work and make the classroom more and more "smart", smart, through the inclusion of educational mobile applications, educational gamification, educational robotics, etc. are inclusive academic lecturers. When technology is accessible, interesting and easy to use for the HEIs student, learning becomes fun and imperceptibly realized in a digital environment. Innovative technologies, used by professors to work in an inclusive educational environment can be presented in several spaces of technology-based solutions:
 - software products - operating systems, office software, database software, mathematical software, modelling software, educational and entertainment computer or mobile games, etc.
 - assistive technologies or devices or programs that compensate for lost or damaged function of a human organ. They allow people to perform tasks they would not otherwise be able to, increase their ease and safety, give them the freedom to be independent and equal citizens, to communicate, to learn. There are two main categories - adaptive and alternative devices and software. Adaptive devices and software extend the functions of standard software and applications or modify and extend the functions of standard hardware devices by making them accessible to people with disabilities. Alternative devices and software are specially designed specialized software programs and hardware devices that give people with special needs access to the computer system.
 - specialized browsers for accessing Internet resources, such as the WebbIE browser,
 - computer or mobile applications such as Be My Eyes, Moovit, Lazarillo GPS, Nearby Explorer Online / GPS application /, Envision AI, JAWS (Java Access with Speech, etc.,
 - educational games
 - educational robotics
 - QR codes with finding resources for them with a proposed electronic platform
 - augmented reality, etc.



A combination of the following types of learning methods can be used in online learning: methods for new knowledge, methods for applying knowledge, methods for cooperation, games in learning (Ghirardini, 2011).

3.5 Etiquette and behaviour of university professors and students in an electronic environment

The etiquette, protocol, and behaviour of conducting e-learning in HEIs are not just a transfer of good upbringing, good manners, and socially acceptable behaviour from those present in the e-environment. Both in face-to-face training and e-learning, etiquette, protocol, and behaviour create not only the first but also the overall impression from all participants in online education in HEIs. Etiquette, protocol, and behaviour in conducting e-learning in HEIs have a subconscious influence on the behaviour, attitudes, awareness, motivation, and activity of participants in the learning process in the e-environment. “Netiquette refers to acceptable behaviour in digital environments. Fostering netiquette is an important policy goal and an essential component of digital literacy and citizenship.”²²

The effect from netiquette/etiquette in cyberspace / affects pedagogical interactions in and with the learning community, social acceptance, and learning effectiveness, as well as inclusive processes for each student and professor.

Netiquette and protocol in the training process in HEIs set out the following requirements:

- Designing an affordable online learning design
 - Before connecting to the video conferencing connection, check the camera and microphone for their operation, select the personally acceptable volume, as well as the light and dark contrasts of the camera.
 - Monitor the range of the camera for the workplace in advance, before the start of the class, as well as checking the volume as perception and as a production.
 - Precise choice of the background, which is necessary to be consistent with the learning activities and not to reflect the momentary, sentimental, or random moods of the participants in the educational process.;
 - Check access according to the needs of the individual student/professor for example for the sound interface, for the tactile interface, the connection of Braille device with refresh options, colour schemes with high contrast or font augmentation, speech recognition, etc.
 - Check the range of different interfaces according to the needs of the student/professor and when using mobile devices.
 - Comply with styling with the educational process. Indeed, styling does not validate learning the most, but it definitely influences social acceptance and inclusion in the learning process in an electronic environment. The outfit from the home or professionally / entertaining environment does not motivate for learning.
 - Careful compliance and selection of the dress code of the participant in the educational process with colour, shape, psychological, and identity subconscious influences of the effectiveness of the educational activities.
 - Compliance of non-verbal behaviour with the digital transmission of:

²² <https://www.oecd.org/education/ceri/21st-Century-Children-as-Digital-Citizens.pdf>



- the personal general-motor and facial repertoire in the Web. Proxemics, kinesics, body language, messages in front of and through the camera.
- the transmission of sound on the Web. It is necessary to speak clearly, distinctly, and more slowly than in everyday life. There is no need to increase the volume of the voice or change the resonance of speech. It would be desirable to avoid monotony in speech, even tone, long pauses, and to bring out emotional and/or logical accents, expressed through the voice, about the learning content.

It should not be forgotten that every participant in the educational process in front of the camera is on a virtual educational stage. The digital educational scene makes the participants in the educational process as visible as in face-to-face learning.

- Structuring the pedagogical design of online learning:
 - creating an accessible design for a course in online learning: volume and transition of slides of presentations; background, text, and images on the individual slide; tables, graphics, audio, etc.
 - improving personal presentation skills in terms of:
 - structuring presentations, videos, simulations, etc.
 - verbal messages through the Web.
 - verbal expression.
 - linguistic pragmatics.
 - explanatory models to the learning content.
 - the pedagogical models, technologies, and methods, etc used.
 - maintaining a positive emotional climate during the lesson. Creating an optimistic mood from the lesson itself depends very much on the professor. In the educational process conducted in an electronic environment and at a distance, the use of active learning improves students' academic achievements and creates a positive creative atmosphere in which each student can reach his or her potential.
 - regulation of basic rules and guidelines for lessons and assessment in individual disciplines such as rules for video lectures, video meetings, animations, quizzes, tests, video tests, etc.
 - use of assistive and adaptive technologies for students with SEN.
 - Inclusion in the educational process of newer and newer electronic technologies for clearer, more perceptible, more powerful expression, better understanding, and effective understanding of the learning content.
 - providing conditions and opportunities for students to create electronic learning resources, digital products, etc.
 - using the opportunities of social networks for educational purposes.

Behaviour in distance learning e-learning requires adherence to a specific **protocol**:

- Assurance that students are included in the lesson through the electronic platform. Problems most often occur when students do not use an institutional account, there are problems with Internet connectivity, low speed internet, technically faulty electronic devices / or with reduced functionality /, unlicensed software, etc.
- Do not allow reasons such as reference to the GDPR, technical malfunctions of electronic devices, so as not to turn on the camera. When participants in the educational process are



convinced that they are in a safe and secure virtual environment, when there is trust in the cyber security of HEI, then there are no worries about opening the camera. In many cases, there are reasons behind such references that the professor needs to understand and support in overcoming barriers. The latter may be related to the student's reluctance or inability to show his workplace or background, uncertainty or reluctance, getting up late and not having time to prepare styling and/or dress code, the presence of other people in the room, etc. Most often, students share as a reason their desire to maintain their own comfort zone for learning. When all participants in the educational process have opened their cameras, then the interactivity of the learning process increases, social and emotional learning is realized more effectively, and learning becomes a more imperceptible and desirable process.

- The existence of rules for synchronous and asynchronous learning. Rules and routines create peace. If students are required to appear on camera, there should be rules about when to turn on the camera, for how long, under what conditions, to avoid the negative effect of unpredictability. In asynchronous learning, the provision of teaching materials and learning resources by the HEIs professor, as well as their use by students to follow copyright rules. Uploading student papers should also be subject to anti-plagiarism. There should be clearly defined evaluation rules and it is desirable to use formative evaluation.
- Negotiating and allowing availability of rules for use of assistive and/or adaptive technologies for students with SEN.
- Use of the most modern and diverse digital technologies for the learning process, etc.

The behaviour of HEIs professors in the electronic environment is effective when it is aimed at:

- use of models, technologies, strategies, and methods from:
 - problem-oriented learning,
 - project-based training,
 - reverse teaching,
 - co-teaching,
 - learning through research tasks / for individual and group solving / with providing opportunities for independent choice for solving learning tasks,
 - learning by doing, by practice,
 - the gamification of the educational content, including the use and creation of digital educational games by professors and students from HEIs,
 - digitalization of the learning content for and by students according to their potential, including the use of m-learning, augmented reality, simulations, etc.,
 - learning by surfing the web, for example with a virtual tour of museums, geographical landmarks, geographical sites, libraries, universities, etc.,
 - open to virtual visits,
 - educational robotics with good digital competence of students,
 - the invention/structuring of symbols, signs, or mnemonics for better mastering of the learning content, etc.
- use of the possibilities of the interdisciplinary approach to training, which implies entering into the role positions of facilitator and moderator by the lecturer from HEIs. Since higher-order thinking involves asking questions and analysing one's own perceived information, suitable models for negotiating learning content with students are:
 - asking questions by students in discovery and purposeful way to the curriculum,
 - making connections of the educational content with its application in real-life situations, etc. such as bringing free interpretations of the educational content into



- social stories, compiling stories containing facts or circumstances from the educational content,
- admission of alternative proposals for solving learning tasks,
- teamwork,
- stimulating the internal motivation of students with learning tasks related to their strengths, key, and contextual competencies,
- selection of incentives to increase interest in learning content,
- creating a positive and supportive educational environment. Short positive humour models are acceptable.
- use of the functionalities of the electronic platforms in the educational process for:
 - the creation of small groups both within the class and in separate groups. Depending on the goals of the learning process / during lectures, seminars, laboratory exercises, etc./, each professor can choose how to create a separate group in the classroom or outside it. Undoubtedly, the student's access to the group, regardless of its model, should be unimpeded and effective.
- use of interactive presentations, simulations, video tutorials, etc.

With these models, students will be committed to mastering the curriculum and higher school achievement. We should not miss the fact that with a higher frequency of informal communication between the participants in the educational process, trust is established and increased.

The behavioural patterns of HEIs students in an electronic environment for distance learners should reflect in synergy:

- normative dispositions related to the rules and norms of the educational institution and the state,
- cognitive dispositions manifested through active learning, initiative, and independent mastering of the learning content,
- stimulating dispositions related to the specifics of the social norms for education in the respective folk psychology and in the world model,
- reflective dispositions related to the reflection and self-reflection of the individual learning profile as a valuable resource for personal development,
- emotional dispositions related to positivity towards and for one's own learning,
- moral dispositions in accordance with the ethical behaviour of the discipline, the professor from HEIs, the educational institution, and the world education.

It is extremely important for HEIs faculty and students to use digital resources in positive and constructive models. For example, "Flop accounts Trolling in social platforms should be used as forums on important topics, not for misinformation and harassment. Freedom of expression should not be used in the model of Internet trolls to manipulate and create false public opinion. Important aspects of digital behaviour are related to cybersecurity and confidentiality, knowledge and skills for using real usernames, avatars, incognito mode. Every anonymity breaks the link between the digital and the physical self.²³

²³ <https://www.oecd.org/education/ceeri/21st-Century-Children-as-Digital-Citizens.pdf>



The Netiquette and digital behaviour of HEIs faculty and students should use models of confidentiality and cybersecurity, copyright enforcement and the elimination of anti-plagiarism.

3.6 Approaches to inclusive pedagogy and universal design for Learning

Inclusive pedagogy is a new trend in the field of pedagogical sciences and reflects the achievements of inclusive practices and theoretical-methodological platforms. Most of the approaches of general pedagogy are used in inclusive pedagogy, such as the systemic approach, the personal approach, the activity approach, the poly-subjective / dialogical / approach, the culturological approach, the ethno-pedagogical approach, the axiological / value/approach, and the innovative approaches. In the space of inclusive pedagogy is the coverage of the diversity in the opportunities and needs of students and their engagement in accessible, appropriate, relevant, meaningful, and most of all effective training.

Inclusive pedagogy:

- derives methodological, theoretical and practical models for dealing with the variety of opportunities and needs, the variety of individual profiles and learning styles of students.
- focuses on learning that recognizes diversity as a valuable resource for development and for learning and engaging diversity, providing and tolerating justice for each student's progress, joint and collaborative activities of professors and students, creating a supportive and positive learning environment and bringing out of personalized training for the flourishing of student and teaching potential.
- "at its core is a student-centered approach to teaching that faculty create an inviting and engaging learning environment to all students with varied backgrounds, learning styles, and physical and cognitive abilities in the classroom. Drawing from a large body of the scholarship of teaching and learning, it is clear that inclusive pedagogy improves learning outcomes when faculty attend to student differences and take deliberate steps to ensure that all students feel welcomed and supported in the classroom" (Florian, 2015; Spratt & Florian, 2015).
- is presented as an effective strategy for integrating the application of universal design and universal learning design.

Contextually, inclusive pedagogy enters into synergies and dichotomous influences with both universal design for architectures and interiors and universal design for learning. The main focus of universal learning design is equity in education for each participant in the educational process. Through universal learning design, there are opportunities for an inclusive learning culture. In the context of terminological diversity and theoretical conceptualisations, it is important to distinguish between "universal design" and "universal design for learning".

"Universal learning design" brings accessibility to everyone in the field of education. Although it takes into account the different potential of learners, universal learning design is not individual learning. It is designed for all pupils, students, professors, people. Its creation began in 1984, when the Center for Applied Special Technology (CAST) was established at North Shore Children's Hospital in Salem, Massachusetts. After several restructurings and relocations, the CAST team positioned itself at Harvard Graduate School of Education, David Rose, partner and chief education officer at CAST in 1990, came up with the idea of curriculum opportunities to deactivate rather than adapt the student. and for the smooth mastery of the curriculum by students with special educational needs and by students who encounter school difficulties. CAST researchers understand that the underlying problem is often not provoked by student learning problems, but by curriculum problems. Thus, Rose proposed the idea of



Universal Design of Learning, which encourages the support of every student in the classroom. Universal learning design is based on Vygotsky's theories and the achievements of neuroscience in education, which studies the ways in which the brain works in information processing (Rose & Meyer, 2002; Rose & Meyer, 2006). Most often, the universal learning design is defined as an approach in which the design of pedagogical strategies, resources, and the environment are built in a way that allows the highest possible use by all learners without the need for adaptation, special design, or additional costs (Tobias, 2003; McGuire et al., 2003).

The universal learning design supports the process of identifying and understanding the essence of student potential by offering flexible goals, methods, materials, and assessments that enable professors to meet the diverse needs of students. The universal learning design framework supports personalized learning with the opportunities provided for students with SEN to achieve success according to their potential, and according to the hypotheses of professors. Universal design for education involves the creation of individual programs including the development of instructions, adaptation of the curriculum and curriculum, consideration of the interests of students in different contexts/school, family, community, etc./ and sensory preferences.

"Universal design" is a design concept created by architect Ron Mace (1985). Named the father of universal design, Mace founded the Center for Universal Design at the University of North Carolina to create a "barrier-free design" for people with disabilities. Universal design involves the research, design and construction of buildings, products, materials and interiors that are physically accessible to people with disabilities.

Similarities between universal design, universal learning design and inclusive pedagogy can be highlighted.

Universal design for architecture, interiors, and products	Universal design for training	Inclusive pedagogy
Fair use ensures accessibility to the environment and spatial design for all people according to their needs.	Fair use of learning resources and technologies accessible to all students.	Fair use of learning resources and technology and fairness to each student's progress. Justice guarantees a holistic, systematic approach and accessibility.
Flexibility in use according to the requirements and preferences of each person.	Flexibility in use - presented through many ways of presentation, many ways to engage, many ways to act.	Flexibility in use according to a wide range of individual preferences and abilities of each student. There is openness and readiness for change / of environments and attitudes, of products and negative stereotypes.
Easy and intuitive use of appliances, technologies, etc.	Easy and intuitive use of learning technologies.	Easy and intuitive use of learning technologies, adaptive and/or assistive technologies.
Easy perception of information regardless of environmental conditions or human needs.	Easy perception of information according to many ways of presenting educational content.	Easy perception of information regardless of the conditions of the educational environment or the sensory, cognitive, and emotional needs of the student.



Universal design for architecture, interiors, and products	Universal design for training	Inclusive pedagogy
Error tolerance	Tolerance of mistakes is expressed in the many ways of engaging students.	Tolerance of mistakes is a basic pedagogical model for active learning and motivating students.
Low physical effort.	Minimal fatigue and learning efficiency occurs.	Imperceptible learning with positive emotions for the prosperity of each student.
Size and space for approach and use.	Spatial dimensions are refined through many ways of action and application of technology.	Spatial design for learning activities in accordance with the psychological influences of size, shape, colours, physical comfort and preferences of students.

Table 3: Similarities between universal design, universal design for learning and inclusive pedagogy - Principles

The seven principles of universal design support people with disabilities by preventing barriers to disability through environmental design. The observance of access to the physical environment of each person stands out quite clearly in compliance with the principles of universal design. The universal design does not design buildings, environments, and products only for people with disabilities, but for all people. Inclusive pedagogy is also for all learners. In this aspect is the main similarity of inclusive pedagogy with universal design - accessibility for all, respected and realized the right to accessibility for all people.

Universal design for architecture, interiors, and products	Universal design for training	Inclusive pedagogy
Universal application with possibilities for use by each person according to his needs.	Universal opportunities for students to use different methods, techniques and technologies for access to the same educational content and to demonstrate their knowledge and achievements according to their personal potential.	Universal opportunities for the professor to personalize the training for each student and work with all students at the same time.
Universal design for architecture, products and interiors is about providing accessibility.	“Universal learning design is a proactive curriculum design (educational goals, methods, materials and assessment) that is accessible to all individuals to gain knowledge, skills and enthusiasm for learning. It provides rich support for learning and reduction of barriers to the standards of curriculum implementation for all students.” CAST (2014).	Inclusive pedagogy gives students the opportunity to use different methods, techniques and technologies to access the same learning content and to demonstrate their knowledge and achievements.



Universal design for architecture, interiors, and products	Universal design for training	Inclusive pedagogy
<p>The universal design for architecture, products and interiors in design takes into account physical and cognitive differences in humans.</p>	<p>CAST (2005) derives neuropsychological explanatory models for learning processes:</p> <ol style="list-style-type: none"> 1. the multiple meaning of representation ("what" is learned). This principle is based on the network of brain recognitions - the network is used to identify and categorize what is seen, heard and read. 2. the multiple meanings of action and expression ("how" one learns). This principle is based on the strategic network - the use of the network is used to plan and perform tasks. These are alternative ways for students to demonstrate what they have learned. 3. multiple meaning of commitment ("why" to learn). Emphasis is placed on affective dimensions. Multiple options encourage active engagement and motivation to learn. Providing multiple opportunities for perception, understanding, engagement, and action is essential. 	<p>Inclusive pedagogy interprets students' neurodiversity and neurotypicality as a starting point for understanding students' individual profiles, personalized learning, learning styles, each student's progress, and equity in learning.</p>

Table 4: Application of universal design for architecture, products, and interiors; universal design for learning and inclusive pedagogy - Applications

The universal learning design is not universally applicable. As Rose and co-authors (2014) note, “the goal of the universal design is to use a variety of teaching methods to remove all barriers to learning and give all students equal opportunities to succeed and build flexibility in the learning process, which varies according to the strengths and weaknesses of each student.” In full sync, the quoted words sound with the basic principles of inclusive pedagogy for awareness and removal of barriers to learning; to take into account the potential of each student; for the presence, participation, and success of each student.

“The universal learning design presents information in different ways that are adapted to the student, instead of requiring the student to adapt to the information. The universal learning design provides an opportunity for students to make the most of their strengths and work to overcome their weaknesses” (Rose et al, 2014). Inclusive pedagogy, in turn, also seeks the potential of diverse students and offers models and ways for personal development.



Element of the curriculum	Universal design for training	Inclusive pedagogy
Objectives	<p>“The objectives of the curriculum are not simply to help students develop a specific body of knowledge or a specific set of skills, but to help them become masters in their own learning or become experts in learning. Expert students have three main characteristics: a) strategists, experts and goal-oriented; (b) well informed and (c) determined and motivated to learn more.” CAST (2005)</p>	<p>Creating general or individual curricula allows professors to remove barriers that students have for school performance, cognitive, social and emotional engagement.</p>
Methods	<p>“Methods are generally defined as learning decisions, procedures or routines that professors use to speed up or enhance learning. Professors apply evidence-based methods and differentiate these methods according to the purpose of the training. Methods based on student variability in the context of the task, social / emotional learning resources and classroom climate are further differentiated. Universal design methods are flexible and diverse and are adjusted on the basis of continuous monitoring of student progress.” (CAST, 2005)</p>	<p>The methods applied and offered by inclusive pedagogy are mainly related to active learning, in which each student is motivated and engaged in the learning process and involved in the group, community and society. Special focus is placed on the positive educational environment as an inalienable predictor of social and emotional learning, the well-being of each student and prosperity on a personal level.</p>
Materials	<p>"Materials are usually perceived as the use of multi-media to present learning content and to demonstrate student knowledge. A distinctive feature of the materials is their variability and flexibility. For teaching conceptual knowledge, the materials offer a variety of multi-media, hyperlink dictionaries, background information, and on-screen coach. For strategic learning and knowledge expression, the materials offer the tools and supports needed to access, analyse, organize, synthesize, and demonstrate understanding in a variety of ways. To engage in learning, the materials offer alternative paths to success, including choosing the right content, different levels of support and challenge, and opportunities to create and maintain interest and motivation.” (CAST, 2005).</p>	<p>Inclusive pedagogy brings out the accessibility and variety of materials and resources used, including electronic materials, electronic resources, digital teaching products, commitment to learning, effective and seamless engagement with learning processes according to the individual profile of the student.</p>



Element of the curriculum	Universal design for training	Inclusive pedagogy
Assessment	<p>"Assessment is described as a process of gathering information about student's performance using various methods and materials, to determine the acquired knowledge and skills, and motivation for the purpose of making informed educational decisions. The aim is to improve the accuracy and timeliness of assessments for all learners. Assessment is multifaceted and is conducted on the model of one student - one professors in appropriate circumstances, written exams/quizzes require more knowledge than memorizing and allowing the use of written exams formulas/notes / short references / indexed cards. (Rose, Meyer & Hitchcock, 2005).</p> <p>"By expanding the means of variable assessment, the universal design reduces or eliminates the barriers to accurate, correct and fair measurement of student knowledge, skills and engagement." (no Rose, Meyer & Hitchcock, 2005).</p>	<p>Assessment in inclusive pedagogy is not the traditional formal assessment. Emphasis is placed on formative assessment, in which the student demonstrates his knowledge through innovative learning models, without stress and with personal initiative and desire.</p> <p>Formative assessment is a fair assessment of the student's progress and his knowledge, skills and especially relations / values and attitudes / towards learning.</p>
Technologies	<p>According to Rose et al. (2005), Assistive technologies and universal learning design have similar goals, such as increasing accessibility and participation in education, although they take different approaches (Rose et al. 2005). While the approaches of assistive technologies are "unique, individual (personal, traveling with the individual), adapted and dedicated", the approaches of universal design for learning are "neither unique nor personal, but universal and inclusive, serving diversity". (Rose et al. 2005).</p> <p>Digital technologies can be used everywhere - anytime, anywhere</p>	<p>Inclusive pedagogy advocates and provides opportunities for the use of technology according to the problems, opportunities, needs and personal preferences of each professor and each student. Digital technologies can create conditions for the demonstration of new competencies by students who have problems with communication during physical contact, as well as allow the realization of ubiquitous communication and ubiquitous learning.</p>

Table 5: Similarities between universal design for learning and inclusive pedagogy

The key questions for universal design are related to the work of the inclusive professors and getting answers to the questions: How to present the information from the curriculum so that students really understand how to learn this information and how to show what they understand and learn?

CAST products help students learn content in a variety of ways and provide opportunities for parents and professors to create new, personalized learning materials and learning environments.



In 2008, the re-actualization of the definition of Universal Learning Design (HEOA) was introduced. The new definition states that “universal learning design means a scientifically valid framework for guiding educational practice by:

- care for flexibility in ways of presenting information, in ways in which students are responsible or demonstrate knowledge and skills, and in ways in which students engage, and
- reducing barriers through instruction, care for accommodation, support and change, and expectations of excellence for all students, including students with disabilities and students with limited achievement.”

According to Ralabate (2011), when universal learning design is applied, most students are: more committed to and for their own education, learning more purposefully and more deeply, with higher school achievement motivated to continue their education.

The Norwegian Directorate for Children, Youth and Family Affairs, The Delta Center (2013) notes three significant trends in universal learning design:

“The first trend is a move from regulation to innovation. The next trend is from accessibility to inclusion. A stricter focus on individual physical solutions such as wheelchair ramps and tactile lines for the blind is increasingly developing a broader view of the overall service or activity that will be universal, such as going to the cinema, traveling by train or tourist activity in a city. This trend goes well with the merging of new services and the design of services as a method of work, thus achieving a more holistic view of the end-user experience. The ultimate trend is from barriers to sustainability. Universal design has both economic and social consequences. Focusing on barriers for a minority of the population can be costly and there are forces that are trying to limit the cost of accessibility. But inclusion supports the contribution, and the contribution creates quality and growth. In order to build a sustainable society, all people must have the opportunity to contribute.”

Universal learning design is an innovative framework that takes into account the individual characteristics of students, their sensory preferences, strengths and weaknesses, both in the learning process and in the process of assessing mastered knowledge. With the opportunities provided for personalization of the curriculum, curriculum, and curriculum for each student, universal design paves the elegant humane, and promising paths of inclusive education.

3.7 Inclusive education in higher education: challenges and opportunities

Inclusive higher education is a current but also a promising trend in education. University systems face new social challenges and demands and where the university must combine its dual goal: educating professional and capable people to build a democratic, pluralistic and just society (Sanchez-Santamaria and Noguera, 2014). This approach is aimed at generating know-how related to the principles of inclusion and equity (Sánchez-Santamaría & Ballester, 2012) from a pedagogical point of view with implications for the policy of teaching, management and practice at the university.

Manzanares-Moya (2017) presents an “updated concept of successful education: It is a set of pedagogical conditions and strategies for generating experiences, so all students are able to get relevant and meaningful learning and providing them with the necessary resources to become citizens.”



Globally, many universities are implementing inclusive practices, but there is still a long way to go on systematic management and methodological basis. Dowens (2014) notes that many countries that have strategies in access to higher education for socio-economically excluded groups “do not have structures in place to ensure the implementation of accessibility strategies”. Even in the rating systems and classifications of universities, there are no clear and specific criteria for the inclusion of students, professors, and administrators. Examples include:

- U-Multirank World University Rankings, which ranks universities in five areas: teaching and learning, research, knowledge transfer, international orientation, and regional engagement. This shows that there is no specific focus on inclusive education, although at least three of the five indicators may include separate indicators for inclusive higher education.
- QS World University Rankings applies six metrics: Academic Reputation, Employer Reputation, Faculty / Student Ratio, Citations per faculty, International Faculty Ratio, International Student Ratio. There is also no metric for inclusive higher education.
- The Carnegie Classification has been the leading framework for recognizing and describing institutional diversity in U.S. higher education. Starting in 1970, the first classification was published in 1973, and since then there have been 9 updates, the last being from 2021. About 50 indicators are used to structure the classification, but no specific indicators of accessibility and inclusion are found.

At the same time, most universities develop their own policies and strategies for implementing the process of inclusive education in accordance with national legislation and their rights to institutional autonomy.

A similar opinion is expressed by Stentiford & Koutsouris (2020), according to which there is no mapping of the field of inclusive pedagogy in HEIs. They argue that “the inconsistency and fragmentation in the perceptions of inclusive pedagogies is a result of the fact that inclusion itself is a philosophically contentious issue; and that this should be reflected in the way inclusive pedagogies are discussed in higher education - even if this runs counter to actual performance and market trends, which emphasize quick solutions to recognizing the complexity of pedagogical issues.”

At the same time, the good inclusive practices for HEIs students manifest not only a regulated and developed normative base, but also concrete actions for access/normative, physical, technological/etc., ensured equality in educational and social activities of universities, as well as inclusive models for full daily functioning. the diversity of opportunities and needs of students in the life of university communities. According to Moriña (2020), “inclusive practices help students stay at university and successfully complete their degrees.” Involving students in universities requires positive and valuable social interactions with fellow students, faculty, and administrators; as well as creating conditions for the subjective well-being of each student by maintaining and supporting the development of his personal potential. Inclusive education in the context of pandemic and epidemiological conditions due to COVID is being reformed into digital inclusive education. Educational institutions are in a process of constant and increasing digital transformation. In the process of transformation, the flow of information related to access, equality, and inclusion of students with disabilities in higher education is increasing.

Under unfavourable conditions for students with disabilities in a university institution, usually, the candidate students with disabilities do not choose the respective university or if they are accepted, they leave it. In addition to these final options, there is also the compromise option, students with a



variety of options due to possession disability to overcome or try to overcome barriers or to fight for social acceptance and inclusion in the academic community, in the student environment.

In this context, there is a need for new models and designs of inclusive education in HEIs; from a new organization and from a new model of inclusive education management; from new models of social interactions of the academic community with other communities interested in higher inclusive education; from new socio-pedagogical and socio-psychological models to support mental and physical health and to ensure the well-being of the academic community, related to providing conditions for self-determination and self-updating of the personality of professors, administrators, and students in HEIs.

For academics, the educational and social worlds are no longer the same as before. A revolutionary leap has been made in education as well, and it, in turn, must not just meet the new requirements, but something more. Through education, humanity is looking boldly into the future. Education has always been and will continue to be a leading role in the development of mankind.

There is hardly another profession that has so dedicatedly made public its professional activities and commitments. That is why the society reacted with applause, applause and stated unequivocally: “It is not easy to teach in an electronic environment from a distance” and “The work of an academic lecturer in online learning is complicated.” Through these few words, society has shown that academic professors are once again enjoying the respect that their work deserves. Once again, society has trusted and fully trusts universities for a brighter future.

Like any rapid and urgent reform, the reform of higher education as an inclusive higher education in education encounters difficulties and problems, but it is quick and manages to find the most effective solutions for all participants in the academic process. Difficulties and problems are sometimes solved ad hoc, but all and all problems are solved, even when the problems are barely noticeable. Academics and HEIs administrators not only become visionaries of inclusive education but also bring it out as digital inclusive education. Moreover, they implement the vision and strategy of educational reform in everyday educational and social functioning with concrete effective inclusive tactics and achieved high results. Undoubtedly, there are challenges, difficulties, and threats. But there are also visible opportunities for the full realization of inclusive higher education.

The daily functioning in academic institutions (both in physical and online learning) requires inclusive processes to be implemented in areas (White W.& Ingram, R. 2021):

- **Academic** - This includes all program-related contexts, learning environments, tutor-student interactions, learning materials, advisor of study interactions, program-related policy, assessment and feedback activities, and administrative practices.
- **University services** - This includes interactions involving IT services, Library services, Health and Counselling, Student Services, Finance, and Housing Services
- **Daily life** - Relates to contexts that are external to study; possible contexts include work, family, and needs-based contexts, food, banking, health and hygiene, social events.
- **Culture** - Reflects the multiple cultural affiliations over time that influence an individual including, as a possibility, family and regional cultures, social cultures, peer cultures, and academic culture.
- **Transition** - These contexts are embedded across the ecological levels and define experiences on entry to, throughout, and exiting the study. Admissions, induction, program orientation,



annual progression through study, and graduation are possible contexts where PGT students experience transitions.

3.8 Challenges Before Higher Inclusive Education

- Construction of philosophical and methodological platforms, which reflect explanatory models and strategies for inclusive higher education in different areas of higher education. There are developed for secondary education philosophical trajectories for inclusive processes and practices, but the specifics of inclusive higher education require new or at least expanded and purposeful philosophical interpretations.
- Personalization of the organization and management of the academic process (training, social and emotional interactions in student life, sports, arts, cultural activities, etc.) for students with disabilities.
- Management of inclusive higher education. The lack of institutional support can be an incredibly serious barrier to inclusive education in HEIs. The management of inclusive education in the educational organization, including in the conditions of distance learning during a pandemic is also related to:
 - processes of change, aimed at building a shared vision for the development of the school in the direction of inclusion of different children/students, dealing with resistance in the team.
 - the organizational culture for decision-making in the team and its connection with the motivation and the desire to involve professors in inclusive school activities.
 - planning the professional qualification of the school team and its confidence to perform its professional duties.” (Tsokov, 2020).
- Creating an inclusive academic educational environment through:
 - providing a safe and secure web environment.
 - providing high-speed internet.
 - support and provision (if necessary) with technological compatibility of electronic, adapted, and assisting devices of students with disabilities.
 - creating permanent opportunities for ubiquitous learning - anytime, anywhere.
 - increasing the interactivity of the training by including electronic resources, digital tools, and digital products.
 - introduction of innovative models of training and overcoming the negatives of conservative/traditional models of training. This type of reform sets requirements for new professional roles for HEIs professors. In order to realize inclusive higher education, the university lecturer needs to get out of the traditional hierarchical roles of only a trainer and a scientist, to get out of his comfort zone, and to fully perform professional roles of facilitator, coach, mediator, advisor, creator of networks and communities. It is likely that the inclusion processes themselves will lead to new professional roles.
- Adaptation of the methods and forms of teaching and assessment of the achievements of students with disabilities for assessment in an electronic environment; creation and maintenance of an electronic portfolio of students (including students with disabilities).
- Personalization of training in HEIs. Personalized learning “is in stark contrast to the traditional universal approach, where (...) students are expected to progress in the same curriculum at the same pace.” (Powell, Kusuma-Powell, 2011). The personalization of the learning goals according to the individual possibilities and abilities, according to the potential of each student brings out the need, not for specific prescriptions and ready recipes, but the fluctuation of



learning styles according to the specific difficulties encountered by a student in distance learning in an electronic environment. The fact that personalized learning determines the creation of a sense of community and identity, and eliminates pedagogical and personal problems, should not be overlooked.

- Promoting the formation of personal and collective self-effectiveness of professors and students in higher education. Increasing the self-efficacy of students, faculty, and administrators from HEIs brings out challenging goals, overcoming barriers, and choosing the environment. Self-efficacy differs from self-assessment.
- Numerous studies on self-efficacy have shown “the powerful truth that confidence, effort, and perseverance are stronger than innate ability/inability” (Dweck, 2000). According to Kaplan & Maddux (2000), self-efficacy cannot be attributed to the individual alone, it is the social position and social roles that one occupies and performs that influence. Collective efficiency is the degree to which it is believed that it is possible to work effectively together to achieve common goals. Collective efficiency is important for people united in groups that have a common goal (by Kaplan & Maddux, 2000). HEIs faculty and students have a common academic and social background, and when access and equality are ensured, then achieving the goals is entirely possible.
- Encouraging the reflection of faculty, students, and administrators at HEIs on all academic activities. Grushka, Hinde-McLeod, and Reynolds (2005) derive three types of reflection: 'reflection on action', 'reflection on action', and 'reflection on action'. They offer a series of technical, practical, and critical issues for professor engagement. For example, when thinking about action, professors are advised to consider the resources available, how long the lesson will take (technical reflection); how to make resources suitable for different learning styles (practical reflection); asking questions about why students learn the specific topic (critical reflection). In inclusive higher education, there is a challenge, but also the opportunity to realize the three types of reflection. Through reflective processes, the HEIs professor can change his / her position in the learning process, gain the ability to change his / her views according to the strengths and potential of the students, and thus achieve greater efficiency in the learning process as in the present. , as well as in distance learning in an electronic environment and undoubtedly a fuller unity between consciousness and responsibility for the learning process and behaviour. “Learners use reflection to achieve metacognition” (Lucas, 2012).
- Increasing the digital competence of professors in higher education in accordance with the European Framework for Digital Competence for Citizens, also known as DigComp (Eurydice Reference, 2019). The competencies in this framework that all citizens need in the fast-growing information society are 21, structured in five main areas:
 - information literacy
 - communication and cooperation
 - creation of digital content
 - safety in a digital environment
 - problem-solving.²⁴
- application of the Deep Learning model in digital inclusive education.
- introduction of new digital technologies and digital products to support and support inclusive processes in higher education.

²⁴ The Digital Competence Framework for Citizens with eight proficiency levels and examples of use, 2017



- creating a positive emotional environment in digital inclusive education to increase interest in learning and increase the general well-being of students and professors.
- documenting and disseminating good inclusive practices in higher education. There is little knowledge of inclusive practices in HEIs internationally, and knowing good practices is a challenge that requires time and resources, but if desired it is quite feasible.
- providing easy access to the Internet for all students (including students with disabilities), because ensuring accessibility is ensuring equality and social justice.
- solving problems with high-speed internet for many students at their place of residence and subsequently causing problems with the use of online tools and resources that require high-speed internet.
- overcoming difficulties in perceiving and interpreting students' non-verbal behaviour and subsequent difficulties in meeting their needs.
- removing difficulties in assessing students' progress in inclusive digital higher education.
- "hearing" the student's voice in active and independent learning and personal development, for access to administrative services and activities, for volunteering.
- conceptualizing the student experience for active inclusion.
- creation and implementation of career guidance programs.
- ensuring cyber security of the learning process and the data for students, professors, administrators, and the know-how of the educational institution itself.
- and other.

3.9 Opportunities Before Inclusive Higher Education:

Inclusive higher education implies many opportunities and perspectives that can be addressed:

- creating a wide variety of strategies for teaching in inclusive higher education, including when conducted digitally.
- providing easy access to the classroom (including the virtual one), with easy use of teaching materials, learning resources, and learning content.
- increasing the cognitive, emotional, and social engagement of student - users according to their interests, according to sensory preferences and interests in a variety of opportunities and adapting the user interface.
- introduction of personalized training in higher education, which will support the implementation of inclusive processes. "Personalized learning and teaching styles in distance learning in an electronic environment are formed and presented according to cognitive, emotional, environmental, social factors and experience. It is important for professors to understand the differences and individuality in their students' learning styles so that they can choose and apply their own best teaching styles in their daily pedagogical practice. Then the learning styles will be effective in the overall process of distance learning in an electronic environment: in teaching, learning, education and socialization" (by Levterova, 2016). Easy and effective personalization of learning content in technology-mediated education and psychological support in technology-based interventions requires adaptation of the physical and graphical interface, as well as adapted feedback according to the neurotypical or neurodiversity of student - users, professor or university administrator, etc.
- designing an individual profile and individual portfolio of students who ensure the implementation of personalized learning as a predictor of inclusive education.



- reforming teaching. Distance learning in electronic environments has changed the teaching styles of HEIs by saturating them with more dialogue, more prosocial behaviour, and empathy and reflection.
- transforming learning. Changed teaching transforms and will continue to transform passive learning into active learning. Active learning is enhanced when:
 - problem-based learning.
 - learning based on research and studies.
 - learning through discovery.
 - learning by doing.
 - learning through experience.
 - learning through emotional experiences.
 - deep learning, etc.
- development of new models for the analysis of brain-computer interface systems, which will allow the effective application of Deep Learning in digital inclusive education through machine learning. For example, the development and application of meta-heuristics for hyperparametric tuning of the learner's neural network to improve the learning process with discovery (by Ashis, Arpan, Mufti, Kaiser & Sarkar, 2022).
- when professors apply teaching models determined by social-constructivist theories of learning and/or in line with the targeted models of active learning, then they change the learning styles of students (in physical and distance learning in e-learning). When all students are motivated to learn, learn imperceptibly and with pleasure, then inclusive practices are every day. Changing models of teaching and learning, distance learning in e-environments, the engagement of many professions in cyberspace to provide online learning inevitably lead to new aspects of career guidance and career realization in likely new professions.
- increase the digital competencies of professors in accordance with The Digital Competence Framework for Citizens with eight proficiency levels and examples of use (2017) or even create separate digital profiles for professors and students of HEIs in the context of inclusive education.
- introduction of new technologies both for inclusive processes, related to opportunities for social and positive-emotional interactions between co-students and between students and professors, as well as for the educational process.
- encouraging team interactions and cooperation between students in face-to-face and online learning. In online training, group projects can be set through the functionalities of electronic platforms, through quizzes and competitions, through blogs and web pages.
- to create a positive emotional educational environment and realize effective communication in the learning process to provide opportunities for analysis of the emotional state of students, professors, administrators according to the linguistic constructions they use. For example, to take into account the analysis of sentiment analysis, analysis of the structuring of sentences using supervised machine learning with extended lexicon dictionary (by Bhowmik, Arifuzzaman, Mondal, Islam, 2021).
- expanding the opportunities for informal communication between professors and students with disabilities. Informal communication between professors and students with disabilities in HEIs leads to increased motivation for learning and achievement. In this discourse, motivating for higher academic achievement and for effective academic and social interactions of and with students with disabilities will increase the effectiveness of inclusive processes. Motivation for effective academic-social positive interactions will lead students with disabilities to subjective and general well-being and personal prosperity.
- promoting the formation of self-efficacy of professors and students in higher education.



- encouraging the implementation of reflective practices and reflective processes in higher education. According to Eby (2000), “reflexive practice is a synthesis of reflection, self-awareness and critical thinking. (...) The philosophical roots of reflective practice are identified in phenomenology (with a focus on experience and personal consciousness) as well as in critical theory (which promotes the development of critical consciousness to emancipation and counteraction to oppression). HEIs clearly outline the possibility of implementing inclusive processes in higher education.
- description and dissemination of good inclusive practices with technology-based learning in higher education worldwide (Ivanova, 2021).
- derivation of new professional qualifications in the interface of sciences and in the interface of services will lead to the elimination of narrow specializations and the emergence of new interdisciplinary professions and professions related to distance activities in the electronic environment. Many universities around the world are already training artificial intelligence designers and robotics designers. New professions will appear related to the development of the intelligent environmental context or the Internet of Things - Smart home environment, Smart educational environment, Smart cities, etc.; with the application of new technologies in everyday life and the social world - robotics, nanotechnology, artificial intelligence, etc. ; with the provision of mental and physical health and well-being for man - information technology in health care, speech therapy, psychology. The fitness of the mind and body, personal health, personal financial and personal social management, etc., etc. (which can and are realized virtually) are entering rapidly and rapidly. In the hypothetical model, there are opportunities for new professions that will require new professional qualifications, such as:
 - designer of an inclusive educational environment
 - designer of learning resources
 - designer of neuro-educational, neuro-economic, neuro-marketing, etc. resources
 - educational gamemaster
 - designer of STEM academic environment
 - designer of educational virtual reality
 - designer of intelligent educational environment for students
 - designer of intelligent educational environment for students with special educational needs
 - designer of robots and robot support (developers, programmers, operation techs, suppliers)
 - solar park specialist; leaders in innovative technologies; designer of virtual worlds; drone operator; architect of green spaces and cities
 - mind fitness trainer; developer of an intelligent system for (various areas of services and production)
 - concierge on robotics, etc.²⁵
- “personal health maestros, genetic modification designers, and engineers; ai-enhanced freelancers; driverless ground crews; data junkies; blockchain architects; 3d printing fabricators; cryptocurrency; sensor system architects and curators, asteroid miners, fusion power plant builders, CRISPR, biohacking, and programmable healthcare gurus, tube transportation infrastructure builders, quantum tech gurus, mixed reality builders, cultured meat producers, IoT & home automation professionals,²⁶

²⁵ https://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

²⁶ <https://futuristspeaker.com/future-of-work/20-common-jobs-in-2040/>



- Improving conventional symmetric and asymmetric security protocols, security and privacy handling in IoT networks, AI-based solutions to improve the security effectiveness of digital inclusive education (by Zaman, Alhazmi, Aseeri, Ahmed, Khan, Kaiser & Mufti, 2021).
- and many other opportunities that appear in a specific environmental context or in promising trends in inclusive higher education.

Undoubtedly, this is a bold look into the future of humanity, a large-scale challenge for the education and professional realization of students with disabilities (and all students). One thing is clear, without inclusive higher education, society cannot develop. This finding was proved in the implemented distance learning in an electronic environment in various formats - through virtual platforms and synchronous learning, through asynchronous learning, through hybrid learning models, and through scientific and empirical research.

Without claiming to be an experience for SWOT analysis, challenges and opportunities for solving them from and in higher education have been identified. The presented challenges and opportunities for inclusive higher education are a kind of perspective strategy so that today's education can respond to the challenges and dynamic socio-economic changes of the future. Education 4.0 is already having a successful start, and it is the academic community that has always looked and looked beyond the horizon of education today to have the educational, professional, and social inclusion and general well-being of humanity tomorrow.

At first glance in a futuristic, but also in a real-provocative context, Ray Schroeder of the DaVinci Institute, a futuristic think tank in Colorado, asks questions about the future of higher education:

- Where will higher education be located in the emerging metaverse? Will colleges and universities host their own “islands” of campuses? Will virtual megamalls of storefronts offer certificates and certifications hosted by a plethora of institutions? Will your institution be represented - welcoming virtual students from around the real world to engage in 3-D learning around the clock? It is important that colleges and universities discuss the opportunities now. We must be prepared to help build the metaverse if we are to ensure that there is a viable place for us in the virtual world of the future?²⁷
- Who on your campus is tracking the demographics and needs of those engaged in the Great Resignation? Are administrators and faculty aware of the emergence of this growing segment of the workforce? Is your institution agile enough to design new programs to meet the needs of these millions of workers who have called it quits in their current jobs?²⁸

Questions that deserve reflection and action, but also raise the basic question: What should be the answer to these questions so that higher education increases its inclusive added value?

The answer depends on each educational institution, on each educational structure, and on each participant in the academic activities.

How would you, the reader of these lines, answer these questions about yourself and your HEI?

²⁷ <https://www.insidehighered.com/digital-learning/blogs/online-trending-now/metaverse-finally-emerging/>

²⁸ <https://www.insidehighered.com/digital-learning/blogs/online-trending-now/higher-education%E2%80%99s-role-era-great-resignation>



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4 Universal Design vs Disability Design

Buildings are a major focus of social and personal life. The created locations influenced public spaces, parks, and personal living environments. Two design theories shape the constructor's plans during the design phase. The universal or disability (accessible) design method may be used to create buildings, social situations, materials, and goods.²⁹ Inclusive design is concerned with discovering new methods to serve a broad range of people who make up a varied market. Rather than a one-size-fits-all approach, this may include diverse solutions or methods for distinct groups of individuals.³⁰

In contrast, rather than attempting to satisfy individual accessibility or inclusion goals, universal design serves the largest variety of users feasible. Typically, universal design does not provide additional support for 'edge situations' instead offering a single solution that serves the broadest potential user base with no further concessions.³¹ Furthermore, while universal design has traditionally focused on environments and architecture, it has increasingly been applied to goods. Inclusive design, on the other hand, may be applied to all of these domains, as well as systems and services.³²

These design principles can be applicable not only for constructions and environments, but also services and products such as websites and online platforms. Digital items and online platforms can be designed according to these criteria in order to increase the accessibility in every step of the life.

4.1 Universal design for buildings, environments, products and materials vs Disability Design for buildings, environments, products, and materials

4.1.1 Universal Design

Universal design is a style of creating that aims to make places, services, and products useable by the greatest number of people. It is founded on seven universal design principles. Some universal design principles include adaptability, simplicity, and fault tolerance. The objective of reducing obstacles for all users is centred on all of these ideas.³³ Using this design concept, designers construct a single solution aimed to reach the greatest number of people, without the need to augment the solution to suit people with varying demands. Universal design has its roots in architecture and industrial design, but it has lately grown to embrace digital goods and services as well.³⁴ In architecture scope, buildings and public places designed according to people with/without disabilities.

4.1.1.1 Principles of Universal Design³⁵

1. Equitable Use: The design is usable and marketable to persons with a variety of disabilities. Strong colour contrast, for example, can be utilized to prevent stigmatizing colour-blind users.

Equitable Use Concepts

- a. Provide all users with the same methods of operation: identical, if possible, equivalent when not.
- b. Do not isolate or stigmatize any users.

²⁹ <https://www.gov.scot/policies/building-standards/monitoring-improving-building-regulations/>

³⁰ <https://sayyeah.com/digital-insights/universal-design-accessibility-inclusive-design/>

³¹ <https://sayyeah.com/digital-insights/universal-design-accessibility-inclusive-design/>

³² <https://www.designcouncil.org.uk/what-we-do/programmes/built-environment/>

³³ <https://universaldesign.ie/what-is-universal-design/>

³⁴ <https://universaldesign.ie/what-is-universal-design/>

³⁵ <https://sayyeah.com/digital-insights/universal-design-accessibility-inclusive-design/>



- c. All users should have equal access to privacy, security, and safety provisions.
 - d. Create a design that is appealing to all users.
2. Usability Flexibility: The design caters to a wide variety of individual preferences and skills. For instance, a customized dashboards can be provided.

Flexibility Use Concepts

- a. Provide a variety of techniques of usage.
 - b. Allow for right- or left-handed use and access.
 - c. Improve the accuracy and precision of the user.
 - d. Allow for adaptation to the user's pace.
3. Simple and Intuitive Usage: The design's use is simple and intuitive, independent of the user's experience, expertise, language abilities, or educational level. For instance, Progressive Disclosure can help to reduce visual clutter.

Simple and Intuitive Use Concepts

- a. Remove any unneeded complication.
 - a. Adhere to user expectations and intuition.
 - b. Allow for a wide variety of reading and linguistic abilities.
 - c. Arrange information in accordance with its significance.
 - d. Provide prompting and feedback that is helpful both during and after job completion.
4. Perceptible Information: The design successfully transmits required information to users, independent of environmental circumstances or sensory capacities. For example, with video transcription, persons with hearing problems may watch videos.

Perceptible Information Use Concepts

- a. For redundant display of crucial information, use multiple modalities (pictorial, verbal, tactile).
 - b. Provide sufficient contrast between important information and its surrounds.
 - c. Increase the "legibility" of critical information.
 - d. Distinguish items in ways that can be explained (i.e., make it easy to give instructions or directions).
 - e. Compatibility with a range of approaches or equipment used by persons with sensory impairments.
5. Error Tolerance: The design reduces dangers and the negative repercussions of unintentional or inadvertent acts. For example, Form Validation (Input Format Validation, Data Validation, Server Validation) helps to reduce submission errors.

Error Tolerance Use Concepts

- a. Arrange elements to reduce dangers and errors: most utilized elements should be closest to the user, and dangerous elements should be deleted, separated, or insulated.



- a. Issue cautions regarding potential dangers and mistakes.
 - b. Include fail-safe mechanisms.
 - c. Avoid thoughtless behaviour in jobs that need awareness.
6. Low Physical Effort: The design allows for efficient, comfortable, and fatigue-free use. For instance, using keyboard shortcuts, may reduce your reliance on the mouse.

Low Physical Effort Use Concepts

- a. Allow the user to keep their body in a neutral position.
 - b. Employ appropriate operational forces.
 - c. Reduce repetitious acts.
 - d. Reduce long-term physical exertion.
7. Approach and Use Size and Space: Appropriate size and space are supplied for approach, reach, manipulation, and use independent of the user's body size, posture, or mobility. For example, consider the target area of a created website while viewing it on a mobile device.

Approach and Use Size and Space Use Concepts

- a. Allow every sitting or standing user a clear line of sight to crucial features.
- a. Make it easy for any sitting or standing user to reach all components.
- b. Allow for differences in hand and grip size.
- c. Allow enough room for the use of assistive equipment or personal assistance.

4.1.2 Universal design with regards to accessible education buildings and physical environment

Participation, meaning-oriented learning, and self-management are all feasible in a strong and secure learning environment. It respects the requirements and specificities of a diverse range of students, adds to learning output, and is in accordance with a diverse range of students' knowledge, interests, and demands.

A strong learning environment aids and supports the learning process of a wide range of pupils. Students learn best when they feel appreciated and included in the group. Certain kids (for example, students with disabilities) may face stigma and stereotyping, which can have a negative impact on their well-being and learning performance. As a result, it is critical for staff and instructors to become aware of any biases and preconceptions that exist, as well as to be attentive to the various needs of pupils.³⁶

Universal design may enable access beyond national construction rules when focusing on an educational facility's entry and internal circulation. Individuals who use wheelchairs, parents who push strollers, students who carry or drag large luggage, and guests who need delivery equipment or other mobility aids are all encouraged to utilize universally adapted educational facilities. Interior circulation space should be reasonable and direct in general. Access paths should be free of impediments and

³⁶ Steunpunt diversiteit en leren (z.d.). Krachtige leeromgeving. Geraadpleegd op 25/01/2019 via <http://www.steunpuntdiversiteitenleren.be/themas/krachtige-leeromgeving/>



give a clear visible path across the interior area. Interior rooms should provide sitting places and, if necessary, railings.

4.1.2.1 Entrances

Entrances should be welcoming, beautiful, and accessible while ensuring security and environmental quality in order to apply universal design to entrances. Entrances should be easily recognized and aesthetically distinct from the outside design of the institution. Lighting, landscaping, canopies, door recess, surface texture should be selected and decorated carefully.

Entrances to educational facilities should be accessible to all visitors through level thresholds, regardless of ability, handicap, or present mobility limitations, thanks to universal design.³⁷

Foot traffic should be able to flow in both directions through entry/exit points and passageways.

Recessed outward-opening doors and canopies provide for plenty of room both within and outside the entry. Outward-opening recessed doors can help protect people from the elements by preventing rain or freezing temperatures from reaching the building front.

4.1.2.2 Doors

Doors should be appropriately broad, clearly identified, and operable, and consistently open in the same direction, even if they are regarded obstacles. Between doors and neighbouring wall surfaces, create dramatic visual and textural contrasts. Low-friction hinges and rising-butt hinges should be utilized with self-closing mechanisms to reduce opening and closing forces. Knob handles should be avoided. Doorknobs should contrast with the door and be easily accessible.

All users should be able to access door security entry systems, which should contrast aesthetically and be easily identified. Video intercoms can help with identification, while speech intercoms with text are valuable communication tools. When feasible, keypads should have raised buttons and embossed symbols and numerals.

Waiting, and administration office areas should consider the following:

- Locate directly across and be visible from facility entrance.
- Offer desks at different heights.
- Offer contrasting colour schemes.
- Have obstacle free circulation routes.
- Provide clean counter space and desks to users.
- Have lighting well designed for visual communication, lip and text reading, and to avoid glare.
- Have firm, slip-resistant floor surfaces.
- Place signage to aid visitors in locating other areas of the facility.
- Locate restroom facilities visible from the reception area.
- Allow free space for wheelchairs, strollers, service animals, and walking aids while providing comfortable seating.

³⁷ Steunpunt diversiteit en leren (z.d.). Krachtige leeromgeving. Geraadpleegd op 25/01/2019 via <http://www.steunpuntdiversiteitenleren.be/themas/krachtige-leeromgeving/>



- Arrange meeting rooms in quiet spaces (new construction).

4.1.2.3 *Hallways*

- The elements of the facility should not have sharp edges and should have appropriate illumination on a constant basis.
- All obstacles that restrict the flow of foot traffic should be eliminated.
- Lockers, cupboards, and closets should all be accessible in educational facilities.
- Colour palettes, floor textures, and materials may all be used to help people navigate.³⁸

4.1.2.4 *Classrooms*

Classrooms should be universally designed to provide an adequate learning environment for all students, teachers, and visitors.³⁹

- Furniture layouts should ensure learning tools are accessible to all users.
- Classroom aisle space needs to be obstacle free to allow users to move freely.
- Provide versatile classroom furniture for learners, sitting or standing, to help adapt the learning environment in preparation for different classroom functions.
- If relevant, provide equitable locations for power sources and space for users to access computers with study materials comfortably.
- Large classrooms should allow wheelchair accessibility in various locations for seating positions.
- Provide sight lines for all users who lip-read, use sign language or speech-to-text screens.⁴⁰

4.1.2.5 *Library*

The libraries within educational facilities should include universally designed space for users to access learning materials.

- Provide different shelf and counter heights for book selection and check out.
- Locate a fair amount of power sources for computer space and personal usage.
- Ensure all users will have space to comfortably use study materials and computers simultaneously.
- Table and chair layouts need to provide space for user movement, table access, leg room, user sitting or standing position, etc.

4.1.2.6 *Surfaces*

To apply universal design to surface finishes, internal environments should assist building users in their effort to:⁴¹

- Navigate the school.
- Identify building features and obstacles.

³⁸ National Disability Authority, Centre for Excellence in Universal Design. (n.d.). Building for everyone: A universal design approach. Vertical circulation. Retrieved from <http://www.sfusd.edu/en/ada/access-guides-for-schools-and-buildings.html>

³⁹ Universal Design New York. (n.d.). 4.1c Wayfinding. Retrieved from the Center for Inclusive Design and Environmental Access website: <http://www.ap.buffalo.edu/idea/udny/Section4-1c.htm>

⁴⁰ Universal Design New York. (n.d.). 4.1c Wayfinding. Retrieved from the Center for Inclusive Design and Environmental Access website: <http://www.ap.buffalo.edu/idea/udny/Section4-1c.htm>

⁴¹ Universal Design New York. (n.d.). 4.1c Wayfinding. Retrieved from the Center for Inclusive Design and Environmental Access website: <http://www.ap.buffalo.edu/idea/udny/Section4-1c.htm>



- Communicate with others in an acoustically balanced environment.

The Centre for Excellence in Universal Design stressed safety as the most important consideration in surface finishes. Inappropriate surface changes, without tactile warning for building users, may be a safety hazard, and increase incidences of slipping and falling. School officials, planners, and designers should avoid directional floor coverings (e.g., deep-pile carpets and coir mattings) and large prints or stripes on the floor, which may be visually confusing.⁴²

Wall and ceiling finishes should coordinate with surface finishes to improve the acoustical, visual, and aesthetic elements of the building design. Lack of attention to acoustical design may affect users with hearing difficulties due to reverberation concerns. School officials, planners, and designers should also avoid bold patterns due to inadvertent visual confusion by the user.

4.1.2.7 *Internal lighting*

To apply universal design to lighting, school officials, planners, and designers, should acknowledge inappropriate lighting may produce uncomfortable situations for those with visual difficulties, such as:

- Glares and shadows.
- Confusion between internal features.

The Centre for Excellence in Universal Design cautioned school officials, planners, and designers to not position windows and lights at the end of corridors, or behind people at reception areas. Proper placement may reduce potential visual difficulties created by lighting contrasts. Internal lighting design should not create shadows which can mask, or hide, step edges. School officials, planners, and designers should consider incorporating sun-shading devices, solar-control glass, and binds to reduce the potential for glares or shadows. Furthermore, design consideration of the nature and use of a particular space, direction, and the effect of light distribution, from natural and artificial lighting, should be accounted for to create an optimal viewing environment.⁴³

4.1.2.8 *Electrical Apparatuses*

To apply universal design to electrical apparatuses all apparatuses should:⁴⁴

- Be clearly visible.
- Easy to reach.
- Simple to operate.
- Consistent in design throughout the educational facility.

School officials, planners, and designers should follow such guidelines to coordinate power supply use throughout the facility. As the building layout is organized in a logical arrangement, so should electrical apparatuses be located logically along routes in the building. Furthermore, a visual contrast should be

⁴² National Disability Authority, Centre for Excellence in Universal Design. (n.d.). Building for everyone: A universal design approach. Vertical circulation. Retrieved from <http://www.sfusd.edu/en/ada/access-guides-for-schools-and-buildings.html>

⁴³ National Disability Authority, Centre for Excellence in Universal Design. (n.d.). Building for everyone: A universal design approach. Vertical circulation. Retrieved from <http://www.sfusd.edu/en/ada/access-guides-for-schools-and-buildings.html>

⁴⁴ Mendell, M. J., & Heath, G. A. (2004). Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. *Indoor Air*, 15, 2



implemented for outlets, switches, and controls to assist building users with visual difficulties. Electrically powered window and door systems should be considered.

4.1.2.9 Acoustics

To apply universal design in internal environments school officials, planners, and designers should consider how important acoustically balanced internal environments are to the academic achievement of students. The Centre for Excellence in Universal Design stated school officials, planners, and designers should consider a host of factors which might hinder an acoustically balanced internal environment, such as:⁴⁵

- Location of a building in relation to external noise sources (e.g., highway, industrial factories).
- Internal layout.
- Size and shape of rooms.
- The acoustical performance of the building and its mechanical features.

Without an appropriate acoustic environment in educational facilities, building users with auditory difficulties could be hindered in their reception of information from a variety of contributors (e.g., teachers, administrators, parents). In order to provide an optimal, acoustically balanced environment, consideration should be given to providing a buffer zone between quiet and noisy learning spaces. Furthermore, school officials, planners, and designers should select finishes and methods of installation which achieve a balance of hard and soft surfaces. Lastly, ventilation systems should be installed, and or retrofitted, to minimize noise impact.⁴⁶

4.1.3 Universal design with regards to accessible and inclusive education environment

It is becoming increasingly vital to give high-quality education to students who require special education.

Inclusion is based on the principles of equality of opportunity and normality. In this context, inclusion is defined as the process of integrating disabled children into otherwise normal educational and social development, based on the values of equality of opportunity and normality.

Teaching students with disabilities in an inclusive classroom can be challenging for instructors who are used to teaching in a traditional classroom; as a result, teachers should be required to possess the essential criteria of effective teaching. Students of all levels benefit from the utilization of instructional resources since it makes learning and comprehension simpler. Educational tools are especially significant for pupils who have learning disabilities.⁴⁷

Students with disabilities may be given an adjustment report that details the impact of their handicap on their studies and proposes appropriate adjustments to teaching and assessment that will remove impediments and reduce the impact.

⁴⁵ Earthman, G. I. (2002). School facility conditions and student academic achievement (wvs-rr008-1002). Los Angeles, CA: UCLA's Institute for Democracy, Education, & Access.

⁴⁶ Mendell, M. J., & Heath, G. A. (2004). Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. *Indoor Air*, 15, 2

⁴⁷ Coşkun, Y. D., Tosun, Ü., & Macaroğlu, E. (2009). Classroom teachers styles of using and development materials of inclusive education. *Procedia-Social and Behavioral Sciences*, 1(1), 2758-2762



Many of the modifications proposed are directly connected to accessibility. Accessible teaching and assessment improve everyone's learning experience and helps to reduce the need for particular modifications.

Universal designed classroom provides not only physical accessibility but also inclusively designed schedule and course materials. Regarding the accessible and inclusive education environment, universal design advises:

- Prioritize the availability of fresh and updated instructional materials.
- Whenever feasible, ensure that instructional materials are supplied ahead of time (recommended two weeks or more, minimum 48 hours).
- Minor adjustments and updates can be provided or delivered closer to the time of instruction.
- Students may need to modify the material before to the session in order to use successful note-taking practices, or they may need to share it with an assigned language interpreter to review ahead of time, or for remote interpreters to prepare and acquire new language and ideas.
- Provide instructional materials in their native format (e.g., Word, PPT, Latex) as well as PDF or ePUB.⁴⁸

It's easy to see how universal design may help kids with disabilities. Students may spend more time together in a learning setting because of the curriculum design, which fosters a sense of inclusion that helps all students in the long run. Because all children learn in different ways, it also allows special needs kids to see and hear knowledge delivered in a variety of ways, which may improve their capacity to absorb the material.

Because there are various paths to learning, some of which work better for specific individuals than others, the adoption of universal design, like differentiated learning, may help students at all levels. Universal design differs from traditional learning in a number of ways, including the presentation of material in visual, auditory, and tactile formats, the use of various testing formats (including oral presentations and group projects), and the increased motivation of students as a result of these various methods of instruction.⁴⁹

4.2 Inclusive Design

Inclusive design is the creation of an environment that allows as many individuals as possible to access and utilize it, regardless of age, gender, or handicap. Inclusionary design extends not just to buildings, but also to surrounding open areas where people go about their daily activities. Shops, offices, hospitals, recreational facilities, parks, and roadways are all included. Individual variety and uniqueness are taken into account in inclusive design. To do this, built environment experts should include prospective users at every level of the design process, from the design brief to detailed design, construction, and completion. It is critical to include handicapped persons in the design process whenever feasible.⁵⁰

⁴⁸ <https://www.dundee.ac.uk/guides/creating-inclusive-teaching-materials/>

⁴⁹ Coşkun, Y. D., Tosun, Ü., & Macaroğlu, E. (2009). Classroom teachers styles of using and development materials of inclusive education. *Procedia-Social and Behavioral Sciences*, 1(1), 2758-2762.

⁵⁰ <https://www.toptal.com/designers/ui/inclusive-design-infographic/>



4.2.1 Principles of Inclusive Design⁵¹

1. Inclusive: So that anybody may use it in a safe, simple, and dignified manner.
2. Respondent: Taking into account what individuals say they require and desire.
3. Adaptable: So, it can be used in a variety of ways by various people.
4. Convenient: It can be used by everyone without a lot of work or separation.
5. Accommodating: All persons, regardless of their age, gender, mobility, ethnicity, or circumstances, will be accommodated.
6. Welcoming: With no impediments that could keep certain individuals out.
7. Realistic: Providing many solutions to assist balance everyone's demands while also acknowledging that one answer may not work for everyone.

4.2.2 Inclusive design with regards to accessible education buildings

Inclusive design is the design of environments, products and services to be usable for as many people as possible. It is based on the observation that things designed for the “average” tend to be suboptimal for the vast majority of people as nobody is precisely average. The designs that have to be accessible for people with disabilities. This involves dropping assumptions about abilities and designing things that can be used in many different ways. For example, a button that is flat and flush with a surface may require a finger to push. If it would be designed with a button stick out such that it is 3 dimensional, a person can activate it with a larger body part such as knee.⁵²

Inclusive design looks for solutions that fit everyone. For example, instead of a building entrance with narrow stairs and narrow wheelchair ramp, the entire entrance may be slope that is attractive, barrier-free and minimalistic.⁵³

In inclusive designs, buildings should be structured for travellers who may not speak the local language and people with visual impairments. Information may be presented in visual, textual, audio and tactile form. For instance, a large-text warning sign a visual illustration and tactile pavement that can convey information such as “danger ahead” to someone with a cane.⁵⁴

Inclusively designed buildings should be designed that allow things to be pushed out of the way and reconfigured on the fly. For example, shelving that moves up and down to be accessed from any height. Besides, constructions should be removing physical task by automating them. For instance, an automated door. The design should be easy to use controls that are unambiguous and error tolerant.

Inclusive design is allowing constructions to be customized in every imaginable way by users. Some users will prefer a simple user interface with basic options, others will want powerful and precise controls.⁵⁵

Lastly, safety features that consider people with disabilities, older people, children and different uses of space such as bicyclists on a road.

⁵¹ <https://inclusivedesign.scot/what-is-inclusive-design/>

⁵² <https://hmcarchitects.com/news/inclusive-schools-designing-for-disability-in-classrooms/>

⁵³ <https://centaur.reading.ac.uk/80777/3/Inclusive%20Design%20submitted.pdf>

⁵⁴ <https://centaur.reading.ac.uk/80777/3/Inclusive%20Design%20submitted.pdf>

⁵⁵ <https://centaur.reading.ac.uk/80777/3/Inclusive%20Design%20submitted.pdf>



4.3 Universal design for learning vs Disability Design for learning

4.3.1 Universal Design for Learning

Universal Design for Learning (UDL) is a broader approach to accessibility that addresses particular characteristics of a website or online learning environment. The emphasis of UDL rules is still on accessibility, but it is not simply on creating disability modifications or according to the law. The purpose of UDL is to give the best level of accessibility and usefulness for as many people as possible.⁵⁶

UDL is based on three main concepts, each of which has several rules and checkpoints for real implementation. A UDL strategy is organized and practical, and it outlines an end goal, similar to accessibility: a product that can be used by the greatest possible variety of people. The framework, on the other hand, places a premium on design, which is simply one part of developing an online course.⁵⁷

UDL can be sustained by following the principles below:⁵⁸

a. Engagement

Affect is an important component of learning, and learners' range greatly in terms of how they might be engaged or driven to learn. Individual variance in affect can be influenced by a number of elements, including neurology, culture, personal significance, subjectivity, and background knowledge, among others. Some learners are strongly engaged by spontaneity and novelty, whilst others are bored, even terrified, by these qualities and prefer tight regularity. Some students prefer to work alone, while others prefer to collaborate with their peers. In fact, no single mode of interaction will be ideal for all learners in all settings; therefore, having several modes of engagement is critical. Engagement can be sustained with:

- Recruiting Interest
 - Enhance individual autonomy and choice.
 - Boost relevance, value, and authenticity.
 - Reduce risks and distractions.
- Sustaining Effort and Persistence
 - Increase the prominence of goals and objectives.
 - To maximize the difficulty, vary the expectations and resources.
 - Encourage collaboration and community.
 - Increase mastery-oriented feedback.
- Self-Regulation
 - Encourage motivational expectations and beliefs.
 - Assist in the development of personal coping skills and techniques.
 - Develop self-evaluation and reflection skills.

b. Representation

Learners have different perceptions and understandings of the information they are given. Sensory impairments (e.g., blindness or deafness), cognitive problems (e.g., dyslexia), language or cultural variations, and so on may all necessitate distinct approaches to material. Others may just be able to acquire information more quickly or efficiently through visual or aural means rather than reading words. Multiple representations also facilitate learning and

⁵⁶ <https://www.understood.org/articles/en/universal-design-for-learning-what-it-is-and-how-it-works/>

⁵⁷ <https://www.understood.org/articles/en/universal-design-for-learning-what-it-is-and-how-it-works/>

⁵⁸ <https://udlguidelines.cast.org>



transfer of learning because they allow students to create connections both inside and across topics. In summary, there is no one-size-fits-all approach to representation that will work for all students; giving a variety of alternatives is critical. Representation may be maintained with:

- Perception
 - Provide options for modifying the way information is shown.
 - Provide auditory information options.
 - Provide visual information options.
- Language and Symbols
 - Make terminology and symbols clearer.
 - Syntax and structure should be clarified.
 - Text, mathematical notation, and symbols may all be decoded.
 - Encourage cross-linguistic understanding.
 - Use a variety of mediums to illustrate your point.
- Comprehension
 - Activate or provide background information.
 - Patterns, key characteristics, significant concepts, and linkages should all be highlighted.
 - Assist with data processing and visualisation.
 - Transfer and generalization should be maximized.

c. Action and Expression

Learners vary in their ability to navigate a learning environment and articulate what they know. Individuals with major physical disabilities (e.g., cerebral palsy), those who struggle with strategic and organizational abilities (executive function disorders), those with language challenges, and so on approach learning activities in very different ways. Some people can communicate themselves well in writing but not in voice, and vice versa. It should also be noted that action and expression take a significant amount of planning, practice, and organization, and this is another area where learners might differ. In fact, no one mode of action or expression will be best for all learners; therefore, giving alternatives for action and expression is critical. Action and expressions can be kept up with:

- Physical Action
 - Change up the response and navigation ways.
 - Improve accessibility to tools and assistive technology.
- Expression and Communication
 - Use a variety of communication mediums.
 - For building and composition, use a variety of tools.
 - Develop fluency with varying degrees of help for practice and performance.
- Executive Functions
 - Orient proper goal setting.
 - Assist with planning and strategy development.
 - Aid in the management of information and resources.
 - Increase capability for tracking progress.

4.3.2 Inclusive Design Learning

Inclusive design learning takes into account the entire spectrum of human variety, including ability, language, culture, gender, age, and other aspects of human variation. The basic ideals of inclusive design are awareness, compassion, and togetherness—awareness to notice variety in learners,



compassion to incorporate the needs of people who are different from us, and togetherness to share good outcomes of the design process.⁵⁹

Designers of inclusive learning experiences understand that each learner is unique. As a result, their concept of accessibility evolves dynamically to fulfil the requirements that emerge not only from disability, but from the whole range of human variation. Designing for human variety is known as inclusive design.⁶⁰

The purpose of inclusive learning design is to use human variety in the design process to create an adaptive and flexible one-size-fits-all learning experience that allows each learner to be the architect of their own learning. Inclusive design for learning is a method of thinking as well as a way of doing.⁶¹

It is a prevalent misconception that technology, which serves as the foundation of the digital world, produces accessibility issues. On the contrary, technology is incredibly pliable and can accept human variation in any form provided we understand human uniqueness and design with empathy, following to digital building regulations in the form of accessibility standards.

Inclusive design can be applied to learning along three dimensions:⁶²

a. Recognizing Variety and Individuality

The first dimension is about acknowledging each learner's variety and individuality, which entails identifying and including the needs of learners on the edges, or margins. It is also about allowing and supporting self-knowledge and self-determination in learners so that they may understand their own learning requirements and make use of the available design and configuration options.

b. Making Use of Inclusive Processes and Tools

The second component is concerned with ensuring that the design process and the tools used in design are inclusive. A good design appeals not only to the learners in the target group's centre, but also to "extreme users." Inclusive design teams must be varied and, if feasible, include people who have lived experience with extreme users in the group for which the products are designed. This would be consistent with the disability community's widespread idea of "nothing about us without us."

c. Enabling A Larger Positive Impact

The third component necessitates that designer of learning systems and services consider the context and larger impact of their work and seek to have a positive influence that extends beyond the intended beneficiaries. Inclusive design must seek to identify the interconnection of people and systems, to capitalize on the "curb-cut effect" through its consequences, and to initiate a virtuous cycle of inclusion.

Whereas Universal Design for Learning (UDL) evolved from architecture, inclusive design "arose from digital settings," and while architecture is fixed, the web is fluid and constantly evolving. As a result,

⁵⁹ <https://idrc.ocadu.ca>

⁶⁰ The inclusive design guide. Inclusive Design Research Centre at OCAD University. CC-BY 3.0.

⁶¹ The inclusive design guide. Inclusive Design Research Centre at OCAD University. CC-BY 3.0.

⁶² <https://idrc.ocadu.ca>



adaptability and process are valued highly in inclusive design. The method is iterative inclusive design. With an emphasis on iteration and process, inclusive design cannot be divorced from the lived experiences of actual users. In other words, if the users (in our case, students) are contributing to and evaluating the design, the development and facilitation activities can no longer be separated.⁶³

Inclusive design, with an emphasis on process, encourages co-creation and regular input from many developers as well as end users. Seeking contributions from excluded populations, in particular, throughout the whole design and assessment process, is crucial to an inclusive approach.

In contrast to accessibility and UDL, inclusive design emphasizes process and iteration.

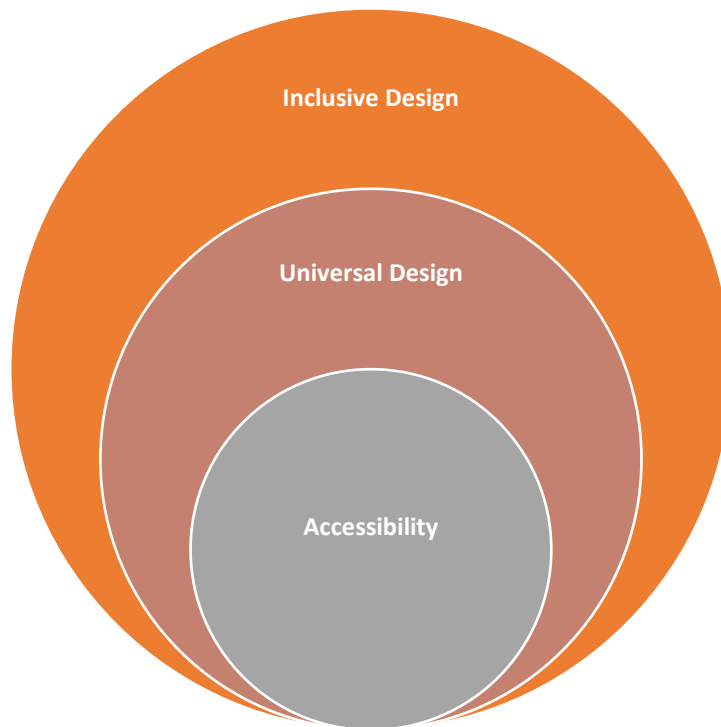


Figure 1: As ultimate goals, an inclusive design approach will always incorporate UDL and accessibility.

One of the most significant lessons learned is that inclusive design is a continuous feedback and iteration process. Inclusive design should be demanded and supported in all sectors to sustain independent living for people with special needs increase the social inclusion. The advantages of inclusive design are numerous, and they can lead to a higher sense of social inclusion. Disabled persons can fully engage in society through social inclusion. Inclusive environments, products, and materials promote equality and make life simpler and safer for everyone.

4.3.3 Inclusive design with regards to inclusive educational material

Inclusively designed materials help children with special needs to be involved in education system. Online platforms are offering customized services and opportunities according to the users' needs. Thus, hearing, visual and physical disabilities can be compensated with inclusively designed materials. Personalized wheelchairs, audio systems, and censored helmets helps children to involve in the

⁶³ Appert, L. et al. (2018) Guide for Inclusive Teaching at Columbia. Columbia University: Center for Teaching and Learning.



educational and social part of the school life. In the twenty-first century classroom, technology is essential.⁶⁴ It not only allows students to stay up with the changing world, but it also makes the curriculum accessible to children with special needs. Technology may play a variety of functions in the inclusive classroom, whether it's a computer, iPad, audio/visual equipment, or assistive devices. It can give instructional software, a curriculum that is accessible to students with special needs, and assistance in differentiating courses. Technology is very engaging and facilitates inclusion in a variety of ways for most groups of kids. Besides, not only children with special needs, but every student in the classroom can benefit from inclusively designed materials.⁶⁵ For instance, a table large enough for small groups of kids is the most critical piece of furniture in an inclusive classroom. A table allows the instructor to gather pupils and give them with a variety of instructional programs according to the group's requirements. Students can also utilize the table to collaborate on projects, have conversations, or as an alternative work location. The table is normally at a prominent location in the room, and it allows pupils to participate in a variety of group activities.

Braille, big print, sign language, and audiobooks are all examples of formats that textbooks should be provided in. Teachers can use a mix of text, supporting images, and photos to present information in a number of ways for different types of pupils using inclusive design principles. The material should aid learning rather than obstructing access to critical information for some pupils. Book images, for example, can supplement text-based information but should not introduce new concepts because they are not available in all media, such as audiobooks or Braille. Besides, technology upgrades the level of textbooks in an upper level. For instance, the printed course content is also available in an electronic version that may be viewed by screen readers and extracted in a variety of forms, including Braille and mp3 audio.

Moreover, technology plays a crucial role in enhancing classroom learning. It includes interactive learning and encourages students to engage in class. It delivers material in a number of media, including audio and video, for students with impairments. To improve their reading skills, they require access to a range of assistive devices. Students should also have continuous and routine access to assistive technology at home. This helps kids remember what they've learned and do their schoolwork. To be effective, assistive technology must be used in conjunction with well-trained teachers.

Visual aids are unquestionably essential in the inclusive classroom. They pique a pupil's attention, clarify a concept, or assist a student in comprehending a lesson. Visual aids exist in a number of shapes and sizes, and a school should have a variety to enable inclusion.

Schedules, posters, number lines, charts, diagrams, visual organizers, and various types of paper such as lined, plain, and graph are some examples. A SMART Board, television, or iPad can all be used as visual aids. Visual aides are always available in inclusive classrooms to help deliver, accommodate, or adjust a course.⁶⁶

Students learn in various ways and at varying rates in inclusive classrooms. Teachers strive to give not only lectures that cater to different abilities, but also classroom resources that are accessible to all

⁶⁴ Coşkun, Y. D., Tosun, Ü., & Macaroğlu, E. (2009). Classroom teachers styles of using and development materials of inclusive education. *Procedia-Social and Behavioral Sciences*, 1(1), 2758-2762

⁶⁵ Coşkun, Y. D., Tosun, Ü., & Macaroğlu, E. (2009). Classroom teachers styles of using and development materials of inclusive education. *Procedia-Social and Behavioral Sciences*, 1(1), 2758-2762

⁶⁶ Acedo, C. (2011). Preparing teachers for inclusive education.



pupils. In addition to textbooks, an inclusive classroom should provide novels that may be read for pleasure.⁶⁷ Offering age-appropriate, fascinating books (or audio books) that can be read by readers of all levels is an important part of making a classroom more inclusive. Besides, in a classroom, a job chart serves various objectives. First and foremost, it aids in the proper operation of the classroom. Second, it enlists the assistance of the pupils, reducing the workload. Finally, and perhaps most crucially, it allows all students to contribute to the classroom's smooth running.⁶⁸ Class jobs are normally swapped once a week, with students contributing in whatever way they can to the group's success. A class job chart, which is often neglected but extremely useful, may incorporate every kid in the classroom in a variety of ways.

Lastly, teachers frequently employ games like card games, board games, and classroom games to reinforce a new topic. They do, however, serve an important role in teaching social skills and teamwork to pupils. Because there are so many game options, a student may engage in a variety of ways. Most significantly, activities may help kids relax in the classroom, enjoy one other's company, and build friendships.⁶⁹

Some inclusive education tools that provided by Microsoft can be listed as:

- i) **Immersive Reader** – The Immersive Reader is a free program that helps students with independent reading and comprehension. It assists readers with many various parts of learning because it is available in so many different apps and platforms. This application has capabilities that read text aloud, break it down into syllables, and give visual layout options such as line and letter spacing, as well as colour themes.⁷⁰
- ii) **Lens for the Office** – Students can use Office Lens to digitize things on their own. Students will be able to access and turn in materials independently from their device when working remotely.⁷¹
- iii) **Use of dictation** – Dictation often known as speech to text, is available on a variety of platforms. Students can talk into a device and the application will display the written content. It's a simple and quick method to write drafts, outlines, notes, or just get your thoughts down on paper. Tools for dictation include:
 - Word⁷²
 - Outlook⁷³
 - OneNote⁷⁴
 - PowerPoint⁷⁵
- iv) **Prediction of Words** – In a word processing application, Word Prediction employs text predictions to aid with writing. The computer guesses the word that pupils are trying to type

⁶⁷ Coşkun, Y. D., Tosun, Ü., & Macaroğlu, E. (2009). Classroom teachers styles of using and development materials of inclusive education. *Procedia-Social and Behavioral Sciences*, 1(1), 2758-2762

⁶⁸ Coşkun, Y. D., Tosun, Ü., & Macaroğlu, E. (2009). Classroom teachers styles of using and development materials of inclusive education. *Procedia-Social and Behavioral Sciences*, 1(1), 2758-2762

⁶⁹ Acedo, C. (2011). Preparing teachers for inclusive education.

⁷⁰ <https://www.youtube.com/watch?v=91XIGU8ZMI>

⁷¹ <https://education.microsoft.com/en-us/resource/9b010288>

⁷² <https://support.microsoft.com/en-us/office/dictate-your-documents-in-word-3876e05f-3fcc-418f-b8ab-db7ce0d11d3c>

⁷³ <https://support.microsoft.com/en-us/office/dictate-your-emails-in-outlook-4010d238-bb25-45e9-89f6-8f9b54fcc0fc>

⁷⁴ <https://support.microsoft.com/en-us/office/dictate-your-notes-in-onenote-2f5d1549-afe1-4abd-95ff-829a839e3d00>

⁷⁵ <https://support.microsoft.com/en-us/office/dictate-your-presentations-and-slide-notes-in-powerpoint-97f3373e-58b9-4e39-b413-83d6d2c09055>



as they type the initial letter or letters of the word. Words appear in a prediction list, from which pupils choose their preferred term.⁷⁶

- v) **Math Instruments** – OneNote's Math Tools can take handwritten equations and translate them to text, as well as describe the solution stages. When students are attempting to visualize equations on a graph, they appreciate the assistance and do not have to beg for it. All of this is possible to accomplish on their own smartphone.⁷⁷
- vi) **Captions in real time** – Live subtitles can appear during PowerPoint presentations or in a live Teams meeting. While individuals are conversing, the spectator can see subtitles. This is a fantastic technique to guarantee that all viewers may engage to the best degree possible, whether they are new to the language, a student with deafness, or someone who has difficulties digesting auditory language.⁷⁸
- vii) **Microsoft Translator** – Microsoft Translator helps students integrate by bridging communication gaps in the classroom by providing live captioning, cross-language comprehension, and even multilingual informal interactions.⁷⁹

In addition to that, teachers can benefit from:

ClassDojo (<https://www.classdojo.com>) – ClassDojo is a classroom tool that helps teachers save time, boost classroom engagement, and improve student behaviour quickly and easily, with no painful data entry. ClassDojo also lets teachers communicate student progress with parents and students. Best of all, it's completely free.

Schoology (<https://www.schoology.com>) – This is a great website to help teachers 'manage their classroom, create and submit assignments, participate in interactive discussions, perform assessments, collaborate with their peers, and much more.

Seesaw (<https://web.seesaw.me>) – Seesaw empowers students to document and share what they are learning in class. Students can independently create, capture, and store artefacts of learning in their private learning journal. Parents (after teacher approval) get notified of new items, giving them a glimpse of their child's day and an opportunity to support learning at home.

Edmodo (<https://new.edmodo.com>) – Edmodo is a web-based platform that provides a safe and easy way for class to connect and collaborate, share content, and access homework, grades and school notices. It is like Facebook but in a safe and controlled environment appropriate for school.

⁷⁶ <https://www.youtube.com/watch?v=fj9wTyC5sz4>

⁷⁷ <https://content.cloudguides.com/en-us/guides/Provide-inclusive-math-tools/>

⁷⁸ <https://www.youtube.com/watch?v=d6Q60Rt4QsU>

⁷⁹ <https://www.microsoft.com/en-us/translator/education/>



5 Blended learning/teaching approaches

5.1 Artificial Intelligence and Machine Learning

Artificial Intelligence is computers or machines that mimic human intelligence while solving a problem. Its purpose is to adapt the complex structure of the human brain to machines. Machine Learning is a sub-branch of Artificial Intelligence. This sub-branch is when machines learn certain information and then make predictions using that information.

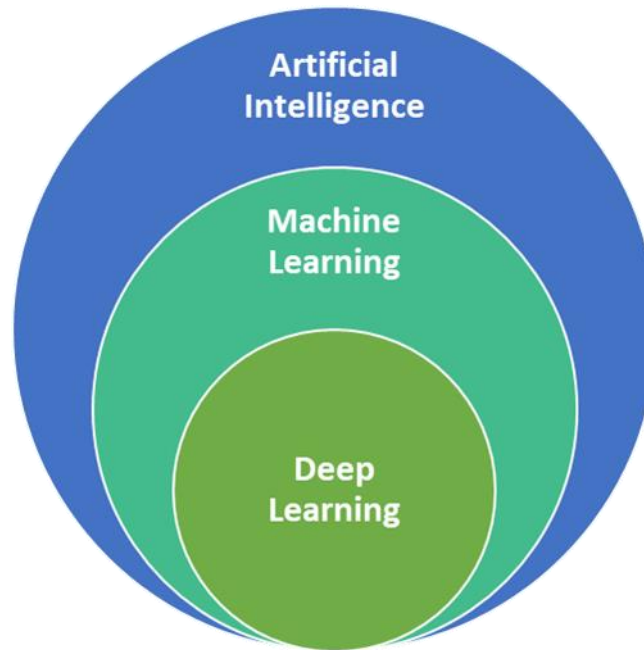


Figure 2: The machine intelligence hierarchy.

There are four types of Machine Learning:

- Supervised Machine Learning
- Unsupervised Machine Learning
- Semi-Supervised Machine Learning
- Reinforced Machine Learning

5.1.1 Supervised Machine Learning

Imagine a high school student who will take the university entrance exam in two days. This student studies to prepare for the exam. When he takes the university entrance exam, he encounters similar questions, not the same ones he solved about the courses he studied. The student worked by solving the practice exams and was able to answer the questions in the university exam through the question model in the practice exams.

Now if this scenario is modelled with Machine Learning. A model (student) is created while solving Machine Learning problems. This model is the model in which the Machine Learning algorithm works. It first feeds and trains this model with information, and then the trained model is asked to predict a new result with the information it has not been given before.



Each of the data used for training the model in Supervised Learning has a label. Labelled data is the determination of which data corresponds to which information.

In the supervised learning scenario, label fields are used to make the prediction from the dataset containing the predetermined information of the model. It is the feature on which the model will base its estimation. Each row in the dataset is example data. An instance can contain both a label and a feature. The purpose of Machine Learning is to give certain attributes and obtain a label value suitable for these attribute values.

5.1.2 Regression Problems

The values to be estimated in such problems are a continuous value. Continuous values take a value from the set of uncountable values, that is, its value is in the infinite range of values. This value type is also referred to as a numeric data type.

5.1.3 Classification Problems

In such problems, the value to be estimated is a discrete value, that is, there are limited values that it can take in a limited range of values. This value type is also called a categorical data type. For example, if we want to estimate height, weight (attributes) information and gender (tag) information, there are 2 values that a gender can take: Female or Male.

5.1.4 Deep Learning

The success achieved in the world's most important object recognition competition named ImageNet, as a result of the classification made in 2012 by Krizhevsky and his friends through Deep Convolutional Neural Networks named AlexNet⁸⁰, has been the biggest impact of deep learning in the world literature. In the literature, deep learning was first introduced in 2006 with a method called deep belief networks.⁸¹ Deep Belief Nets (DBN) was tested using the preferred MNIST database (image data of 70,000 28 x 28-pixel handwritten characters ranging in numbers 0–9) to measure and estimate the accuracy of each image recognition method.

In recent years, techniques developed in deep learning research are affecting a wide range of information processing studies, both in traditional and new forms, within expanded scopes, including the most effective and important aspects of machine learning and artificial intelligence.

Although deep learning is a sub-field of machine learning, it is an increasingly common application area of deep neural networks. In this area, it is aimed to cover a larger data set of solutions based on learning data, rather than customized algorithms for each study. There are different definitions of deep learning.

Definition 1: Supervised or unsupervised feature extraction and transformation is a class of machine learning techniques that uses many layers of nonlinear computing for model analysis and classification.

Definition 2: A subfield within machine learning that relies on algorithms to learn multiple levels of representation to model complex relationships between data. Thus, high-level features and concepts

⁸⁰ Krizhevsky, A., Sutskever, I., and Hinton, G. E. (2012). 25th International Conference on Neural Information Processing Systems. *ImageNet Classification with Deep Convolutional*, 1097–1105. Lake Tahoe, Nevada: NIPS'12 Proceedings

⁸¹ Hinton, G. E., Osindero, S., and Teh, Y.-W. (2006). A fast learning algorithm for deep belief nets. *Neural Comput*, 1527–1554



are defined as low-level features, and such a hierarchy of features is called a deep architecture. Most of these models are based on learning unsupervised representations.

Definition 3: Deep Learning is a new field of machine learning research introduced with the aim of bringing machine learning closer to one of its original goals (artificial intelligence). Deep learning is about learning multiple levels of representation and abstraction that help in understanding data such as images, sounds and texts.

Deep learning is a machine learning technique that uses a deep neural network. Deep neural networks are multilayer neural networks that contain two or more hidden layers ⁸²

In deep learning, there is a structure based on learning more than one feature level or representation of data. High-level features derive from low-level features, creating a hierarchical representation.⁸³ The representation for an image can be a vector of per-pixel intensity values or features such as edge sets, custom shapes. Some of these features better represent the data. In deep learning methods, efficient algorithms are used for hierarchical feature extraction that best represents the data instead of manually extracted features.⁸⁴

There are two main points in common among the various high-level definitions of deep learning.⁸⁵

- Models consisting of multiple layers or nonlinear computing stages.
- Methods for supervised or unsupervised learning of feature representation in successive higher, more abstract layers.

In order to run deep learning algorithms and solve problems, machines with high capacity (especially GPU) and large amounts of data are needed. Unlike standard machine learning algorithms that break down problems into parts and solve them individually, deep learning solves the problem from start to finish. More importantly, the more data a deep learning algorithm feeds, the better the task execution will be. The time factor is also important. Studies that are not time-constrained can produce better results when fed with big data.

Three major reasons for the popularity of deep learning today are the greatly increased processor capabilities (e.g., graphics processors (GPU)), the massive increase in data used for education, and recent advances in machine learning and signal/computing processing research. These developments have enabled deep learning methods to effectively take advantage of complex, combinatorial nonlinear functions, learn distributed and hierarchical feature representations, and use both labelled and unlabelled data effectively.⁸⁶

In machine learning, the algorithm distinguishes between a square and a triangle based on information provided by humans. In deep learning, the program does not start with previously fed information.

⁸² Phil, K. (2017). *MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence*. Seoul, Soul-t'ukpyolsi, Korea: Apress.

⁸³ Bengio, Y. (2009). Learning Deep Architectures for AI. *Foundations and Trends in Machine Learning*, 2, 1–127. doi: 10.1561/2200000006

⁸⁴ Song, H. A., and Lee, S.Y. (2013). International Conference on Neural Information Processing. *Hierarchical Representation Using NMF*, 466–473. Daegu, South Korea.

⁸⁵ Deng, L., and Yu, D. (2013). Deep Learning Methods and Applications. *Foundations and Trends in Signal Processing*, 7, 197–387. doi: 10.1561/2000000039

⁸⁶ Deng, L., and Yu, D. (2013). Deep Learning Methods and Applications. *Foundations and Trends in Signal Processing*, 7, 197–387. doi: 10.1561/2000000039



Instead, it uses an algorithm to determine how many vertices the shapes have, whether they are connected, and whether they are perpendicular. The algorithm understands whether a circle added as a result fits the square and triangle orderings.

Solving problems such as image and/or sound identification, which can be easily done by humans, is difficult for artificial intelligence methods. These intuitive problems can be solved by computers learning the ability to understand and experience the world hierarchically, the simplest concepts that can be defined in relation to each other. With the knowledge gained through experience, there is no need for formulas and calculation processes specific to each problem used by computers. When the hierarchical structure is considered as a graphic, a multi-layered deep structure is formed, each of which is built on top of the other. For this reason, artificial intelligence methods based on hierarchical structure emerge as deep learning.⁸⁷

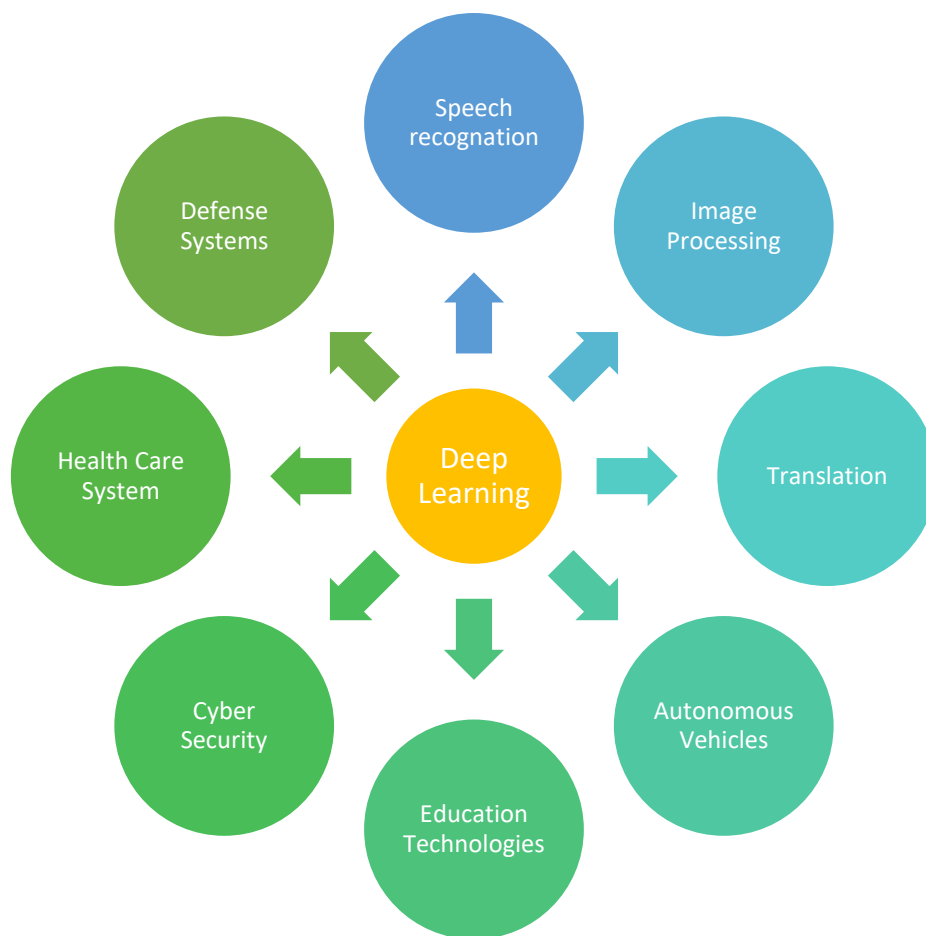


Figure 3: Deep learning spectrum.

The research areas of deep learning neural networks are at the intersections between artificial intelligence, graph modelling, optimization, pattern recognition and signal processing.⁸⁸ These algorithms have started to show themselves in many applications such as driverless vehicles, health

⁸⁷ Goodfellow, I., Bengio, Y., and Courville, A. (2016). *Deep Learning*. MIT Press. <http://www.deeplearningbook.org>

⁸⁸ Deng, L., and Yu, D. (2013). Deep Learning Methods and Applications. *Foundations and Trends in Signal Processing*, 7, 197–387. doi: 10.1561/20000000039



services, movie recommendations, translation services, chatbots, page recommendations, advertising services.

The factors that make deep learning architectures such a field of study are as follows:

- Making available worldwide text, image and audio datasets for research.
- Start of production of high processing power graphics cards (GPU).
- AlexNet, ZFNet, ResNet, GoogLeNet, VGG16–19, Inception etc. the introduction of deep architectures such as
- Keras, Tensorflow, Theano, Caffe, Pytorch, MatConvNet etc. Beginning to use deep learning platforms and libraries such as
- Activation functions, data training and data augmentation methods, and effective optimizers are developed and made available by researchers.

Deep neural networks have two or more layers of hidden neural networks. In deep neural networks, more comprehensive relationships are established within the data from simple to complex. Each layer tries to establish a relationship between itself and the previous layer. Thus, a more detailed examination of the inputs is made and a more accurate decision is made. Different activation functions can be used when creating a deep neural network structure. These functions may vary depending on the type, structure, size of the data and the person who created the model. The activation function determines the output that this cell will produce in response to the input to the cell. Usually, a nonlinear function is chosen. The main activation functions are Sigmoid, TanH and ReLU.

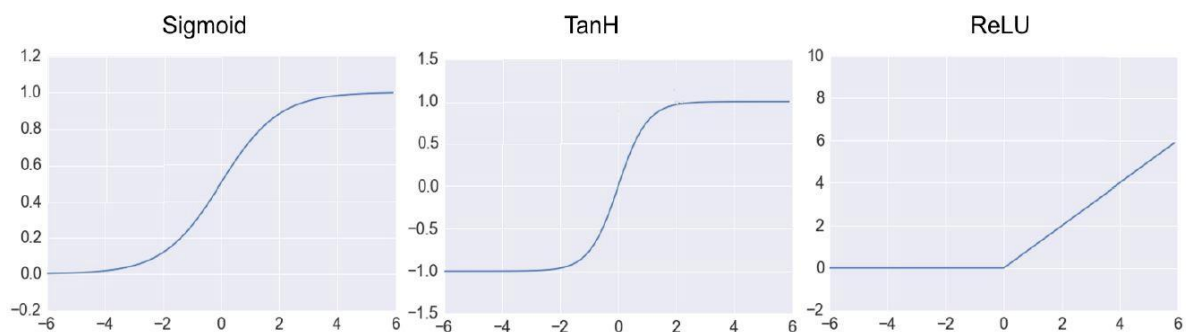


Figure 4: Activation functions.

5.2 Data Analysis and Data Science

Data, big data, computer science concepts are components of a field that has gained importance in recent years and needs to be talked about and studied. I want you to know that I am talking about the concept of Data Science as a general name. Technological developments have led to the formation of large and complex data sets. The volume of data generated has also increased. In fact, the increase in data is good, but the necessity of filtering, analysing and using this data as a competitive and strategy tool has revealed the need for "Data Science".

5.2.1 What is Data?

Data can be expressed as a piece of information. The fact that data is called a piece of information is because it does not make sense on its own. According to another definition, data includes all kinds of information that is kept in the system in an unprocessed state and can be analysed in the next process.



In the light of technological developments, the speed of data generation has increased greatly. The world is moving towards a process that can be called the data age, where information and information are at a high level.

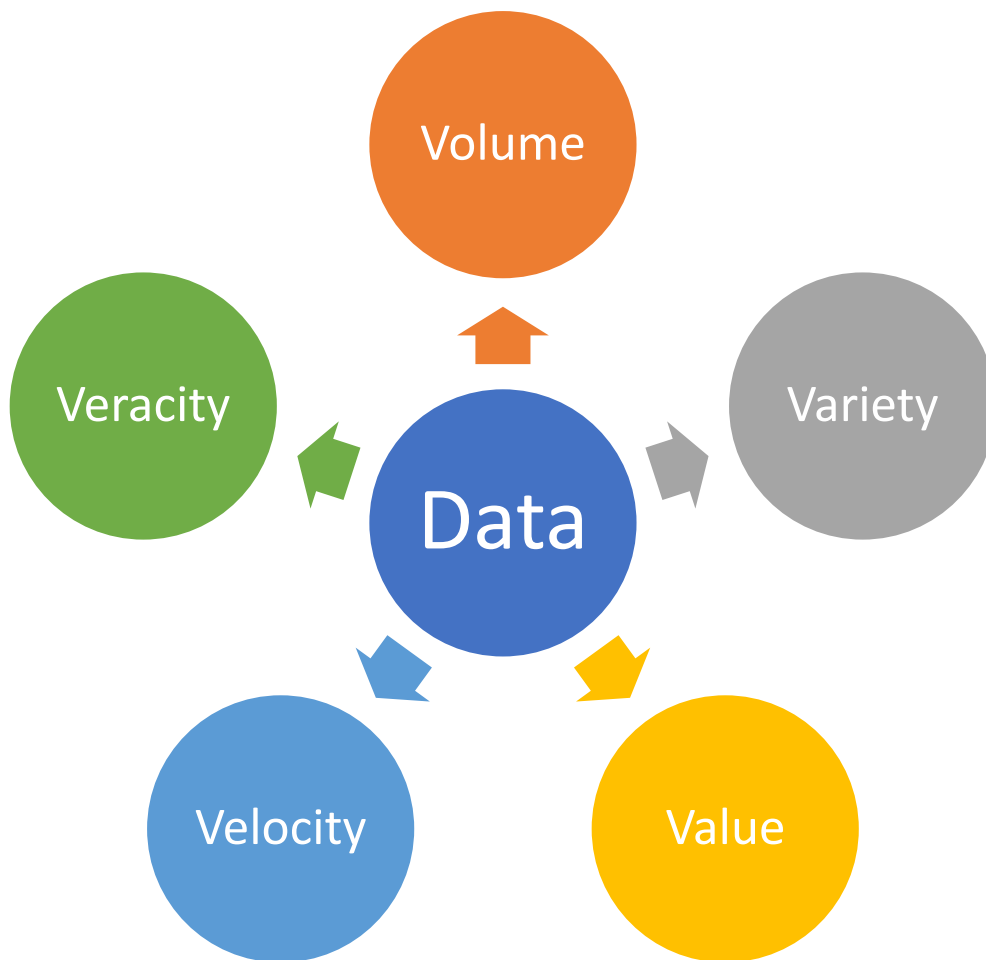


Figure 5: Data properties.

5.2.2 What is Science?

Data science is a multidisciplinary field covering statistics, computer technologies, mathematics and many other branches of science, which makes sense of the problems that will occur in organizations with data and offers data applications that will develop solutions to these problems. Data science includes revealing information that can produce solutions to the problems experienced, based on raw data, collecting, preparing and analysing the data, and making sense of the analysis results and using them in the process of taking solution-oriented steps.⁸⁹

⁸⁹ Hamilton, B. A. (2015). *The Field Guide to Data Science*, 126.

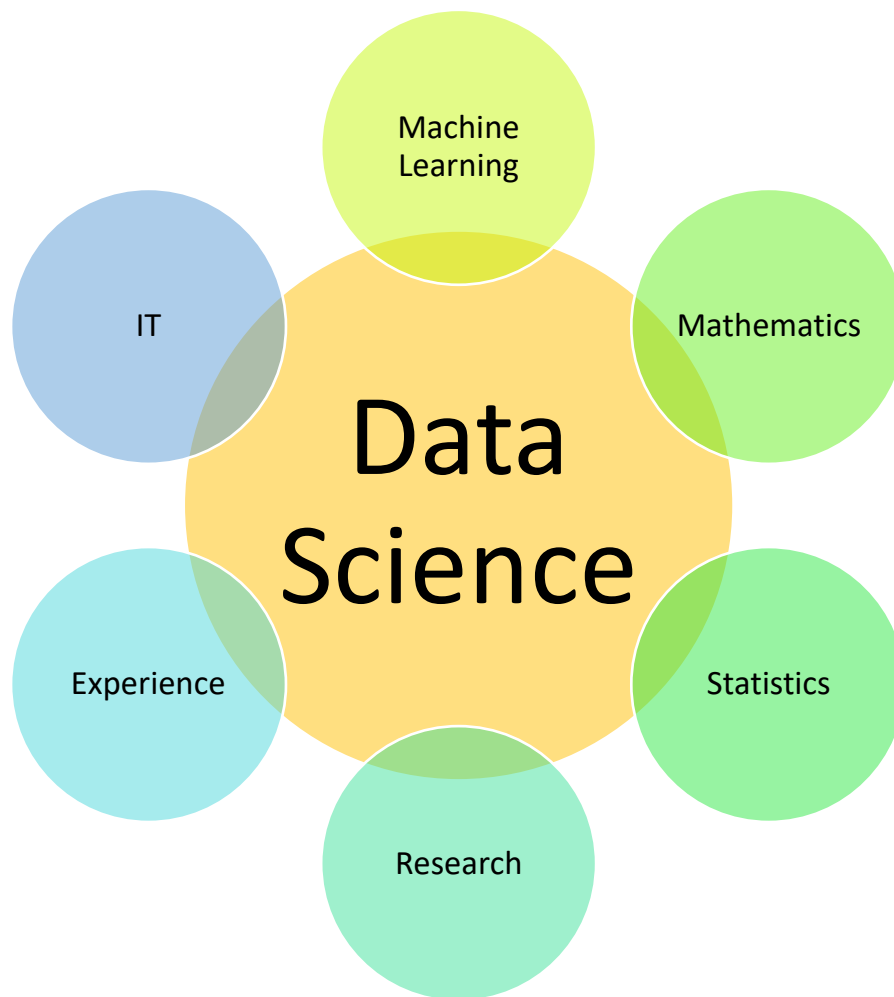


Figure 6: The data science discipline Venn diagram.⁹⁰

Data science, machine learning, deep learning, big data and data mining are descriptive, diagnostic, predictive and directional analytical methods using technologies, techniques and methods. Data science aims to find solutions to different problems on data sets.

5.2.3 Key Components of Data Science

Data science works in collaboration with many fields. But the areas that constitute the basic building block of data science are certain. We can classify them as:⁹¹

- Mathematics
- Statistics
- Information Technologies:
 - Signal Processing
 - Probability Models
 - Machine Learning
 - Statistical Learning

⁹⁰ <http://drewconway.com/zia/2013/3/26/the-data-science-venn-diagram/>

⁹¹ Wickham, Hadley, and Garrett Grolemund. (2016). R for data science: import, tidy, transform, visualize, and model data. O'Reilly Media.



- Programming
- Big Data/Processing
- Data Engineering
- Visualization
- Data Warehouse

5.3 Process Automation

Process Automation is a system that detects repetitive operations performed by computers in organizational processes and enables these processes to be performed faster and error-free by machines instead of humans. Process Automation is an emerging method of business process automation technology based on the metaphorical concept of software robots or artificial intelligence (AI) workers.

The purpose of Process Automation is to provide a solution where people are more in control, rather than replacing the purpose of business processes. The number of software that Process Automation can replace is actually limited. Because, in order to automate the processes of a software with process automation, it is necessary to program all processes on process automation and naturally have a very good command of the business area and business domain to be programmed. Beyond that, process automation systems also include some limitations and risks that we will discuss later in the article. In addition, while developing an information security policy, it is to automate the operational processes after process automation integration. Your personnel employment should not be reduced to such an extent that you cannot carry out the process without process automation. A possible problem in process automation software or other IT problems may force the management of manual processes without process automation.

As you know, process automation carries some risks, like most of the systems that seem perfect. For now, the biggest problem is the necessity to update the process automation implementation made as a result of the change of interfaces of the integrated software. For example, a bank needs an SFTP username and password with the necessary permissions to upload the XML file that creates its system. Such data are stored in a different structure safe in process automation systems and they request authorization from this system because the distributed process automation is only necessary. In other words, this information is not found in the place where the related software is installed (deploy). Also, process automations often run on CPU logic. That is, they can do a transaction at time T. If a valuation is to be made in order to compare; if a normal person takes 16 hours to examine and verify an Excel containing 10,000 records, Robotics Software can identify it in 1/2 minute without error. Of course, this value also depends on the validation process, the nature of the data and a few other factors, but only how fast they are.

In order to get high efficiency from process automation, it is more suitable for institutions to be at medium or large scale, as at this stage, the processes are clarified, certain certifications such as ISO 27001 and ISO 9001 are passed, and information security policies are implemented. If the processes are not documented, it will be difficult and costly to set up process automations. e.g., two staff are working to do a job and process automation can be used to reduce the annual total cost of these people. The same work will be realized with less personnel and cost.

There are various software technologies involved for process automation integration. By using this software, process automation integration solutions can be produced. If the software interface of business processes automated with process automation changes, software integration solutions



should be improved again. Because this process does not only cover the software development process. Because the industry and the business model (naturally) need to explain the processes to a software integration firm and create UML flow diagrams by making the relevant planning. Robotic Software is completed by performing the integration and writing the tests. The most important advice here is that both the integrator institution and your company's experts should be included in the testing process. It can also automate errors such as the creation of necessary tests regarding the processes to be automated and processes. This is one of the risks of robotic automation. Robotic process automations do not understand that it is a faulty operation unless there is a software error. These should be determined in advance by confirmatory tests. Validation tests should be run after the procedures.

5.4 Digital Transformation

Digital transformation is the digital transformation of the intensive use of information technologies and the transfer of business processes and information to the electronic environment by digitization, saving money and time. Digital transformation helps to carry the speed and convenience of the world to our business life with digitalization. If the digital transformation is analysed in terms of companies; The digitalization and digital transformation processes of the main production units and production supporting units of the companies are emerging. It is necessary to classify the studies to be carried out here according to the level of digital transformation, digitalization and e-transformation. Digital Transformation is the use of new, fast and frequently changing digital technology to solve problems. One of the examples of digital transformation is cloud computing. It reduces dependency on user-owned hardware and increases dependency on subscription-based cloud services. Digital transformation is the process of using digital technologies to create or change new business processes, culture and customer experiences to meet changing business and market requirements. Redesigning the business in the digital age is digital transformation. While digital transformation aims to respond in the best way to social, economic and socioeconomic needs that change over time, it is benefiting from the benefits offered by modern technology in the field of information, software, hardware and communication. Increases return on capital, efficiency and profitability with automation and logging. Technology innovations such as Virtual Reality, Augmented Reality, 360-degree video capture, virtual tour, IoT, edge, Cloud, artificial intelligence, advanced 3D visualization, social media management and digital twin are creating new opportunities for industries.

Digitization of production with Industry 4.0 covers all processes involving digitalization and digital transformation in the main production units of companies. Digitization of Production Supporting Units is the first stage of digital transformation. It is important for digital transformation that the location of both private and state institutions is at the level of "Digitalization of Production Supporting Units". In order for digitalization to be fully realized, we also need to be successful in the digitization phase of production. In the process of digitization of production supporting units, which is the second stage of digitalization; The production, distribution and storage of valuable financial documents in electronic environment should be implemented.

In Industry 4.0 and digital transformation details; We can say that the machines that are currently working under human management in industrial production now operate autonomously, independent of humans, and the follow-up of business processes with digital transformation. With digitalization and digital transformation, all stages of unmanned production can be realized with the communication of machines among themselves.



For digital transformation companies, the digital transformation process of companies is a digital transformation where they can make online payments through a secure website. Moving the database to cloud systems is a digital transformation step. Even when digital transformation companies and company teams come up with software that they can manage and follow their work schedules with mobile phones, this is an example of companies' digital transformation steps.

Digital transformation offers measurable instantaneous performance and data. If we are talking about digital transformation in production, you can see the cycles, temperatures, production outputs of your equipment park, machines, and perform performance optimization and maintenance. Or, you can observe which points increase the work efficiency of your employees and which points minimize them and you can optimize your work processes according to efficiency. Or, with digital transformation, you can optimize your logistics and transportation strategy with vehicle tracking programs and devices.

The steps taken by Education 4.0 towards digitalization in education, the use of virtual reality in education, the use of augmented reality in education, the use of 360-degree video in education, the developments in artificial intelligence and robot technologies have started to change the way people work, learn and communicate in recent years. Digitalization in education and digital transformation in education and STEM Education system are components of education 4.0. If we quickly summarize STEM education, which makes visualizations in science, technology, engineering and mathematics (STEM) subjects, develops research and project-based activities and keeps interest and curiosity alive in these fields; To create new value, people; STEM education aims to provide skills such as critical thinking, creativity, communication and cooperation. With Digital Transformation in Education, students in a technology-rich equipped classroom significantly increase their problem-solving skills; Students in a non-digital classroom environment can progress a little more slowly in this regard.

Today, students of institutions that have realized digitalization in education are not at all unfair when they say that with the innovative and modern structure of the STEM education model, they cannot think of a school without tablets or computers with technology-supported education, digital transformation in education, and the ability of students to solve problems and creative thinking.

In the digital transformation process in education, the focus of all needs is scalability, cost advantage, and quickly utilizing the flexibility of human resources and the system. 4.0 in Education makes gamification in education a very important component of digital transformation in education.

Digital transformation in education is not just evolving for students. Digital transformation in education also ushers in a great era for educational institutions and teachers. With Digital Transformation in Education, teachers can interact with teachers from anywhere in the world, not just their own classrooms, schools or cities. In other words, digital transformation in education is becoming widespread throughout the institution with an inclusive structure with education 4.0. Teachers on the platform can share their prepared lesson plans with other teachers and become a part of this large network with digital transformation in education.

Learning with digital transformation in education, saving time for teachers and helping them to collaborate, can be the reason for preference of students and parents by making use of the unlimited support power of technology and differentiating your educational institution.

Education has an important place and importance both in the academic field and in the institutional field. While the digital transformation of education in the academic field creates a new and experiential



bridge between the teacher and the student, it opens the door to learning independent of time and place for professionals in the institutional field. With both industry 4.0 and education 4.0, it has become clear that education can no longer be realized from the perspective of the old generation, both for the academic world and the corporate world.

Digital transformation in education should not be perceived as a revolution that will take place in a short time, but should be seen as a long-term evolution, and this process should be managed and directed by professional/academic circles. Devices or applications used in the digital transformation of education are only tools. Transformation cannot be expected to occur only by expanding the use of these tools. Therefore, it is necessary to consider this as a mentality issue and focus on the content, software and the quality of the educators rather than the device used.

The gamification method in educational technologies contributes to students' problem solving and critical thinking skills. Digital transformation is not possible with tablets and applications, but with dynamics and changes on dynamics. Encouraging students for technical production is a positive development; this production should be supported by digital literacy and content production skills. What is digital education or what is online education? What is distance education? it can be called the disappearance of the classes formed by teachers whose hands are covered with chalk, and students who write what is on the blackboard with a pencil in their notebooks. It is digital education that the blackboard is replaced by computer whiteboards called Smartboard, this touch-screen board resembling a giant smartphone in schools, tablet computers and even VR glasses replace pen and notebook.

Digital education increases the motivation of many students. Because they switched from the system they were used to with digital education to a new application. In fact, with digital education, students who are weak in reading or spelling and who can write more comfortably on the computer than writing by hand are integrated into the classroom.

If we talk about the benefits of Virtual Reality Use in Education and Virtual Reality Education Applications, namely VR Education Applications.

Virtual reality is a technological tool that is very useful and produces positive results for both students and teachers in the field of education. The use of virtual reality in schools greatly alleviates the burden of teachers. In virtual reality environments, teachers have a facilitating role for students to discover and learn. Rather than simply answering student questions, teachers guide students in self-discovery and generating new ideas. The use of virtual reality in the field of education has many benefits for students.

Experiential Learning and Interactive Learning: The use of Virtual Reality in education provides opportunities for the development of new perspectives through experiential learning. With the use of Virtual Reality in Education and VR Education Applications, students; It is expected that they will gain various virtual experiences as a result of interacting with objects in the virtual reality environment.

Interactive Learning: It shows some features and important points of the subject to be taught in a more realistic way with the use of Virtual Reality in Education compared to other methods. Since it requires mutual interaction, it enables students to move from passive to active. The student interacts with various objects in the virtual reality environment. By changing the properties of objects, students



have the chance to examine and observe them from various angles. It provides students with a wider range of time rather than giving them experience in confined classroom environments.

Storytelling: With Virtual Reality Applications in Education, the topics described in the virtual reality environment have narrative features. It allows each student to experience according to their own learning pace and thus to realize the learning event more effectively.

Paying attention to the senses: VR Education Applications and the Use of Virtual Reality in Education and the sound, light and interaction feature of VR environments integrate the sensory organs of the students.

5.5 Remote Sensing Technologies

It is very important to keep up with the developing technology and not to fall behind. Remote sensing technologies are location-based science. Because it is easy for people to understand or make sense of the place they live in with these technologies. Again today, countries compete in space exploration and use their own satellites. In this context, Remote Sensing technology has become a necessary field both for understanding and making sense of space and for the use of satellite technologies.

Remote sensing is a science that provides information on the observation and measurement of objects without physical contact with the earth. This information is obtained as a result of the detection, recording and analysis of reflected or emitted energy. To determine the height of a tree or the depth of a lake, they need to be approached and measured.

Aerial photography is one of the cornerstones of remote sensing from past to present. Today, remote sensing data is also provided by aircraft, drones and satellites equipped with cameras and sensors. Cameras and sensors display the image; They form the electromagnetic spectrum by measuring the energy reflected and emitted from the earth in the ultraviolet, visible and infrared regions within the scope, which is called the "spectral image region".

Remote sensing is not just about aerial photographs and satellite images, it also includes medical scans, microscopic studies, sonar and radar. Remote sensing processes include 7 elements, the figures and explanations of which are explained below, depending on the interaction between the target and the incoming beam.

As the energy spreads from the source to the target, it encounters the interference of the atmosphere. This inhibition also occurs when traveling from target to sensor a second time. The energy coming to the earth's surface is blocked depending on the characteristics of the surface and the emission. Following the dispersion of the energy in the atmosphere or reflection from the target, the sensor collects and records the electromagnetic energy. The energy data recorded by the sensor is usually sent electronically to the station where it will be processed and turned into an image. Targets on the image are evaluated visually and/or digitally or electronically. It includes the process of using the obtained information in various fields or making it helpful in solving special problems.

Remote sensing technology started in 1858 with a black and white photograph taken by a camera placed in a balloon. It has developed in the period until the launch of the LANDSAT satellite into space and has reached a level that can meet today's needs.



Cameras have been used in remote sensing service for more than 150 years. These cameras are equipment that record targets within the visible band of the electromagnetic spectrum on a silver-based film medium, by means of a lens. The targets on the films were determined by utilizing black/white brightness differences or colour tones.

Following the experiment with the camera using a balloon, a kite equipped with a camera was flown for a meteorological application in 1882. In 1909, a motion picture was shot with a camera used from an airplane. During the First World War, military cameras were mounted on airplanes and valuable information was obtained by photographing large ground surfaces. Understanding the military importance of aerial photographs, countries imported aircraft designed only for reconnaissance missions into their inventories and obtained 80% of their military intelligence from aerial photographs in the Second World War.

In parallel with the development of reconnaissance planes, infrared sensitive elements were developed in the 1940s and subsequently, "False Colour Infrared" films produced in 1950 were used for military purposes and for the production of plant maps. The subject of remote sensing from the atmosphere emerged at the beginning of the space age. After the Second World War, the V-2 rockets seized from Germany were launched into space, equipped with automatic still and cinema cameras, within the framework of a program called Viking. This rocket reached an altitude of 227 km before being put into orbit.

5.6 Internet of Things

The Internet of Things (IoT) is a large communication network consisting of interconnected objects over the Internet, which has developed rapidly in recent years.⁹² The concept of IoT was first used by Kevin Ashton in 1999. Ashton used this concept while describing the benefits of an internet-based information service architecture that uses Radio-frequency identification (RFID) technology in the supply chain of Procter & Gamble (P&G).^{93,94}

Today, IoT is seen as a new generation communication network that has advanced enough to establish the connection between the real world and the virtual world. Figure 2 shows that many IoT applications are used for the use of people, vehicles, homes, cities, commerce and industry. Computers, smart phones, smart sockets, school buses, smart grids, smart health, smart office and wearables are some of the IoT applications.

The common feature of IoT applications is the collection and use of smart object data with embedded sensors over the network. IoT applications are increasing day by day and their usage areas are expanding and making human life easier. Large amounts of personal data and sensitive information are collected, shared and analysed with IoT applications such as smart cities, smart environment, smart metering, security and emergency, retail sales, logistics, smart agriculture, smart livestock and smart health that make human life easier.⁹⁵

⁹² Jensen MC. The modern industrial revolution, exit, and the failure of internal control systems. *J Finance* 1993; 48(3): 831–880.

⁹³ Hazarika M, Dixit US and Davim JP. Chapter 1—history of production and industrial engineering through contributions of stalwarts. In: Davim JP (ed.) *Manufacturing engineering education*. Oxford: Chandos Publishing, 2019, pp. 1–29.

⁹⁴ Lee CKM, Zhang SZ and Ng KKH. Development of an industrial internet of things suite for smart factory towards re-industrialization. *Adv Manuf* 2017; 5(4): 335–343.

⁹⁵ Stock T and Seliger G. Opportunities of sustainable manufacturing in Industry 4.0. *Proced CIRP* 2016; 40: 536–541.



According to the research of Cisco, it is predicted that approximately 50 billion devices will be connected to the internet in 2020.⁹⁶ Considering the United Nations' estimation of the world population in 2020 to be 7.7 billion,⁹⁷ it is calculated that there will be approximately 6 electronic devices per person. In addition, it is estimated that in 2020, objects will be brought into daily life by enabling communication with each other and their environment, the trend of personalization with IoT platforms will peak and the world will experience a continuous change after this stage.

With the widespread use of IoT platforms, the personalization trend created by the use of collected data has an important place. Data collected with IoT applications can be shared without the knowledge of users for advertising, marketing, statistical and commercial purposes.

These developments in IoT increase existing security concerns and make it necessary to take new measures.⁹⁸ Difficulties such as the nature of IoT consisting of heterogeneous devices, producing large data, machine-machine (M2M) interaction, limited computing and limited energy power make it difficult to solve security problems.⁹⁹

IoT is not only limited to the analysis of data collection and use, but also includes intelligent systems that make sense of the collected data and can make decisions and implement big data analysis methods with M2M interaction when necessary.¹⁰⁰ IoT-specific behaviours, such as the increasing personalization of IoT platforms and the fact that M2M interaction is beyond human control, bring increasing demands on security protection.^{101,102} The abuse of sensors or objects that can directly communicate with each other through machine-machine interaction without human intervention, the inability of traditional security methods to meet IoT security requirements, the ubiquity of IoT devices have made NP-hard a problem.

Kevin Ashton originated the phrase "Internet of Things" in 1999 in the context of supply chain management.¹⁰³ The Internet of Things (IoT) is a network of physical objects known as "things" that are embedded with sensors, software, and other technologies that allow them to communicate and share data with other devices and systems through the internet. These devices range from common domestic objects to sophisticated industrial machinery.¹⁰⁴ Although the notion of 'Things' has varied with technology, the basic objective of letting a computer comprehend information without human involvement has remained constant. IoT has emerged from its infancy, owing to the popularity of

⁹⁶ Kang HS, Lee JY, Choi S, et al. Smart manufacturing: past research, present findings, and future directions. *Int J Precis Eng Manuf Green Technol* 2016; 3(1): 111–128.

⁹⁷ Nur Altun S, Dörterler M and Alper Dogru I. Fuzzy logic based lighting system supported with IoT for renewable energy resources. In: *Proceedings of the innovations in intelligent systems and applications conference, Adana, Turkey, 4–6 October 2018*, pp. 1–4. New York: IEEE.

⁹⁸ Almada-Lobo F. The Industry 4.0 revolution and the future of manufacturing execution systems (MES). *J Innov Manage* 2016; 3(4): 16–21.

⁹⁹ Yao H, Cao H and Li J. Design and implementation of a portable wireless system for structural health monitoring. *Meas Control* 2016; 49(1): 23–32.

¹⁰⁰ Kang HS, Lee JY, Choi S, et al. Smart manufacturing: past research, present findings, and future directions. *Int J Precis Eng Manuf Green Technol* 2016; 3(1): 111–128.

¹⁰¹ Zhang Y, Qiu M, Tsai CW, et al. Health-CPS: healthcare cyber-physical system assisted by cloud and big data. *IEEE Syst J* 2017; 11(1): 88–95.

¹⁰² Wang L, Törngren M and Onori M. Current status and advancement of cyber-physical systems in manufacturing. *J Manuf Syst* 2015; 37: 517–527.

¹⁰³ Cui Z, Ye W and Choi-Grogan YS. User equipment categories for machine-to-machine devices operating in an internet of things network. Patent 9848279, USA, 2017.

¹⁰⁴ Jeschke S, Brecher C, Meisen T, et al. Industrial internet of things and cyber manufacturing systems. In: Jeschke S, Brecher C, Song H, et al. (eds) *Industrial internet of things*. Cham: Springer, 2017, pp. 3–19.



devices enabled by open wireless technologies such as Bluetooth, radio frequency identification (RFID), Wi-Fi, and telephonic data services, as well as embedded sensor and actuator nodes [16].¹⁰⁵

The Internet of Things (IoT) is made up of billions of individuals, personal electronic devices, and services that generate and communicate with valuable information and also sensitive data. These devices range in size from embedded devices to large-scale equipment. IoT is becoming an appealing target for cyber assaults as a result of its popularity, quick growth in applications, and variety.¹⁰⁶

The physical layer of IoT systems is the layer in which objects, sensors, and actuators generate data. Furthermore, assaults on the physical layer of IoT include manipulation, eavesdropping, denial of service (DoS), and jamming. Furthermore, sensors are the most susceptible interface of IoT systems since they may be readily abused because they are the devices that gather data directly. However, in the majority of situations, sensors are directly targeted by manipulation and jamming attempts.

Network attacks against IoT platforms, which gather and analyse data in real time, might have disastrous repercussions. The network layer on the IoT platform is a target for numerous cyber-attacks, similar to those in information systems. Some examples of network attack are Man-In-The-Middle (MITM), Spoofing, Desynchronization, Flooding etc.

The data acquired by sensors in IoT is often processed in cloud systems, which results in the generation of the data processing layer. Malware inserted in data from edge nodes or sensors is used to launch attacks on the data processing layer.

The application layer is the layer through which end users' interface directly with the IoT platform. The application layer is used for a variety of functions such as report generating, querying, data analysis and visualization, authentication, and interface with IoT. Methods such as authentication and data access limitation can be used on IoT systems to offer security to the application layer. In IoT situations, a vast volume of data is continually created, making it challenging to store huge volumes of data. As a result, securing the application layer is similarly tough.

In the end, blockchain is a distributed, immutable log of events. When used correctly, it considerably simplifies the reconciliation of event history among various entities. Blockchain enables IoT devices to conduct transactions and be tracked in terms of time and location. IoT devices that have been properly provided with identity management trust anchors may transact safely and effectively across permissioned blockchains.¹⁰⁷ Blockchain technology can help tackle IoT security and scalability issues. Using blockchain to store IoT data provides another layer of security that hackers must overcome in order to get access to the network. Blockchain provides a substantially higher level of encryption, making it practically impossible to remove existing data records.

5.7 Big Data

Big Data is one of the most popular concepts today and has gained a larger dimension with the introduction of the internet into our lives. Data comes from research, internet, social media, etc. assets

¹⁰⁵ Monostori L, Kádár B, Bauernhansl T, et al. Cyber-physical systems in manufacturing. *CIRP Ann* 2016; 65(2): 621–641.

¹⁰⁶ Bosso N, Pasquale GD, Somà A, et al. Design and control of a sensorized trolley for the measurement of industrial cranes. *Meas Control* 2016; 49(10): 307–316.

¹⁰⁷ Jing Q, Vasilakos AV, Wan J, et al. Security of the internet of things: perspectives and challenges. *Wirel Netw* 2014; 20(8): 2481–2501.



obtained from places. Big Data is the classified, meaningful and processable form of data by analysing it.

Big Data creates a big data pile when the accesses in social media accounts we use constantly, search engines, movements with bank accounts, blogs, emails, sensors and all activities with the internet are brought together. For this reason, we can consider big data as a treasure trove that offers us information.

Big data makes the found data more useful and provides customers with simpler use of data by acting with big data principles. Previously, big data consisted of a limited number of spreadsheets or databases. But later, as the internet developed, the data became very complex. Data now includes a wide range of data, from database to photos, videos to audio recordings, text and sensor data. To understand all this complex data, artificial intelligence and machine learning are required in big data projects. Big data is used unlimitedly in many places. Usage areas of big data; It is used by many people and institutions, including sellers who want to monitor their consumption, new companies that want to grow, tools that want to research their current situation, or entrepreneurs, and institutions benefit from the positive aspects of big data.

According to research, companies using big data; they earn more profit. Market studies of institutions are more effective, advertising expenditures are less and the rate of social media usage is increasing.

Big data is used in a variety of ways, not only in business, but also around us:

- In health services; Medicine includes medical record and image analysis, helping to detect disease early and develop new drugs.
- They use big data to predict natural or human-induced disasters and take precautions against them.

Big data affects human life at an unprecedented rate. If it is used correctly from big data, the benefit and profit will increase. In the near future, the cause of wars may not be land but big data. The data is so voluminous that it can be used to solve previously unsolvable problems.

Big data has the following features.

- Volume
- Variety
- Velocity
- Validity
- Value
- Variability
- Detailed
- Should be expanded
- Scalability

Big data has the following benefits.

- It ensures that the cost is low.
- It saves time.



- It helps to produce efficient products.
- It ensures that errors and problems are easily found and solved.
- It enables customers to use correct data.
- Provides quick response to customers' problems.
- It helps to identify the threats against the institutions beforehand.

The most important of these is time and cost savings. Big data offers us opportunities, data security, data privacy and data discrimination can create vulnerabilities. These problems are the most important parts of Big data.

There is also a lot of structured and unstructured data in e-commerce. All of these are considered examples of big data. While the public provides efficiency in the use and innovation of big data, its flaws are not inevitable. Here, data analysis often requires multiple parts of government to work collaboratively and create new and innovative processes to achieve the desired result.

Advances in big data analytics provide cost-effective opportunities to improve decision making in critical development areas such as health, economic productivity, crime, security, and natural disaster and resource management.

5.8 Information Security

Information security is the whole of the measures taken to protect the information from damage. Information Security is basically realized by providing the concepts of Confidentiality, Integrity and Availability (CIA).

5.8.1 Confidentiality

Keeping sensitive data confidential is an important issue today and a much more important issue tomorrow. Our data leaking from hacked systems every day is sold in various forums in the depths of the internet, distributed free of charge and used for various reasons. Confidentiality ensures/purposes that at this point, unauthorized users do not access stored/still or in motion system data. Here, the user can be a human as well as applications, processes, etc. it can be too. While the system is being designed, it is determined which sensitive data can be accessed by each user type and at what sensitivity criteria. At this point, of course, the cryptographic process, data encryption, is very important. However, it should be taken into account that these encryption processes will create extra time complexity. Confidentiality can be provided not only by software, but also by authorizing access to offline storage media (hard disk, etc.).

5.8.2 Integrity

It ensures the integrity of the system, its data, and its hardware. Integrity can be achieved by not allowing changes other than authorized parties. Integrity can be protected with algorithms for detecting intentional and unintentional changes.

Cyclic Redundancy Check (CRC) is a common Error Correction Code function used to detect unintentional, accidental changes in storage systems. Therefore, unlike hash functions, it has a reversible structure.



Intentional changes are tried to be prevented with cryptographic checksums based on hash functions. The generated hash code is stored and checked in communications or changes to provide change detection. Some known checksums algorithms are: MD5, SHA-1, SHA-256 and SHA-512.

5.8.3 Availability

Availability is based on the availability of the system whenever users need it. The most common concept that disrupts system availability is denial of service attacks. Network traffic pattern monitoring systems are commonly used to ensure availability, and system availability is maintained by blocking abnormal movements. At this point, the person exhibiting abnormal movements must do Authentication and Entity authentication. With these verifications, the authenticity of the person performing the transaction authentication and whether the reality is as claimed entity authentication is questioned. Although the CIA is a basic concept in information security, it should be kept in mind that many different principles and targeting are also available.

5.8.4 Input Verification

Input Verification is the process of verifying the conformity of input data by users by using software interfaces such as URL and form fields to ensure software security. It is performed to ensure that only properly generated data is entered into the workflow in the information system. Detecting characters and patterns such as the apostrophe (') character, the string 1=1, or the <script> tag, and using ban list validation is a common method of input validation, but it's not too difficult for attackers to disable these ban lists. Whether the data entered into the systems by the user is data created to manipulate the system or normal data should be checked by the software using secure code development methods. For structured data such as date, ID number, social security number, zip code, e-mail address, the programmer can define a very strong input validation model. If data fields or forms consist of a fixed set of options, such as a drop-down list or radio buttons, the data entry must exactly match one of the values presented to the user in the first place. Content validation processes are required for text fields where the user can enter flexible data. However, users may want to type apostrophes (') or less than (<) or greater than (>) in form comment fields or text fields, and there may be completely innocent reasons for this. However, since such meta characters can also be used by attackers, input validation processes should be operated using secure software development methods. Any JavaScript input validation performed on the client can be circumvented by an attacker who disables JavaScript or uses a Web Proxy. Any input validation performed using Javascript on the client must be performed on the server side, as well as using the web programming language in which the software was developed.

All validated user input and malicious data must be encoded when returned to the HTML page to prevent execution of cross-site scripting (XSS) or SQL injection attacks. For example, the encoding type (<script>, <script>) is specific to the context of the page to which user-controlled data is inserted. When performing file upload from the software interface, input validation must be performed to ensure that the filename is using an expected extension or file type. It should be checked that the maximum file size of the uploaded file is not larger than the file size that the system will accept. If the website supports downloading compressed files such as ZIP or RAR, a validation check should be done before decompressing the file.

A new filename format must be used to store files uploaded to the web server in the server operating system. It should not use any user-generated text for the filename or temporary filename. When the file is uploaded to the server, it is recommended to rename the file in storage. For example, if the uploaded file name is test.jpg, it should be renamed to JAI1287uaisdjhf.jpg with a random filename.



The purpose of doing this is to avoid risks from direct file access and ambiguous filename to evaluate filter like test.jpg, test.asp or ../../../../test.jpg. Uploaded files should be analysed for malicious content (anti-malware, static analysis, etc.). The file path must not be determined by the client. The file path must be decided on the server side. The upload feature should use an allow list approach to only allow certain file types and extensions. However, the following crossdomain.xml and clientaccesspolicy.xml file types should not be allowed, which, if allowed, allows cross-domain data loading in Flash, Java, and Silverlight, and can cause security vulnerabilities.

5.8.5 Authentication

Authentication is the process of verifying that a person, entity, or application is who it claims to be. In the context of web applications, authentication is typically accomplished by sending a username or ID and one or more items of private information that only a particular user needs to know. Session Management is a process by which a server maintains the state of an entity interacting with it. This is necessary for a server to remember throughout a transaction how to react to subsequent requests. Sessions are held on the server by a session identifier that can be forwarded back and forth between client and server when transmitting and receiving requests. Sessions are unique per user and computationally very difficult to predict.

Usernames or user IDs should not be case sensitive. User 'admin' and user 'Admin' must be the same user. Usernames must also be unique. For high security applications, usernames can be assigned and hidden instead of user-defined public data. E-mail address can also be used as a user name during the authentication process.

In Authentication processes, Login should not be allowed in the application UI, including its middleware and database layer. For unsecured access (e.g. public access/DMZ) the internally used authentication solution (e.g. IDP/AD) should not be used.

A major concern when using passwords for authentication is password strength. A "strong" password policy makes it difficult or even impossible for a person to guess the password by manual or automated means. A strong password policy is defined below.

- The minimum length of passwords must be enforced by the application. Passwords shorter than 8 characters are considered weak. (std: NIST SP800-63B).
- The maximum password length should not be set too low as this will prevent users from creating passwords. A common maximum length is 64 characters due to limitations in certain hashing algorithms. Long password It is important to set a maximum password length to prevent Denial of Service attacks.
- Unicode and all characters, including spaces, should be allowed in passwords. There should be no password generation rules that limit the types of characters allowed.
- Rotation of credentials should be prevented when a password is leaked or during security breach identification.
- A password strength meter should be used to help users generate a complex password and prevent common and previously breached passwords.
- PWNED Passwords is a service where passwords can be checked against previously breached passwords. Using the PWNED API, it can be detected whether passwords have been breached before.



It's common for an app to have a mechanism that provides a means for a user to access their account if they forget their password. For details about this feature, the Forgot Password feature can be used.

It is very important for an application to generate a password using the correct encryption technique.

User-generated passwords must be password-hashed using a secure password authentication function provided by the language or framework, such as the `password_verify()` function found in programming languages. To ensure that the user who made the password change is the real user, in case of abuse, a real user is using the public computer to log on. User may forget to log out. Using the same computer, another user can change the password without verifying the password.

Some applications must use second factor authentication to check whether a user can perform sensitive operations. TLS Client Authentication, also known as two-way authentication, consists of the browser and server sending the corresponding TLS certificates during its process. Using the certificate and asking a Certificate Authority (CA) if the certificate is valid, a server can be authenticated, while the server can authenticate the user by obtaining a certificate from the client and verifying it against a third-party certificate. To do this, the server provides the user with a certificate created specifically for it, so that it is used to determine which user the certificate should authenticate.

In the case of the authentication function, incorrectly executed error messages can be used for user ID and password enumeration purposes. An application, using any of the authentication mechanisms (login, password reset, or password recovery), responds with a generic error message regardless of the following:

- Incorrect user ID or password error.
- There is no such account.
- Account is locked or disabled.

The goal is to prevent the creation of a discrepancy factor by allowing an attacker to initiate a user enumeration action against the application.

5.8.6 Authorization

Authorization can be defined as "Approved Verification Process for an Action or Service". Authorization is different from authentication, which is the process of authenticating an entity. An authenticated user is not authorized to access all resources and perform actions. For example, a web application can have regular users and administrators, and administrators can perform actions that the regular user does not. Also, authentication is not always required to access resources; An unauthenticated user might be able to access certain public resources, such as an image or a login page, or even an entire web application.

Vulnerabilities in authorization logic are an important information security issue for web applications. The impact from using authorization problems is highly variable in both form and importance. Attackers can access, create, modify or delete resources that need to be protected. Thus, the principles of confidentiality, integrity and usability, which are among the information security criteria, are violated. However, the real impact of such actions is linked to the criticality and sensitivity of the resources compromised. Therefore, the operating cost of a successfully exploited authorization flaw can be very high.



Both completely unauthenticated visitors and authenticated (but not necessarily authorized) users can exploit authorization vulnerabilities. While errors or carelessness by non-malicious entities can enable authorization bypasses, access control threats often need to be malicious for them to be fully implemented. Horizontal elevation of privilege (i.e. being able to access another user's resources) is an especially common vulnerability that an authenticated user can exploit. Errors related to authorization control can allow malicious insiders and outsiders to view, modify, or delete sensitive resources of any kind (database records, static files, etc.) or take actions such as creating a new account or starting a costly account, but these actions should not be allowed to be performed. Also, if access control related logging is not set up properly, such authorization violations may not go undetected, or at least not attributed to a specific person or group.

As a security concept, Least Entitlements refers to the principle of assigning users only the minimum privileges required to complete their work. Although perhaps most widely applied in systems administration, this principle is of interest to the software developer as well. Least Authority should be applied both horizontally and vertically. For example, although both the accountant and the salesperson are at the same level in an organization's hierarchy, they both need access to different resources to perform their jobs. The accountant should probably not be granted access to a customer data and the salesperson should not be able to access payroll data. Similarly, the head of the sales department is likely to need access to more privileged authority than his subordinates.

Failure to enforce the lowest privileges in an application can compromise the privacy of sensitive resources. Authorization strategies are primarily applied during the Software Architecture and Design phase.

The following best practices should be considered:

During the Software Design phase, confidence limits should be defined. The types of users who will access the system, the exposed resources and the operations that can be performed on these resources (reading, writing, updating, etc.) should be determined. For each combination of user type and resource, it should be determined what actions, if any, the user should perform on those resources, based on role or other attributes. For example, a Sales Representative may need to access a customer database from the internal network during office hours, but not from home during off hours.

- Tests should be conducted to verify that the permissions mapped during the design phase are applied correctly.
- Regularly checked for permissions and authorizations in the system; that is, it should be ensured that the privileges of users in the current environment do not exceed those defined at the design stage.
- It is easier to grant additional permissions than to take the privileges that users previously had.

The “deny by default” mentality should be adopted both during initial development of the application and when new functionality or resources are introduced by the application. It should be able to clearly justify why a particular permission is given to a particular user or group, rather than assuming that access is the default location. Although some frameworks or libraries may adopt a default-deny strategy, explicit configuration should be preferred rather than relying on framework or library defaults.



Software developers have access to a large number of libraries, platforms, and frameworks that allow them to incorporate robust, complex logic into their applications with minimal effort. However, these frameworks and libraries should not be seen as the solution to all development problems. Two common concerns with framework and library selection regarding proper access control are lack of developer-side misconfiguration and security vulnerabilities within the components themselves.

Even in a securely developed application, vulnerabilities in third-party components could allow an attacker to bypass normal authorization checks. Such concerns need not be limited to unproven or poorly maintained projects, they affect even the most robust and popular libraries and frameworks. Developing software that is both complex and secure is difficult. Even the most proficient developers working on high-security libraries and frameworks can make mistakes. Any third-party component included in an application should be considered as vulnerable to an authorization vulnerability.

The security of static resources is often overlooked in applications. While the security of databases and similar critical data stores is more important, static resources also need to be properly secured. To ensure the safety of static resources, the following qualities should be considered.

- Static resources should be included in access control policies.
- All cloud-based services used to store static resources must be secured using vendor-provided configuration options and tools.
- Static resources, like critical infrastructures, should be secured using access control logic and mechanisms used to secure other application resources and functions.

It should not rely solely on client-side access control controls. Client-side checks can be made, but only client-side checks should not be decisive in granting or denying access to a resource. Because only client-side checking is usually easy to bypass. Access control controls must be performed on the server side, at the gateway, or using the serverless function.

Logging is one of the most important controls in application security. Inadequate logging and monitoring are considered among the most critical security risks. Appropriate logs not only detect malicious activity but are also an important resource for post-incident investigations. It can be used to troubleshoot access control and other security-related issues and is used in security auditing. Although easy to miss during the initial design and requirements phase, logging is an essential component of holistic application security.

Unit and integration tests are required to verify that an application works as expected and consistently across changes. Defects in access control logic may go unnoticed, especially when requirements are complex; however, a minor logical or configuration error in the access control can have serious consequences. While it is not a replacement for specific security testing or penetration testing, automated unit and integration testing of access control logic can help reduce the number of vulnerabilities to production.

5.9 Block Chain Technologies.

In 2008, a person named Satoshi Nakamoto (pseudonym) published the bitcoin whitepaper, which expanded on W. Dai's concept to build bitcoin. Bitcoin is the blockchain used throughout this case.



Bitcoin, on the other hand, employs block chain technology.¹⁰⁸ A distributed database of records, or public ledger, of all transactions or digital events that have been conducted and shared among participating parties is known as blockchain. Each transaction in the public ledger is validated by a majority of the system's members. Information can never be deleted after it has been submitted. Every transaction that has ever taken place is recorded on the blockchain, which can be verified.¹⁰⁹

The transactions in a single block are regarded to have occurred at the same time on the blockchain. These blocks are linked to each other in a correct linear, chronological manner (like a chain), with each block holding the hash of the preceding block. Each block in the blockchain will be approved if it provides an answer to a very specific mathematical problem. This is also known as "proof of work"—the node that generates a block must demonstrate that it has sufficient computer capacity to solve a mathematical challenge. For example, a node may be required to discover a "once" that, when hashed with transactions and the preceding block's hash, provides a hash with a specific number of leading zeros.¹¹⁰ Hash is a digital signature of some kind of data that recognizes a block and all its contents and is like a specific fingerprint. The connection of Hash in Blockchain is that the Blockchain is essentially a chain of blocks, and each block holds the digital signature upon the digital signature of the previous block. The Digital signature of the subsequent block relies upon the digital signature of the current block. As blocks are linked to one other via their hash codes, the whole blockchain ecosystem becomes extremely secure. When a blockchain transaction flag is raised, a blockchain consensus must be reached in order for the transaction to be updated in the blockchain.¹¹¹

When it comes to data storage and management, blockchain and traditional databases operate in very different ways and the primary difference between this two is centralization. Data may be easily saved and accessed in a traditional database. At the main level, CRUD (Create, Read, Update, and Delete) is used to verify the application's correct functionality. This also implies that data can be deleted and replaced with new values if necessary. Traditional database environments cause issues such as data redundancy and variability, program-data reliance, security concern or integrity issues, and unrestricted access. Traditional databases, on the other hand, because to their centralized nature, do not enable any type of transparency. Users are unable to check the facts if they so choose. An administrator, on the other hand, can make a collection of data public, but data verification cannot be done by an individual. When it comes to blockchain data storage, on the other hand, operates differently. Immutability is supported by blockchain, which implies that data that has been written cannot be wiped or replaced. The network's immutability means that no data manipulation is feasible. Traditional databases lack immutability and are thus more vulnerable to manipulation by a rogue administrator or third-party hackers. Another important feature of blockchain is that anyone with the right tool may verify the data once it has been recorded into the public blockchain. Transparency guarantees that the public may have confidence in the network. The immutability of blockchain allows it to maintain its integrity. Data that has been saved cannot be altered or modified in any manner, ensuring data integrity at all costs. When compared to databases, blockchain is significantly slower. However, this could be due to the fact that blockchain is a relatively new technology that still requires

¹⁰⁸ S. Øines (2016, September). Beyond bitcoin enabling smart government using blockchain technology. In International conference on electronic government (pp. 253-264). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-319-44421-5_20

¹⁰⁹ M. Crosby, P. Pattanayak, S. Verma & V. Kalyanaraman (2016). Blockchain technology: Beyond bitcoin. Applied Innovation, 2(6-10), 71. <https://j2-capital.com/wp-content/uploads/2017/11/AIR-2016-Blockchain.pdf>

¹¹⁰ B. Bitcoin (2015) Blockchain Technology. Tech. Rep. <http://book.itep.ru/depository/blockchain/BlockchainPaper.pdf>

¹¹¹ R. Raj (2021, 7 April) How does blockchain work? <https://intellipaat.com/blog/tutorial/blockchain-tutorial/how-does-blockchain-work/>



a significant amount of time to grow and meet the criteria of more established technologies such as databases.¹¹²

Blockchain is characterized by its decentralization, distributed ledger, and better security, particularly in Hashing. One of the characteristics of this hashing is that it is irreversible. It is simple to go from an input to an output hash, but it is very impossible to go the opposite way, from the hash to the input. The encrypted format makes it hard to interpret the original data. In blockchain, there is also called avalanche effect. If the input becomes different, the hashes automatically change as well. However, we use the traditional database for third-party, the MariaDB in raspberry pi which is same in MySQL for an implementation only to provide the student's information or data that we are going to put in the blocks in blockchain.

5.10 Software and Application Development

Software is machine commands that increase the usability of electronic devices by providing compatibility and communication with each other. Software is a set of meaningful expressions created using computer language. There are different languages for this. C++, C#, Java, Pascal and p. When programs are run, they are loaded into RAM, which makes applications run with memory.

We will talk more about application software and application development. Application software are programs coded with programming languages offered to users in order to meet the needs of banks, libraries, universities on a certain subject. Application software is made specifically for different operating systems. That is, application written (coded) for windows does not apply to Linux. Application software is divided into two categories, general purpose and special purpose. For example, office software, security software, education, accounting software are general purpose software. Any planning, organization, prognosis, analysis and p. software that can be used in stages. Application development does not consist of a single coding. The production and usage process of a software is its life cycle. The life cycle of the system is the succession of processes that covers the various aspects of the system from the moment it needs to be created to the moment of complete removal from exploitation. The life cycle has several stages: the idea, its formulation, its creation, its exploitation, its exploitation, and its use.

ISO/IEC 15288 is an international standard aimed at the system engineering process and lifecycle. This standard, which is the joint work of software and systems engineering, was created by the ISO technical committee and electronics committee. It started in 1994. The previously adopted standard, MIL STD 499A (1974), was revoked after a memo from the United States Secretary of Defense (SECDEF) banning the use of most U.S. Military Standards without a waiver. The first edition was published on November 1, 2002. Stuart Arnold was the editor and Harold Lawson was the architect of the standard. In 2004, this standard was accepted as IEEE 15288 by the Institute of Electrical and Electronics Engineers. ISO/IEC 15288 was updated on 1 February 2008 and 15 May 2015.

- ISO/IEC 15288:2015
- Revisions: ISO/IEC 15288:2008 (harmonized with ISO/IEC 12207:2008)
- Revisions: ISO/IEC 15288:2002 (first edition)

¹¹² G. Iredale (2021, 30 July) Blockchain Vs Database: Understanding the Difference <https://101blockchains.com/blockchain-vs-database-the-difference/>



There are several models of the software process and are used. V-model, Spiral model, Waterfall model. In this model, care is taken to realize all the stages included in the succession. In order for the next stage to feel felt, the previous stage must be moved to full height. This model has its problems, for example, after each phase is over, it goes to the next step, for example analysis, new models were designed because we could not go back and correct again when changes were noticed during coding.

In this model, each stage is related to both the previous and the next stage. When we realize that the application is not working after all stages are completed, we can return to the stage where the error occurred and start the stages again, starting from that part. If there is a problem in the analysis phase, the system returns to the first phase, which is the worst case. Because designing, coding, testing and p. redo the steps.

Since the risks are high in large projects, it is very difficult to make the analysis and planning without any problems. Since the spiral model is the more up-to-date model, such risks are less. In each loop of the spiral, a version of the application is made, the analysis and quality are deqiqq, and the plans are made for the loop.

It is the model with the addition of verification and validation to remove the mistakes that the waterfall model can make. The V-model has ensured that the system can also tidy up during the execution of your application by placing validation and validation against each stage from start to finish.



6 Inclusive teaching content provision

6.1 General accessible content creation

6.1.1 Documents

These general guidelines apply across all document creation methods to enable accessible content:

6.1.1.1 Text Formatting and Fonts

A minimum of 11pt should be used with larger recommended. Fonts should be sans serif which is easier for the reader. Some recommended fonts include Arial, Calibri, Helvetica, and Verdana. Capital letters should be avoided for emphasis. Bold text is good for emphasis and better than underlining or italics which can make text harder to read.

Hyperlinks are best displayed as descriptive text with a link -rather than the full link text - such as ‘Go to the DiversAsia website¹¹³ for further information’.

6.1.1.2 Text Spacing and Alignment

This should be carried out using the tools available within the software rather than by using the tab and enter keys. Use wide spacing between lines of 1.5x or even double. Paragraphs should be formatted to leave a bigger space after each paragraph.

Alignment of the text is best kept to left aligned. This allows the text to have equal sized spaces between the words which again increases clarity.

6.1.1.3 Use of Colour and Visual Elements

Contrast needs to be kept high – so use of a plain background is recommended. This can be off white and should be used with a dark colour text. Pure white can be dazzling to some users. People with dyslexia may have specific colour combinations which work best for them. A contrast checker can be used to check compliance of text colours on plain backgrounds, such as this contrast checker by snook.ca.¹¹⁴

Some colour combinations should be avoided – notably green with red, light green with yellow and blue with purple. These can be hard to tell apart for some users. The use of colour alone to highlight elements should be avoided in favour of using bold text.

The use of images should be considered carefully. Images can help to make the text content clearer for some readers but should not be relied on to convey information alone. Alternate text should be added to each image or visual element to allow access to screen reading software.

The resolution of images used should be high – 300dpi or above so that they maintain good resolution when zoomed. Images should be avoided if they are low quality, they contain text, or they have poor contrast.

¹¹³ <https://diversasia-accessible-he.eu>

¹¹⁴ https://snook.ca/technical/colour_contrast/colour.html#fg=33FF33,bg=333333



6.1.1.4 Document Layout and Structure

The styles such as headings/title/normal feature should be used to allow easy indexing and searching with a document. This will allow for an automatic table of content to be generated as well.

Lists should be bulleted to make the text easier to read. Tables should never be used to structure the page, but if necessary for the document to present information, column headings should be used, and like for images there should be accompanying alternative text.

There is an excellent “designing for diverse learners” poster available here,¹¹⁵ summarising the main dos and don’ts of design for diverse learners.

6.1.2 Presentations

Some key guidelines to make presentations accessible are as follows:

- Include alternative text for any visual aspects.
- Check the order of reading of items in your presentation to ensure it makes sense to those using a screen reader. Built in slide designs (in PowerPoint) include a correct order for contained items, so it is recommended to use these.
- Use meaningful text for your hyperlinks. ScreenTips can be a useful place to add a hyperlink.
- Be careful with your use of colour – which should not be the only distinguishing feature to highlight an item. Contrast should be kept high also.
- Give each slide a unique and descriptive title as these may well be used to navigate around the presentation by those using screen readers.
- Keep any necessary tables simple and ensure the columns have headers.
- For presentations minimum font size should be 18pt. Also, fonts should be sans serif, and spacing text well on the slides will make reading easier for people with dyslexia.
- If using video content – subtitles are a very useful addition. You can also add descriptions which get across what is being shown in the video visually.
- Use of the accessibility checker built into Microsoft PowerPoint is highly recommended. It can be found in the review ribbon item entitled ‘Check Accessibility’.

Some excellent guidelines for accessibility in PowerPoint are provided by Microsoft.¹¹⁶

6.1.3 Web Sites

At the time of writing, the current best complete descriptors for web accessibility can be found in the Web Content Accessibility Guidelines (WCAG2.1).¹¹⁷ These guidelines aim to ensure web content is accessible in a number of ways – in that it is:

- Perceivable
- Operable
- Understandable
- Robust

¹¹⁵ <https://libguides.hull.ac.uk/diverselearners/>

¹¹⁶ <https://support.microsoft.com/en-us/office/accessibility-support-for-powerpoint-9d2b646d-0b79-4135-a570-b8c7ad33ac2f/>

¹¹⁷ <https://www.w3.org/TR/WCAG21/>



- Conformance

Important criteria covered by the guidelines are as follows (this list is not comprehensive – for the full list refer to the guidelines from the link above):

Perceivable:

- Text alternatives to non-text content should be available.
- Alternatives to time-based media should be provided.
- Make content adaptable – so that it can be presented in different ways without loss of content or meaning.
- Different device orientations should be supported.
- Colour is not used as the only visual means of conveying information or interactivity.
- Audio controls should be available for distinct items.
- Contrast should be high.
- Text should be resizable without assistive technology.
- Text should not be presented in an image format.
- Text should be spaced suitably to enable easy reading.

Operable:

- All functionalities should be operable from a keyboard.
- No keyboard trap – there should be a clearly defined way to move the focus to all parts of the web page.
- Time limits must be flexible.
- Content should not be designed in a way known to cause seizures or physical reactions.
- The content should be easily navigable.
- Multiple input modalities should be supported.

Understandable:

- Languages should be determinable by code to enable translations.
- Abbreviations should be explained.
- Web pages should appear and behave in predictable ways.
- For input errors by the user, suggestions should be made on how to fix them where possible.
- Context-sensitive help should be offered.

Robust:

- Content should be compatible with the multiple available browsers and by assistive technologies.

Conformance:

- To conform to levels A, AA or AAA of the WCAG2.1 all criteria for that level must be met.
- The whole page or series of pages must conform – if any part does not conform-then the page/page series does not conform.



You can check your HTML code against a relevant standard by using tools on sites such as HTML_CodeSniffer.¹¹⁸

Many universities now use partial or complete online course content delivery – the use of which has been exacerbated by the recent COVID-19 pandemic. This content can provide excellent opportunities to increase accessibility by enabling access of course information by different media and in alternative formats, allowing access in many ways, at speeds and times convenient to each individual user. It should be noted that all web accessibility guidelines should also be followed within the content on these systems. As the course content will be developed by course leaders/lecturers/professors, it is vital that they receive training in creating this accessible content. This training could indeed be delivered as at NTU by an accessibility course within the system itself.

6.2 Guidelines for specific software

6.2.1 Microsoft

Microsoft Office Accessibility Centre provides support for specific accessibility features within Microsoft Office. There are accessibility checkers for documents produced in Word, Excel, Outlook, OneNote, and PowerPoint on Windows, Office Online, or Mac, and Visio on Windows.¹¹⁹

6.2.2 Libre/Open Office

The following accessibility features are part of LibreOffice:

- Libre Office supports external devices and applications.
- Access to all functions is provided by use of the keyboard alone. The keys that replace the mouse actions are listed in the LibreOffice Help.¹²⁰
- Improved readability of screen contents.
 - Use of automatic font colour for screen display.
 - High-contrast mode which can be automatically detected from the operating system settings.
 - System colours can be used for page previews.
- Zooming of on-screen user interface for menus, icons, and documents.
- The user interface may be scaled using the operating system's settings. The default font size is 12pt, which represents a scale of 100%. This can be increased and decreased to suit the user. The font size for dialogs can be set in Tools - Options - LibreOffice - View. The zoom factor of the document itself can be changed in View - Zoom, or by double-clicking on the zoom factor on the Status Bar.

The accessibility settings can be found in 'Tools > Options => LibreOffice > Accessibility'.

6.2.3 Adobe

Adobe Acrobat Pro contains a set of tools to enable and ensure the creation of accessible pdf documents:

¹¹⁸ http://squizlabs.github.io/HTML_CodeSniffer/

¹¹⁹ <https://support.microsoft.com/en-us/office/office-accessibility-center-resources-for-people-with-disabilities-ecab0fcf-d143-4fe8-a2ff-6cd596bddc6d/>

¹²⁰ <https://help.libreoffice.org/latest/en-GB/text/shared/guide/keyboard.html>



- **Make PDFs accessible:** This built-in tool automates many tasks, checks accessibility, and provides instructions for any manual fixes required.¹²¹
- **Check accessibility:** The Accessibility Check tool verifies whether the document conforms to specific accessibility standards.¹²²
- **Report accessibility status:** This tool produces an Accessibility Report which summarises the accessibility check findings and contains links to assist you in fixing any identified problems.¹²³

For accessible pdf documents, there are then tools available in the Adobe Acrobat Reader tool which enable users to access these documents in the ways that suit them best. The Accessibility Setup Assistant allows a user to set up Adobe Acrobat Reader with their screen reader or screen magnifier software. This can be found in the menu Edit – Accessibility – Setup Assistant.

6.2.3.1 Document to PDF Production

The best way to create a pdf is by using Adobe Acrobat Pro, but you can also create one if you do not have access to this software. Microsoft Word for example has a 'Save as... Adobe PDF' option in the file menu and an Export > Create PDF/XPS option. Libre Office also has an option to Export as PDF from the file menu. To check accessibility of your PDF, you should use the accessibility test tool in Adobe Acrobat Pro (access from the menu tools/protect and standardise/accessibility).

¹²¹ https://helpx.adobe.com/acrobat/using/create-verify-pdf-accessibility.html#make_PDFs_accessible

¹²² https://helpx.adobe.com/acrobat/using/create-verify-pdf-accessibility.html#check_accessibility_of_PDFs

¹²³ https://helpx.adobe.com/acrobat/using/create-verify-pdf-accessibility.html#fix_accessibility_issues



7 Assistive technology into education

7.1 What is assistive technology?

Assistive technology is 'any device or system that allows individuals to perform tasks they would otherwise be unable to do or increases the ease and safety with which tasks can be performed'.¹²⁴ It is a broad term that refers to any tool, low tech or high tech, which can be used to enable student learning.

Assistive technology (AT), a major source of adapted educational services, has been accepted as a valuable tool for students with disabilities in schools.

Assistive technology (AT) has the potential to increase developmental skills and provide solutions to challenges, such as behaviour, attention, and communication, faced by students identified with disabilities or at risk in early childhood settings. Early childhood education professionals must have AT knowledge and competency to effectively use AT with young children and to include AT in the curriculum. Teachers share responsibility for effectively preparing all young children to develop important readiness and literacy skills enabling them to successfully participate in public school settings.¹²⁵

Assistive technology is changing rapidly, and it is no longer confined to being specialised, high-tech equipment. It can be low tech, free/low-cost technology or settings that are built-in to consumer devices. Assistive technology can also be used to benefit a wide range of students in the classroom.

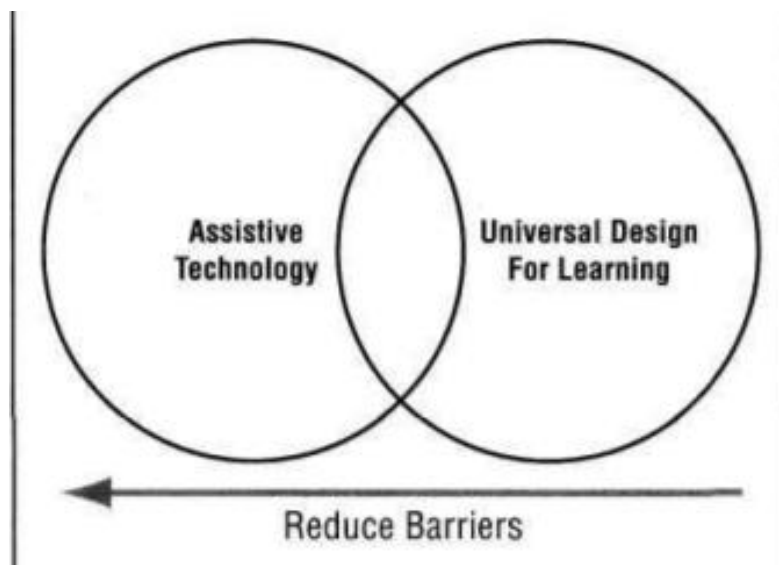


Figure 7: The relationship between AT and UDL.¹²⁶

Assistive technology is technology that increases, improves, or maintains the functional capabilities of students with disabilities. Usually, it is specifically designed to assist individuals with disabilities in

¹²⁴ World Health Organisation, 2004. A Glossary of Terms for Community Health Care and Services for Older Persons. WHO Centre for Health Development, Ageing and Health Technical Report, Vol 5.

¹²⁵ Howard P. Parette & Julia B. Stoner, 2007. Benefits of Assistive Technology User Groups for Early Childhood Education Professionals.

¹²⁶ David H. Rose, Ted S. Hasselbring, Skip Stahl & Joy Zabala, 2005. Assistive Technology and Universal Design for Learning: Two Sides of the Same Coin.



overcoming barriers in their environment and in increasing their opportunities for independence. Because the intended consumers are usually individuals, specifically individuals with disabilities, AT can be carefully engineered, fitted, and adapted to the specific strengths and weaknesses of each person. In that regard AT is unique, personal (travels with the individual), customized, and dedicated.

Some examples of assistive technology that are used regularly in classrooms include:

- literacy software or built in settings that allow text to be read aloud to a student.
- software or settings that adjust the screen display to suit a student's needs.
- tools that allow magnification of content on a screen.
- speech to text tools that allow a student to dictate their writing.
- communication tools that can be low or high tech.

7.2 Making decisions about assistive technology

As part of the personalised learning and support process, assistive technology may be considered as a way to support a student's access to the curriculum.

Decision-making about assistive technology starts at the school and includes the student, the parents or carers and relevant staff.

The school learning and support team facilitates the personalised learning and support process where appropriate adjustments are considered. These adjustments may include the use of assistive technology to support the student's access and participation in their learning.

Local School Services can provide additional support if needed.

7.3 Accessibility options on a range of technology

Many devices have built in accessibility features which can assist students to access the curriculum, including:

- Microsoft/Windows accessibility
- Mac/iOS (iPad)
- Google accessibility
- Android accessibility

7.4 Set of assistive tools

7.4.1 Speak selection on the iPad

Speak selection on the iPad is an inbuilt accessibility tool which can support students with reading difficulties. It allows a student to select text on the screen which can be read aloud. The speed, language and voice can be adjusted to suit the student's needs and the text can be highlighted while read.

7.4.2 Microsoft Learning Tools

Microsoft Learning Tools is a free resource which can be used to support students with reading and writing difficulties. It includes a range of features to support students including text to speech, adjustable display of text and colour, picture dictionary, line focus and it can highlight certain word features.



7.4.3 Voice typing in Google Docs

Voice typing in Google Docs is an easy to use tool which allows students to dictate their writing and is very useful in removing the barriers that many students face with writing.

7.4.4 Safari reader on the iPad

Safari Reader is an accessibility tool that is built into the Safari browser on the iPad and helps people to declutter webpages and it provide a clear, personalised reading experience for students.

7.4.5 Dictation on the iPad

Dictation on the iPad is an inbuilt accessibility tool which can be useful for students who have difficulty with typing or spelling. This tool allows students to dictate or talk into their iPad and it will write for them. This feature appears on the on-screen keyboard, next to the spacebar, which allows for the student to use this speech to text tool as an alternative to whenever they need to type, such as searching something online, sending an email, or working on a document.

7.4.6 Windows 10 ease of access

Student's computer settings in Windows 10 can be personalized by visiting the Ease of Access center. There are a range of adjustable settings for optimizing the computer for people who are blind, optimizing the visual display, using the computer without a mouse or keyboard, making the keyboard and mouse easier to use, making it easier to focus on tasks, adjusting the contrast and many others.

7.4.7 Adobe Connect screen sharing

Adobe Connect has a screen sharing feature which allows a student with vision impairment the ability to view what is displayed on a teacher's computer or smartboard on their device. The student can then adjust their device settings to suit their needs, such as using magnification tools or inverting contrast settings.



8 Mainstream Technologies and Techniques that Support Inclusive Education

Research in the field has consistently identified and described a range of benefits that technology can offer disabled students in Higher Education, these technologies have the potential to mitigate in some way the disadvantages that they experience.¹²⁷

Each student is unique and what is suitable for one and enhances the learning process may not be appropriate and hinder it for another. Studies exploring patterns of technology access and use, reveal that disabled students combine both assistive and mainstream technologies to support their studies.¹²⁸ A piece of mainstream technology for one learner could function as an assistive device for another.

Mainstream technologies have increasingly added accessibility features for people with disabilities, making them more inclusive and easier to use. This applies especially to mobile devices, where the design of the operating systems, and the proliferation of low-cost or free software in the form of apps. This means that now assistive features and tools are more developed and widely available.

The integration of mainstream technologies can provide university students greater independence by helping them to complete their work and the tasks, in which they have encountered difficulties, with greater ease. For example, many students who need additional help academically, like taking notes in class, writing a text, or studying for a test, might find mainstream technologies useful. They can help students access and read the lecture and course material, record lectures, and produce summary notes of their studies.

In addition, they can improve their study efficiency, helping them to read or write faster and therefore saving them time in terms of organization of time; writing essays, and finding references and information quickly. This will also help them demonstrate their progress and achievements in learning.

Research on technology for deaf and hearing-impaired people largely coincides with research on mainstream technology. This is because the information and communication revolution has been largely based on visual communication. Since the beginning, they have had the opportunity to use the huge potentialities of novel information technologies. Deaf and hearing-impaired people have thus actively contributed to mainstream technology. They have been among the first adopters of video chat technologies and services such as Skype, Google Hangout, and FaceTime. The same holds true for Instant Messaging (IM). Furthermore, text-to-speech and speech recognition software has been promoted – and first used – by deaf people to communicate with others without the need for sign language or lip reading.¹²⁹

¹²⁷ Seale, J., Colwell, C., Coughlan, T. et al. (2021). Dreaming in colour: disabled higher education students' perspectives on improving design practices that would enable them to benefit from their use of technologies. *Educ Inf Technol* 26, 1687–1719
<https://doi.org/10.1007/s10639-020-10329-7>

¹²⁸ Seale, J., Colwell, C., Coughlan, T. et al. (2021). Dreaming in colour: disabled higher education students' perspectives on improving design practices that would enable them to benefit from their use of technologies. *Educ Inf Technol* 26, 1687–1719
<https://doi.org/10.1007/s10639-020-10329-7>

¹²⁹ WFD – World Federation of the Deaf. 2014. "Working Document on Adoption and Adaptation of Technologies and Accessibility – Prepared by the WFD Expert Group on Accessibility and Technology." <https://www.wfdeaf.org/wpcontent/uploads/2015/02/Working-Documents-on-Adoption-and-Adaptation-of-Technologies-and-Accessibility-October-2014.pdf>



8.1 Word prediction

One type of mainstream technology is word prediction software which generates a list of correctly spelled words from which the user can select. It was originally conceived and designed to assist people with physical disabilities to type faster and with fewer spelling mistakes. Writing through prediction is a huge benefit and has been proven to support learners with difficulties using communication devices. It is now widely used on computers and mobile devices as a mainstream technology.

It requires using a keyboard. This can be an onscreen keyboard on a smartphone or tablet, or a physical keyboard connected to a device or computer. Predictive text offers suggested words and phrases, which closely match the first few letters that have been typed. It can help to reduce the number of required keystrokes, by predicting the word you are typing, and the next word based on word frequency and context of what is being typed.¹³⁰ For example, in the illustration below, predictive text on an iPhone has offered 'he', 'hey', and 'here' after typing 'he' as a potential word completion.

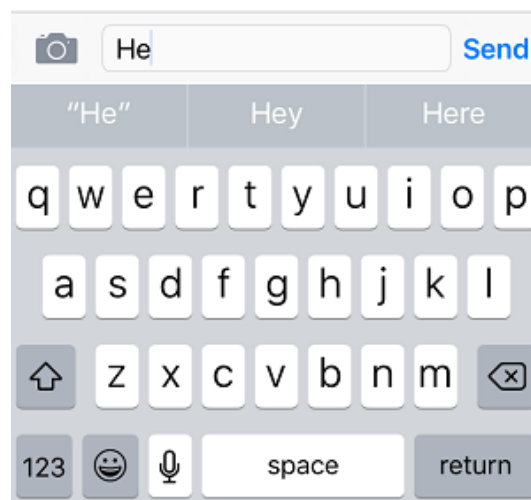


Figure 8: Predictive text displayed on a mobile phone keyboard.

Many students with disabilities feel overwhelmed with the writing process, especially physically disabled students, learning disabled, those who are severely spelling disabled, and even students with emotional and behavioural disorders. Word prediction software may improve writing fluency and accuracy, for students whose typing is slow and time-consuming by lessening spelling and keyboarding errors.

Some students simply cannot retain ideas in their memory long enough to express them in writing. They struggle not only with trying to sequence ideas associated with a given topic but also have trouble writing when their ability to generate text cannot keep pace with the flow of their ideas.

This type of software also has tools that make suggestions adjusted to specific topics, for example, the words used in a science report will differ a lot from those in a biology paper. For greater accuracy of the suggestions, learners can choose special dictionaries for what they write about.

¹³⁰ CALL Scotland (2019), The University of Edinburgh, A guide to using word prediction with learners who experience difficulties with literacy, 1-1 <https://www.callscotland.org.uk/common-assets/cm-files/books/a-guide-to-word-prediction.pdf>



The use of word prediction has many benefits for learners with disabilities in higher education. For example, for those students with learning difficulties, they could use a laptop or tablet with a word prediction program that offers speech feedback. In this way, they can compensate for the motor and spelling difficulties they face and so they can answer their questions related to the task or write their reports.

It can facilitate the writing process and support learners who have difficulty, not only with spelling, but also with grammar, especially dyslexic students. It can also help to increase text production. It may be beneficial in the studying process to those who experience fatigue or have limited motor skills as it requires less effort to type, requiring only one or two keys to complete longer words and sentences.

Word prediction software can help learners to focus on the writing task and to be more creative and expand their ideas, rather than avoiding words they cannot spell. Thus, students could be more confident and take ownership of their learning.

There is built-in word prediction software, as well as dedicated word prediction applications and programs.

1. **Built-in word prediction software.** Free word prediction is embedded into almost every device. This includes Android and iOS mobile devices, Windows tablets, and Chromebooks. The technology is also available in the Windows 10 and macOS operating systems. Students do not need to purchase or download anything to use these built-in tools. In Windows 11 there is a Virtual keyboard tool with a Text Prediction option.
2. **Applications.** Students can download many word prediction apps on smartphones and tablets. Some of them are:
 - a. Grammarly¹³¹
 - b. Dicom Portable¹³²
3. **Dedicated software programs.** There are several literacy software programs for desktop and laptop computers. They offer word prediction in addition to other reading and writing tools. Examples include:
 - a. Kurzweil 3000¹³³
 - b. Ghotit Real Writer & Reader (for People with Dyslexia and Dysgraphia)¹³⁴
 - c. The Co:Writer¹³⁵
 - d. ClaroRead – There are universities in the EU that offer a subscription to this software for their students.¹³⁶
 - e. Light Key¹³⁷
 - f. iWordQ¹³⁸

¹³¹ <https://app.grammarly.com>

¹³² <https://portableapps.com/apps/accessibility/dicom-portable/>

¹³³ <https://www.kurzweiledu.com/default.html>

¹³⁴ <https://www.ghotit.com>

¹³⁵ <https://learningtools.donjohnston.com/product/cowriter/>

¹³⁶ <https://www.clarosoftware.com>

¹³⁷ <https://www.lightkey.io>

¹³⁸ <https://www.quillsoft.ca/wordq-desktop/>



8.2 Touchscreens

Touch screens can serve as suitable alternatives to the computer mouse and keyboard, as they have a more direct relationship between a user's hand movements and the on-screen effects.

The portability of a tablet, the ease of use, visual impact, and intuitive interface, have led to many success stories for students with disabilities previously avoiding computers for reasons linked to touch sensitivity or finding the use of mouse and keyboard too complicated.

While using a tablet they do not have to work out how to use the computer, which means that they can fully focus on the particular learning task. But for those with motor disabilities as a result of cerebral palsy, multiple sclerosis, or any other situation that has, as a consequence, a motor disability in hands or arms, the touch screen can be challenging to access. These individuals may find that the touch screen reacts too quickly when trying to touch it and that unwanted actions are performed.

The touch screen is more accessible for individuals with coordination or learning difficulties. For example, touch screens can help students in the autism spectrum who have difficulty processing everyday sensory information, especially hyper and hypo touch sensitivity. The intuitive access provided allows for a light touch for all gestures used to control a touchscreen device, such as dragging, zooming and pinching, touching the screen to type.

Touch screens facilitate quick navigating through presentations. They are widely used by students studying art and design, for touchscreen drawing.



Figure 9: Using a tablet, in a library.

Learners can choose to use touch screen hardware such as Android devices – tablets and smartphones; iOS devices – iPad/iPhone/iPod Touch; Windows touch screen devices; All-in-one touch screen computers and laptops. Some of the more advanced options that may be helpful for learners in university are multi-touch interactive whiteboards and touch-tables.

8.3 Voice control

Voice control is a hands-free technology tool that recognizes speech, allowing the voice to serve as the “main interface between the human being and the digital device.” In voice control communication is one way - person to the device. It is built into the iOS operating systems and does not require an



internet connection to function. The feature is not enabled by default - the user has to turn it on from the device Settings.

Voice control is very innovative and enables a world of productive possibilities for students with disabilities, especially those with physical impairments who struggle to work with a mouse, keyboard, or touch screen and those who find typing difficult and even impossible sometimes. It allows them to use and control their devices with voice commands for touch and swipe gestures, also to tap, switch on/off, scroll down, and others.

Unlike speech recognition, no special time is required for the device to get used to your speech, which makes the operations more efficient and faster, because it recognizes the commands.

The well-known mainstream software Zoom has a useful and new option of voice command, where students with disabilities can easily start a meeting, join a discussion, end a session, and check in and out of a conference room only by using their voice. They can type messages to other meeting participants as well. A similar feature was announced to be released by Microsoft for Teams.

There is built-in voice control software, as well as dedicated mobile applications.

1. Built-in Voice control software – Free voice control tool is available in all iOS mobile devices (iPad/iPhone/iPod Touch/iMac). Students do not need to purchase or download anything to use this built-in tool.
2. Applications:
 - a. Voice Access App for Android – this App allows students to control their device with spoken commands, such as to open apps, navigate, and edit text hands-free.¹³⁹
 - b. Voice Search¹⁴⁰

Similar to voice control software is a speech recognition system, which allows people with disabilities to dictate a document on a computer as an alternative to using the keyboard. It takes a short training period for the software to recognize speech patterns and some post-dictation editing. This technology has been widely used by students with visual impairments, as well as by those with learning difficulties.

There is built-in speech recognition in some Microsoft tablets and laptops. Some examples of dedicated Android applications and speech recognition software are:

- Voice typing – Gboard – the Google Keyboard¹⁴¹
- Dragon Naturally Speaking Software¹⁴²

8.4 Audio-recording

An audio recorder, also known as a tape recorder, is a sound recording and reproducing device that records and plays sounds. It once used magnetic tape for storage, but analogue magnetic tape has been largely replaced by digital recording technology, since the first decade of the 21st century.

¹³⁹ <https://play.google.com/store/apps/details?id=com.google.android.apps.accessibility.voiceaccess>

¹⁴⁰ <https://play.google.com/store/apps/details?id=ru.yvs>

¹⁴¹ <https://play.google.com/store/apps/details?id=com.google.android.inputmethod.latin>

¹⁴² <https://www.nuance.com/dragon/industry/education-solutions.html>



For students with memory impairments, visual impairments, attention deficit or distraction, dyslexia, impaired hearing, or limited manual dexterity, taking notes during lectures is impossible or a big struggle. Therefore, audio recording is a convenient and practical solution for them. A good solution to this is to allow students to record information in different ways.

Portable audio recorders can also be used to record personal notes, discussions, or lectures.

According to regulations in some universities in the EU and other countries around the world, students with disabilities who cannot read or take notes are allowed to record lectures for personal learning purposes only. It is common practice for these students to sign an agreement that they are not allowed to share the lectures recorded for personal use.

Recording lectures may help students with disabilities to review the recordings and fill the gaps in their notes by listening to the audio, as they have full control over the recording. This is useful for visually impaired students, those with dyslexia and learning difficulties. For the students with memory, issues are helpful to record the whole or parts of sessions.

These students need to consider where they are sitting when using audio and tape recording. They should sit as near the lecturer as possible for maximum quality recording.

Types of audio recordings are:

1. Built-in audio or tape recording = Free recording tools are embedded into almost every device. This includes Android and iOS mobile devices, Windows tablets, and Chromebooks. The technology is also available in the Windows 11 and macOS operating systems.
2. Interactive forms of notetaking where audio recording is an option.
 - a. One Note¹⁴³
 - b. Glean¹⁴⁴
3. Digital Dictaphones Apps are found in the Google Play and Apple App Store. Some other audio-recording Apps are:
 - a. Notability: Notability on the Apple App Store¹⁴⁵
 - b. Audio Note¹⁴⁶
 - c. Sonocent Recorder – (for Mac and PC. Using the app on iPhone, iPad, or iPod touch)¹⁴⁷
 - d. Cogi – voice recorder¹⁴⁸
 - e. Krisp – (for iPad or touch screen computers)¹⁴⁹

8.5 Audiovisual assistance

Audiovisual (AV) is electronic media possessing both a sound and a visual component, such as slide-tape presentations, films, television programs, corporate conferencing, church services, and live

¹⁴³ <https://www.onenote.com>

¹⁴⁴ <https://glean.co>

¹⁴⁵ <https://apps.apple.com>

¹⁴⁶ <https://luminantsoftware.com/apps/audionote-notepad-and-voice-recorder/>

¹⁴⁷ <https://sonocent.com>

¹⁴⁸ <https://cogi.com>

¹⁴⁹ <https://krisp.ai>



theatre productions. Audiovisual service providers frequently offer web streaming, video conferencing, and live broadcast services.¹⁵⁰

Computer-based audiovisual equipment is often used in education, with many schools and universities installing projection equipment and using interactive whiteboard technology.

The use of audiovisual technologies in higher education is widespread. It is an integral part of the teaching and learning experience too. The use of audiovisuals in education has become the norm to meet the needs of different types of learners, including those with disabilities, as they often help students reach a better understanding of the class material.

Audiovisual material is a growing trend in higher education. There are hundreds of websites available online listing educational videos.

Videos are now being used by professors and lecturers in all areas of study. For example, for people who are deaf, it is relatively simple to provide captions to a video, and mainstream technology is making this even easier. Captions have been found by many studies to improve the comprehension of online videos and streams, while also making them easier for those people to watch. Several video-calling platforms also have this function, which can be very useful for online class meetings. To take Zoom, for example, this video platform enables users to integrate a third-party captioning service in both Zoom meetings and webinars.



Figure 10: Videoconferencing.

The most commonly used audiovisual technology is the audiovisual and video-calling platforms. Students with disabilities can collaborate in real-time with others, which makes them feel more included in the learning process. Some of these platforms include planners as different add-ons which is helpful for them to be more organized.

¹⁵⁰ <https://en.wikipedia.org/wiki/Audiovisual/>



The auto-generated live captioning and the ability to enlarge the speaker's video can be very helpful for these students too. In some of these platforms, learners can record meetings and as well to attract attention such as raising a hand.

There are Disability and Access Services in some of the EU universities, where students are required to fill out forms to request the Audio-Visual Support Service.

Some popular mainstream software and platforms are:

1. Zoom¹⁵¹
2. Webex¹⁵²
3. Skype¹⁵³
4. Google Classroom¹⁵⁴
5. Microsoft Teams¹⁵⁵
6. Khan Academy¹⁵⁶
7. YouTube¹⁵⁷
8. Anki app¹⁵⁸
9. Sonocent¹⁵⁹

8.6 Voice amplification

Voice amplification is a technology that is created for an individual who has difficulty speaking loudly enough, to be heard in noisy environments or who has a medical need to speak softly due to voice limitations, possibly caused by vocal damage resulting from surgery. It can be helpful for people with acquired communication difficulties too.

Voice Amplifier tools enhance audio from the mobile device, using headphones. They can be used to filter, augment, and amplify sounds in the environment and on the device. Important sounds like conversations can be increased without over-boosting distracting noises.

This type of technology is crucial to helping students with hearing loss or a voice, speech, or language disorder to communicate more meaningfully.

Sound Amplifiers are committed to making audio clear and accessible for everyone.

Examples of mainstream sound amplification Apps for mobile devices are:

- Sound Amplifier – (Android)¹⁶⁰

¹⁵¹ <https://www.zoom.us>

¹⁵² <https://www.webex.com>

¹⁵³ <https://www.skype.com>

¹⁵⁴ <https://classroom.google.com>

¹⁵⁵ <https://teams.microsoft.com/edustart>

¹⁵⁶ <https://www.khanacademy.org>

¹⁵⁷ <https://www.youtube.com>

¹⁵⁸ <https://apps.ankiweb.net>

¹⁵⁹ <https://sonocent.com>

¹⁶⁰ <https://play.google.com/store/apps/details?id=com.google.android.accessibility.soundamplifier>



- Megaphone – (iOS)¹⁶¹

8.7 Specific technical examples

8.7.1 Google Chromebooks come with audiovisual assistance

Students who are blind, dyslexic, or have another diagnosis that impairs their reading ability, can benefit from devices such as Google Chromebooks, which come with audiovisual assistance.

Chromebooks have a built-in screen reader called ChromeVox which reads the content out loud for users on the Chrome browser. Chromebooks also have features that make on-screen content easier to read, such as screen magnifiers, high-contrast mode, and select-to-speak. Students can also plugin or pair a Braille keyboard with Bluetooth in case they need it. Popular cloud-based applications such as G Suite for Education and Microsoft Office 365 also have dictation capabilities that allow students to type by using their voice.

There are word prediction and speech-to-text software tools that can assist students with speech disabilities in communicating with their professors and peers. For example, Office 365 applications have Dictate,¹⁶² an add-in that allows students to speak into a microphone and have their speech converted into text on the computer.

Tools such as memory aids, audiobooks, and text-to-speech systems are especially helpful for students with autism, who need assistance with learning, attention, and organization.

8.7.2 8.7.2. Microsoft's Surface Pro

Microsoft's Surface Pro is loaded with assistive technology, including text-to-speech software, word prediction, and settings that allow screens to be adjusted for students with epilepsy and colour blindness.

Microsoft Surface devices include tools and accessibility features for people with disabilities.

Users who are blind, colour-blind, or visually impaired can use the narrator function as a screen-reader and magnifier. They can also customize screens to suit their needs, whether they have colour blindness, photosensitivity, or other visual preferences. There are features such as "Colour Filters" that increase contrast or eliminate colour. Another useful feature is "Tell Me", which allows students with disabilities to use the device to quickly access commands across multiple Office 365 applications without having to navigate the command bar.

Immersive Reader can be found in a variety of applications, including Word, OneNote, and Teams. Immersive Reader has reading and text preferences for visually impaired users.

Microsoft Surface devices have accessibility features that include closed captions (in applications such as Microsoft Teams, PowerPoint, and Stream), mono sound, live transcript, and video transcription. They support users with hearing needs.

¹⁶¹ <https://megaphone.smudge.com>

¹⁶² <https://support.microsoft.com/en-us/office/dictate-in-microsoft-365-eab203e1-d030-43c1-84ef-999b0b9675fe>



Microsoft Surface devices are accessible for users with dyslexia, seizures, autism, and other cognitive differences. They can use tools like dictation in Word, OneNote, and Outlook. All Surface devices have built-in microphones makes using applications like dictation helpful. In addition, Windows Hello makes it simple for users to sign-in securely and get to work quickly with the easily accessible rear and front-facing camera.

Surface devices help people with mobility problems. These may include arthritis, quadriplegia, and spinal cord injuries. The pro-grade microphone allows users to use speech recognition and dictate to type with their voice and use voice commands. In addition, users can use the flexible keyboard with backlit keys to use keyboard shortcuts. Finally, users can use the powerful camera experience to click with their eyes.¹⁶³

Surface devices help minimize stressors for people living with mental health problems. Some features and applications help users with distraction and concentration. Outlook Calendar and Tasks help users keep track of tasks and deadlines. Focus Assist limits distraction, for example by allowing users to determine which notifications they see and hear and when.

8.7.3 Support with guide dogs for mobility and orientation

It can be difficult or impossible for students with vision impairment to navigate campuses, which can, in turn, impact their confidence and wellbeing. Orientation and mobility are part of the training of these students as they need to be able to move safely, orient themselves efficiently and as independently as possible.

There is a practice in some universities to offer orientation and mobility services to blind or visually impaired students with certified guide dogs. Therefore the role of the dogs in these universities is indeed important. This service allows students with visual impairments to achieve a systematic orientation and safe movement in their university environment, for example being able to move from one place to another or going from the student dormitory to the library.¹⁶⁴

What are these dogs? These are trained dogs to guide people who are blind or visually impaired. The most common pure breeds are Labradors, Golden Retrievers, and German Shepherds. They can be useful for many people, but they are not suitable for everyone. One who uses a guide dog must have excellent skills for orientation and mobility. Students and dogs must undergo special training, which includes building good relationships between them and good knowledge of the territory of the university.

One way of training is for the dog to know the terrain and specific commands very well, and through them to lead the student to a place chosen by him. For example – “take me to the library” or “take me to campus”.

In conclusion, the guide dog is the key to independent mobility, a new self-confidence, new levels of personal freedom and activity, a new quality of life.

¹⁶³ Transforming the higher-education experience with the Surface suite of devices <https://learn.microsoft.com/en-us/training/educator-center/>

¹⁶⁴ A guide for Higher Education Providers. Supporting students with vision impairment during Covid-19, 10 (2020). <https://www.pocklington-trust.org.uk/wp-content/uploads/2020/10/supporting-students-with-vision-impairment-during-covid-19.pdf>



8.7.4 E-libraries with audiobooks for mobile and desktop devices – Audible, Kobo Books, Google Chrome Books, Storytel, and others

An audiobook is a recording of a book being read aloud. Users can listen to audiobooks on any smartphone, tablet, computer, or home speaker system. Audiobooks can be purchased or downloaded in the same way as digital music. Students with disabilities who struggle with reading, whether they have dyslexia, visual impairment, or a disability that makes reading print difficult, a lack of access to books can have serious implications on their ability to learn and develop.

An eBook is an electronic representation of a traditional print book that can be read by using a personal computer or mobile device, by using an eBook reader, or mobile devices that can display text, such as smartphones and tablets, which can also function as e-readers.

1. eLibraries:

- a. Project Gutenberg – offers over 53,000 eBooks¹⁶⁵
- b. Google Scholar¹⁶⁶
- c. Internet Archive¹⁶⁷

2. Audio Books:

- a. Google Books¹⁶⁸
- b. Kobo Books¹⁶⁹
- c. Storytel¹⁷⁰
- d. Librivox¹⁷¹
- e. Audible¹⁷²

¹⁶⁵ <https://www.gutenberg.org>

¹⁶⁶ <https://scholar.google.com>

¹⁶⁷ <https://archive.org>

¹⁶⁸ <https://books.google.com>

¹⁶⁹ <https://www.kobo.com/us/en/p/apps>

¹⁷⁰ <https://www.storytel.com/in/en/>

¹⁷¹ <https://librivox.org>

¹⁷² <https://www.audible.com>



9 Types of Assistive Technologies for Inclusive Education for Students in HEIs

9.1 Video/braille display or speech synthesizer-Assisted Learning in inclusive HE teaching.

Many of these approaches apply a transformation of some kind to the visual output, to enable it to be understood and interpreted by people with limited or no vision. (This does not apply to AAC or braille embosser etc.)

9.1.1 Audio Output Devices (E-Readers).

These devices enable digital text to be read aloud to the user. This is accomplished by converting the displayed text to speech.

9.1.2 Augmentative Communication Software.

This provides an alternative way for people with language disorders to use expressive or receptive language. Augmentative communication can be provided by specialised software on computers or handheld devices, or it can be achieved through low technology such as picture communication systems. These systems are also known as alternative and augmentative communication (AAC), alternative communication, assisted communication, facilitated communication, functional communication, or supplemental communication.

Although the same system can be used for either augmentative communication or alternative communication, these two definitions differ. Augmentative systems are used by people who have some speech but are either unable to be understood or have limited speaking ability, and can benefit from tools that support, or supplement what they can say verbally. Alternative communication is the term used when a person has no speech, so they must completely rely on another method to make all their ideas, wants, or needs known.

9.1.3 Refreshable Braille Displays

A braille display is a specific piece of computer hardware which consists of a series of pins which can be raised or lowered to display braille in a physical form. This allows a user who can read braille to read from the computer system by feeling the raised pins. A common issue however is that this technology is prohibitively expensive often costing thousands rather than hundreds of pounds.

9.1.4 Braille Embossers

A braille embosser is essentially a printer that prints braille. It uses pressure to indent the paper so that the printed braille can be read by touch. Again, expense is a key limiting issue in their use costing around £2000 where an ordinary printer can be purchased for a 20th of that.

9.1.5 Braille Translation Software

Special translation software is required to translate a text document into braille that can be printed using an embosser as mentioned above. Much of this software is paid, although there are some free alternatives, for example OdttoBraille an extension available for Open/Libre Office, or Biblos (by DiGrande.it). Other popular solutions include Index Braille, Duxbury and Euler.



9.1.6 CCTV magnifiers

CCTV magnifiers are digital devices used to assist users with low vision conditions. They consist of a camera and a screen. There are specialised devices for this, but there are also a number of apps available for standard phones, iPads and tablets which enable this technology to be used at low cost, for free, and on existing devices that the users would be carrying anyway.

9.1.7 Large Print Keyboard

Large print keyboards can be purchased cheaply which help users with low vision to be able to see which keys they are pressing. They come in a number of different factors and colours which can support users with different preferences and needs.

9.1.8 Low Vision Aids

This is a broad area of assistive devices, and low vision aids fall into a number of categories. Magnifiers can use either a lens (such as a magnifying glass) or technology – cameras and displays. They could be products designed in a way to make them clearer such as by using high contrast or colour in a different way. They may be specifically designed devices such as a clock with a bigger face or a digital clock with large bold numbers. Also something that should be considered is large print versions of documents, newspapers etc. These are often available on request.

9.1.9 Low Vision Computer Software

Modern operating systems on computers come with a range of versatile inbuilt accessibility options which can be turned on and off to help users with a range of disabilities and requirements. In Windows 10 Hold the windows key and press 'U' to open the ease of access centre. Within this section there are settings to adjust the display (text sizes, icon sizes, resolution etc), the mouse pointer, the text cursor, there is a magnifier, colour filters, high contrast modes, and there is also a Narrator that can be used as a simple text to speech option. These modes are also available in iOS and Linux versions, and you should check your documentation on the best ways to access them. OS X contains a built-in tool called Apple VoiceOver which includes magnification, keyboard control, as well as verbal descriptions of screen interaction. It can convert text content to audio including web pages, emails and documents. ORCA is a free open-source screen reader for Linux systems.

9.1.10 Monitors

The choice, and indeed setup, of monitor is an important consideration, particularly for users with visual impairments. Positioning the monitor correctly is the first step, setting it so that the top of the monitor is below the eye level, as this can reduce eye strain due to the physical features of the eye. Windows should be to the side of the monitor rather than directly ahead or behind. This can prevent glare, reflection and issues with changing brightness outside.

Aspect ratios should be considered, and it can be noted that modern widescreen aspect ratios can be harder for a visually impaired user to use as they require more eye or head movements to see the full area. Classic aspect ratios may be better suited.

Brightness and contrast are important factors for many people with low vision, so a good quality monitor should be selected enabling a wide range of brightness and contrast settings. An anti-glare screen can be additionally useful, particularly where an inverted colour scheme is preferred by the user. A dark background with light text is more badly affected by glare issues.



In dual monitor setups, the two monitors should be the same and set up with the same settings to avoid differences in brightness when looking from one to the other. When a user wears glasses, these should be designed for use with a computer monitor, which is something that your optician can help with. The monitor can only do so much when viewed through the wrong glasses.

9.1.11 Notetakers

Note takers – or automated transcription software can be used by users with hearing impairments to improve their ability to understand meetings, conversations or presentations. Some online meeting technologies such as MS teams have a built-in transcribing tool which supports live transcription of conversations. The accuracy of transcription may be better in some languages than others, and there is always the odd glitch in recognition of speech, but overall, this technology can be a big help.

9.1.12 Scanners

Scanners with text recognition software, are a valuable tool in converting images of text into actual readable text which can in turn be read by a screen reader or equivalent.

9.1.13 Scanner/Reader

Scanner/reader pens are a valuable tool to help with a number of visual and intellectual disabilities. They allow a user to run the pen over text and receive audio reading the text to them. Many are equipped with headphone jack ports to enable use in the classroom without disturbance.

9.1.14 Screen Readers

Bespoke screen reader software can be purchased enabling flexible and controllable reading of screen content. Most software comes with a selection of reader voices, and many have optional voices that can be purchased additionally. Screen reader software such as Jaws is available on several different user licences, often paid on a time limited use basis, and can be a costly option, but is frequently used due to reliability and completeness.

There are however some free and cheap alternatives – though they may not offer such a smooth experience or all the same features. NVDA is a free and open-source screen reader which can be used directly from a USB stick – meaning it is good for students who need to access it on multiple machines through their day.

Serotek System Access is another more affordable tool, though some additional features require payment to access. ORCA is a free screen reader for Linux and is included on the Ubuntu installer.

Web Anywhere is another useful one to know about as it requires no software on the machine and can enable web access to blind people on any machine they have access to.

For Google Chrome users, ChromeVox and ChromeVis extensions are worth a visit. These act as web screen reader and webpage magnifier respectively.

9.1.15 Voice Recorders

Talking Digital Voice Recorders enable recording of audio, such as a lecture or seminar, with easy-to-use navigation. The devices include software that provides spoken prompts and beeps to assist users with visual impairments while they record their interactions. It can also give notifications on such important factors as battery levels, recordings, and file deletion using audio cues.



There are also apps available for smartphones that do similar thing for example, on Android, Recorder for the Blind, or on iPhone, Pocket Recorder.

9.2 Learning Analytics in inclusive HE teaching.

Learning analytics (LA) is referred to as collection, measurement, analysis, and reporting of the learners' data to understand and optimize the learning environments. LA uses the data generated when students interact with digital learning platforms/technologies. LA can be used to help the decision making of humans in activities such as designing curricula. Some of the popular techniques used in LA are clustering, process mining, sequence mining, network analytics, graph mining, text mining, etc [30-32]. LA can help in higher education by providing solutions to issues such as student retention and progression, student satisfaction and learning experience, innovation and quality in teaching, and ranking and performance of the higher educational institutes [33]. LA can also be used to understand the learning strategies, behaviours, and processes of the students, reduce the student dropouts in higher education, improving the curriculum design and also supporting the learning process, data based personalized recommendations of courses, and providing constant feedback to both the educators and students, etc [34].

LA has a potential in contributing to the inclusive education and enhance the learning experience for students with special needs. LA can help in identifying and addressing the challenges/barriers that the students with learning disabilities face, identifying the courses that the students with learning disabilities may be interested in, identify the courses or modules that have higher dropouts of students with special needs, and also can provide feedback on personalized learning for students with special needs [35].

9.3 STEAM in inclusive HE teaching.

STEAM refers to the ways in which the Arts (art-practices and sometimes more broadly the Humanities and Social sciences) engage with the STEM subjects (Science, Technology, Engineering and Mathematics).^{173,174,175}

The teaching of STEM subjects has a beneficial influence on a nation's economic success, however, the way these subjects are currently taught can raise concerns, particularly regarding a lack of creativity, a need to focus on inter- and multidisciplinary work, a need for a broader conception of science, and STEM's marginalisation of concerns for society and the environment.

The arguments for the inclusion of the Arts in STEM in education are wide-ranging, extending from contributing to making science education more appealing, through to seeding development of more embodied, affective, and interdisciplinary models of school education.

STEAM was developed by Georgette Yakman in 2006, although the core philosophy of bringing the worlds of science and art together, to innovate, goes back centuries. Working in education, she saw the utility of incorporating the creativity and innovation seen in the arts into STEM education. She developed a STEAM curriculum in 2007 which matured into professional development for teachers a

¹⁷³ <https://educatingengineers.com/resources/steam-education>

¹⁷⁴ <https://artsintegration.com/2016/02/25/6-steps-to-creating-a-steam-centered-classroom/>

¹⁷⁵ <https://dx.doi.org/10.1128%2Fimbe.v19i1.1360>



few years later. By 2019, almost 3000 teachers across the world had been trained in the principles of STEAM.

9.3.1 What Is the STEAM Process?

The STEAM teaching process consists of six sequential steps, that the educator and their students follow. These form the basis of the classes and help students to develop their learning process.

1. Focus – Define the essential question or problem. The teacher should clearly understand how this relates to the STEM and Arts content selected.
2. Detail – Identify key elements of the question or problem and how they fit together. This allows identification of knowledge, skills, processes and background information the students already possess, that could contribute to answering the question.
3. Discovery – Research solutions, work out what fits and what doesn't. This identifies the gaps in skills/processes that need to be taught.
4. Application – Apply the previous learning and research gained at the discovery stage to find solutions to the problem. Students can try to create innovative solutions using all of the skills, processes and knowledge amassed up to this point.
5. Presentation – The work should be presented, allowing the student to express their ideas from their own perspective. It is also important for the student to give and receive feedback.
6. Link – Finally, there is the opportunity for reflection and revision of their work, to make final improvements, incorporating information from their teacher and other students.

9.4 OERs/MOOCs for inclusive HE teaching

Massive Open Online Courses (MOOCs) and Open Education Resources (OERs) have gained significant prominence recently. MOOCs have immense potential in increasing the access to the courses for all learners from different backgrounds. They are online courses that are developed by teachers from several institutes which are free to access by the learners around the globe. The recent lockdowns imposed across the globe due to covid-19 pandemic has facilitated the increase in the MOOC courses developed over the past 2 years [1-4].

It is widely believed that students who are excluded from higher education institutes due to several reasons can benefit from MOOCs [5-9]. MOOCs also have the potential to increase the skills and knowledge of learners who are excluded that can improve the social inclusion in higher education [10-11]. By learning required skills and gaining sufficient knowledge, the students can attain skilled jobs. Even the students with learning difficulties can gain immensely from MOOCs. Students who struggle to grasp the concepts quickly can use the recorded contents from the MOOC, play them several times, slow the pace of delivery in the video lectures, etc to understand the topic in their own time. These days, even All India Council for Technical Education (AICTE), India is encouraging the higher educational institutes to encourage the students to register the MOOC courses developed by eminent professors from reputed institutes [12-13]. Some of the courses also have an option of choosing the captions in local languages. However, most of the courses that don't give the option of captioning in other languages is a disadvantage to millions of students who couldn't understand English. Some of the popular MOOC platform like coursera, edx, udacity, etc. have also started to levy registration fee on the courses they are offering making it difficult for the students from economically poor background to register for the courses [14-15].



9.5 Mobile Apps for inclusive HE teaching

The students with learning disabilities, may find it difficult to grab the concepts taught in the traditional classrooms instantly. Learning based on mobile apps can help those students to instantly access the classrooms virtually. Some of the popular mobile apps that can be used in the schools to cater the needs of the students with special needs are discussed below:

9.5.1 The Social Express

Students suffering from Autism can find it difficult in developing the social skills. A recent mobile app, namely, “The Social Express” is developed to provide communication lessons to the to the students suffering from Autism. This app will help the students with Autism to get trained in several social situations. The teachers can use this app in the classroom to encourage social learning in the students suffering from Autism.

9.5.2 Montessori Numbers

The students who have learning disabilities may feel difficulty in understanding the concepts of mathematics subject. A mobile app, namely, “Montessori Numbers” is developed to make the students with learning disabilities to understand mathematics efficiently through several visual methods.¹⁷⁶

9.5.3 Symbol Support

“Symbol Support” is a mobile app that can help the children with disabilities in reading who find it very difficult to understand sentences. This app converts the words into illustrative pictures which will help the students to understand the sentences and hence learn better. The major advantage of this app is that the entire document can be converted into pictures.¹⁷⁷

9.5.4 Time Timer

Some children may find it difficult to keep track of the time. For instance, these kinds of special children may find it very difficult to track how much time is left for them to complete a task. “Time Timer” app is a perfect solution that helps the children to keep track of time.¹⁷⁸

9.5.5 Avaz App

This app was developed in collaboration with a support organization based in India. This app helps the children having trouble with speech by using pictures, voice synthesis, and symbols. To make the app inclusive, six of the Indian regional languages, namely, Telugu, Hindi, Kannada, Malayalam, and Tamil are supported by this app.¹⁷⁹

9.5.6 Proloquo2go

Proloquo2go app can be used by the children with difficulties in speech due to several reasons such as Aphasia, Down Syndrome, Cerebral palsy, and Autism in order to gain a voice. Sentences, that are difficult to be expressed by the children through words, can be created by this app. Also, Proloquo2go has inbuilt voice modifier which provides several accents.¹⁸⁰

¹⁷⁶ <https://lescapadou.com/wp/en/montessori-numbers-app/>

¹⁷⁷ <https://apps.apple.com/us/app/symbolsupport/id571654488>

¹⁷⁸ <https://www.timetimer.com>

¹⁷⁹ <https://avazapp.com>

¹⁸⁰ <https://www.assistiveware.com/products/proloquo2go>



9.5.7 Seeing AI

This app helps visually impaired or blind students in a classroom setting. This app can read several categories of texts that includes handwritten, short, and long text. The children can identify books in a library by using this app through a scanner.¹⁸¹

9.5.8 Khan Academy Kids

This is an award-winning app that is developed by experts at Stanford for young students with learning difficulties. This app focuses on the catering to the needs of the children in understanding the core academic subjects and also emotional/social aspects. Using this app, the students can develop math skills, improve literacy, practice language and speech skills, encourage curiosity, and improve problem solving capabilities.¹⁸²

9.5.9 Choiceworks

This app helps the children with autism who face difficulty in following their daily schedules, measuring/telling time, and completing their routines. This app has a special timer, as well as a “waiting” screen that helps the students with learning disabilities to wait for the further steps or an activity.¹⁸³

9.5.10 Otsimo

This app helps the students with learning disabilities with the help of some games to cater to the needs of the kids having problems in communicating.¹⁸⁴

9.6 VR and AR for inclusive HE teaching

Augmented Reality (AR) and Virtual Reality (VR) can play a significant role in catering to the needs of students with special needs by making the learning more engaging, experiential, memorable, practical, and accessible [18]. AR/VR technologies can be used for simulating scientific experiments, virtual industry/field trips, immersive simulations, etc. Mobile devices and some advanced headsets can provide basic AR/VR experiences. VR can create a simulation of a person’s presence in an environment; hence the students with learning disabilities can develop skills and knowledge which are not possible otherwise [23]. Through VR, the students with learning disabilities can learn the tasks that are difficult to learn due to their disability constraints. VR can help the students with physical disabilities, who have limitations regarding their movements by giving them immersive learning experiences [24]. Students having communication problems such as Asperger’s or Autism can develop and practice the social skills in safe environments [17]. VR can also help the kids who have sensory disabilities by making them learn and experience things like how to avoid obstacles, how to navigate in a shopping mall/busy road in digital world before trying out in the real world. VR can also help the students with diverse needs by providing customized/personalized learning experiences. Likewise, AR can also help the students with learning disabilities by combining real objects with virtual objects and necessary information, thus catering to the visual, touch, smell, and hearing senses of the students [16, 19-22]. Several studies have shown that AR can positively impact the learning skills of the students with special needs,

¹⁸¹ <https://news.microsoft.com/features/bonjour-bienvenidos-seeing-ai-expands-to-5-new-languages/>

¹⁸² <https://learn.khanacademy.org/khan-academy-kids/>

¹⁸³ <https://learningworksforkids.com/apps/choiceworks/>

¹⁸⁴ <https://otsimo.com/en/>



improve their level of commitment and interest, increase their confidence levels, enable self-learning capabilities and enhances the learning through collaboration [24-26].

The users will be immersed fully on a digital world through VR, whereas digital elements are superimposed in a real-world environment through AR. VR technologies or apps can help the students to immersively experience several challenging experiments, tough subjects like mathematics, etc [29]. In AR, the learners are external observers, that might positively impact the students with special needs who don't respond positively to new environments [28]. For instance, an AR app can bring printed resources and books to life by superimposing audio, video, and 3D images to them. One popular AR app is the Otsimo Speech Therapy app [27]. Otsimo Speech Therapy app provides speech therapy to the students having issues with verbal communication, autism, and articulation by understanding what the kids are trying to communicate. This app makes use of speech and voice recognition to understand the student's articulation and pronunciation.

9.7 Learning Analytics in inclusive education

Learning analytics (LA) is referred to as collection, measurement, analysis, and reporting of the learners' data to understand and optimize the learning environments. LA uses the data generated when students interact with digital learning platforms/technologies. LA can be used to help the decision making of humans in activities such as designing curricula. Some of the popular techniques used in LA are clustering, process mining, sequence mining, network analytics, graph mining, text mining, etc [30-32]. LA can help in higher education by providing solutions to issues such as student retention and progression, student satisfaction and learning experience, innovation and quality in teaching, and ranking and performance of the higher educational institutes [33]. LA can also be used to understand the learning strategies, behaviours, and processes of the students, reduce the student dropouts in higher education, improving the curriculum design and also supporting the learning process, data based personalized recommendations of courses, and providing constant feedback to both the educators and students, etc [34].

LA has a potential in contributing to the inclusive education and enhance the learning experience for students with special needs. LA can help in identifying and addressing the challenges/barriers that the students with learning disabilities face, identifying the courses that the students with learning disabilities may be interested in, identify the courses or modules that have higher dropouts of students with special needs, and also can provide feedback on personalized learning for students with special needs [35].

9.8 References

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10 E-Learning and M-learning inclusive HE teaching (using E-learning and M-learning in face-to-face, blended and hybrid learning)

10.1 E-learning, online learning, distance learning, M-learning

There is no generally accepted conceptualization of e-learning in the scientific world. E-learning can be defined as learning in an e-environment, using electronic devices and/or electronic platforms, using e-resources. In the last two years, e-learning has been implemented mainly by distance and this has led to an overlap of the two concepts.

When defining e-learning, there are terms such as: “distance learning”, “online learning”, “virtual learning”, “e-learning”, “Internet-based learning”, “web-based learning”, “computer-based learning” and etc. These terms are often used interchangeably and interchangeably. Indeed, the urgent reform of education in the direction of digital transformation provokes in-depth research and analysis of the content field of the concept of e-learning. E-learning is already presented as a phenomenon in world educational practice and has been interpreted from various scientific points of view and authors' positions.

Moore, Dickson-Deane, Galyen & Chen (2014) note that there are different designs of e-learning, distance, and online learning. After conducting a study, they conclude that there is a “lack of consistency in terminology”. A new model of education has emerged for the pedagogical, student, and family communities - education in an electronic environment. A similar opinion was expressed by Totkov, Denev (2006): “there are no generally accepted definitions of the terms ‘e-learning’ and ‘distance learning’. The reason is the one-sided consideration of the problem depending on the professional orientation of the respective authors (technological or humanitarian).”

According to Oye et al (2012), “E-learning is basically the network-enabled convey of skills and knowledge. E-learning refers to using electronic applications and processes to learn. E-learning applications and processes include Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. EL is when content is delivered via the Internet, intranet/extranet, audio or videotape, satellite TV, and CD-ROM. E-learning was first called ‘Internet-Based training’ then ‘Web-Based Training’ Today you will still find these terms being used, along with variations of E-learning. EL is not only about training and instruction but also about learning that is tailored to individuals. Different terminologies have been used to define learning that takes place online.” Oye et al (2012) define the following characteristics of e-learning: educational courses, informal learning, blended learning, communities, knowledge management, learning networks.

According to Psycheva-Forsyth (2009), e-learning is most often perceived in its broadest sense as “learning aided by the use of information and communication technologies”. Very clearly the definition of the term “e-learning” highlights the possibility in traditional models of face-to-face learning to use technologies that use electronic devices, electronic resources with relevant software applications, and more. even without using the opportunities offered by the Internet.

In addition, e-Learning is defined as “a qualitatively new learning process, unlimited in terms of time and place, which provides individualization of the learning process and provides the necessary learning resources at the request of the learner as a result of perceived necessity. It uses computer network technology, mainly the Internet, to provide information and instructions to individuals.” (E-learning methodologies, 2011). “E-learning approaches can combine different types of e-learning components, including:



- (a) e-learning content;
- (b) e-tutoring, e-coaching, e-mentoring;
- (c) collaborative learning; and
- (d) virtual classroom” (E-learning methodologies, 2011).

E-learning can be used both in the traditionally structured classroom and in the organization and conduct of various real and simulated learning forms of learning and learning situations in cyberspace.

E-Learning is “time- and place-independent comprehensive and in-depth learning that is tailored to the learner's personal characteristics and provides in-depth knowledge, dynamically changing learning content and opportunities for real-time interaction between learners and trainers” (E-Learning learning methodologies, 2011).

E-learning can be differentiated from distance learning, but it can also be combined in a conceptual context. Distance learning brings distance and distance between the participants in the educational process. According to Keegan (1996), distance learning includes concepts such as correspondence learning, home learning, independent learning, external learning, distance learning instructions, and distance learning, although the terms are not synonymous. Distance learning may not use electronic forms of communication and learning. E-distance learning combines e-learning models (with organizational, pedagogical, and assessment aspects) with the spatial remoteness of learning. Moore and Kearsley (2012) define e-learning as “planned learning, where teaching usually takes place in a different place from learning, which requires communication through technology, as well as a special institutional organization.” The definition provided by Finch and Jacobs (2012) is similar. According to them, e-learning is presented as “all forms of teaching and learning, where the learner and the teacher are separated in space and time” (Finch & Jacobs, 2012).

“Distance learning is a form of education that meets the requirements of flexible learning and is oriented towards the dissemination, development, and decentralization of educational services. It uses and combines forms of e-learning and traditional learning in educational situations where learners and learners are separated in time and space. Distance learning is a modern and preferred form of organizing, conducting, and maintaining lifelong learning, which implements a learning process in order to obtain a certain educational qualification. DO is open to people, methods, ideas, and resources - more quality and effective training for more people (Sivakova, Trichkov, 2020).

Distance learning can overcome the shortage of teachers, provide access to education for all students, and be implemented in models suitable for all students. In this context, a synergy of distance and inclusive education can be noted, although rather a distance inclusive education is a component of inclusive education similar to traditional inclusive education.

The term “online learning” is linked to ICT training on the Internet. Understanding the use of the Internet is basic for defining online learning. Online learning is virtual learning that requires electronic platforms. Online learning provides opportunities for HEIs students to participate fully in the learning process, as it provides access and accessibility to learning.

Mobile learning, M-learning or mLearning is “learning across multiple contexts, through social and content interactions, using personal electronic devices” (Crompton, 2013). As Feser (2010) notes, mLearning is not eLearning on a Mobile Device. Mobile learning is not a simple transfer of learning to



a mobile phone instead of a computer. Through mobile learning, it is possible to realize ubiquitous learning or U-learning (Ubiquitous Learning).

Ubiquitous training can be implemented at any time and from any place in the presence of Internet connectivity. Weiser, M. (1993), introduced the terms 'ubiquitous computing' and 'ubiquitous learning', which refer to the process of seamlessly integrating computers into the physical world. "U-learning or in the ubiquitous classroom, students move around u-space and interact with various devices and other social partners. This invisibility of computer technology in all aspects of life, Weiser (1993) describes as "quiet technology". Casey, D. (2005) derives the famous formula: U-Learning = E-Learning + M-Learning, because every HEI's student, every HEI's teacher and administrator is involved in learning according to the devices they have, the availability and speed of Internet access and your motivation to learn, teach and support. No fantasy or futuristic thoughts. Technologies such as telephone, television, computers, smartphones, the Internet, mobile phones, death devices for controlling household appliances, etc. have been introduced into people's lives. The future belongs to "smart" systems, "smart" institutions, "smart" cities, and so on. According to Weiser (1993), ubiquitous technology in education is the future of education. In fact, his opinion turned out to be prophetic and was demonstrated during the COVID-19 pandemic. television, computers, etc. (everywhere), in learning and in the environment with or without social support (depending on educational needs) (Levterova & Ivanova, 2020).

The inclusion of all HEIs students wishing to study, regardless of the variety of their needs, is tolerance and fairness for the right to education. Universal learning actually delivers effective and inclusive education.

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10.2 Challenges of online platforms in inclusive education

E-learning is an electronic delivery of an organized course or learning experience that can also contain performance support content. An e-learning programme can also include a variety of features such as live or pre-recorded lecture content, video, quizzes, simulations, games, activities, and other interactive elements.

10.2.1 Benefits of E-Learning in Higher Education

An examination of the advantages of online learning will prompt us to explore how today's teachers, students, and institutions desire relevant and easily accessible content.

This is achieved through online learning, as students can learn at their own pace and convenience. COVID-19 resulted in the closure of schools and colleges all over the world. Globally, more than 1.4 billion students are out of classes. As a result, education has changed dramatically, with the distinctive rise of e-learning. Both as distance learning and on digital platforms. The researcher suggested that online learning has been shown to increase retention of information and takes less time which means that changes caused by coronavirus may be present to survive (Muthuprasad et. al. 2021).

Various advantages of e-learning in inclusive education:

1. Everyone's needs can be met through online learning.
2. Students or tutors can attend classes from any location and at any time that suits them. (Muthuprasad et. al. 2021)
3. Learning scalability, content, and duration may all be measured in a reasonable way. It is good for those who are nervous in groups and feel alienated. It allows one to learn without having to give up the conveniences of home. You're comfortable with In E-Learning, consistency of exposure, inputs, results, and coordination is highly valued since it gives teachers a greater degree of coverage to present content on a regular basis. This guarantees that learning is consistent.
4. The method is made accessible at a significantly reduced price. The significance of E-Learning education is that it is rapid and inexpensive. The lengthy training time, as well as infrastructure, stationery, and travel costs, are all minimized.¹⁸⁵
5. Students can access study material at any time.
6. Last but not least, eLearning is good for the environment because paperless education has helped save a lot of trees. Tutors also like this option since it allows them to evaluate each student online, which is faster and less tiring.

Many educational bodies build future plans to adopt e-learning and create an integrated e-learning subject. Now in India higher education has already started the compulsory MOOC course content in all universities (Mishra et. al. 2020).

Learners are limited to their desks for study purposes since e-learning takes place on desktop computers and laptops. Learning takes place using mobile devices such as smartphones and tablets, enabling for learning on the go. Both schools and families are rapidly adopting mobile technology, which is essentially being repurposed as assistive technology for students with disabilities (Gentry et al., 2010). Mobile technologies' potential importance as assistive technology for students with

¹⁸⁵ <https://www.digitalclassworld.com/blog/importance-of-elearning-in-education/>



disabilities cannot be emphasized, given their widespread adoption as educational aids for all students. Many students with disabilities rely extensively on assistive technology to participate more fully in the majority of their life's settings. They use this technology for mobility (wheelchairs, electronic navigation systems), communication (Dynavox, PECS systems), social skills acquisition (video modelling), learning (computer software), literacy (screen readers, audiobooks), etc. (Merbler, Hadadian, & Ulman, 1999). Some students need several different devices. This can be inconvenient when moving from one environment to another. Mobile technology can provide different types of support on a single device by using different personalized applications. For example, you can use a screen reader application to support literacy, use a communication app with communication, or use a movie app to teach social skills.

10.2.2 Challenges of the online platform in inclusive education

Inclusive classroom instructions are still a big problem in elementary schools and colleges. There is no time for Individualized instruction, and they don't have any skill over teaching a Blind, Deaf, and Mentally Retarded individually..." One of the respondents stated. If any issues and problems are with classroom teaching, then what will be the scenario in online learning? (Mohanty et. al. 2017)

Inclusive online learning at home is in full swing for students across the world. It is the biggest challenge for the families who have students with special needs, the lack of hands-on help has hindered some learning practices. The benefits and need of electronic learning are undeniable. In practice, however, both students and teachers encounter significant challenges that obstruct successful learning. Overall findings indicate that the extent of challenges and strategies varied from one student to another (Barrot et. al. 2021) Hence, they should be viewed as a consequence of interaction with several many factors. Moreover, the issues associated with the transition from physical to the online environment also cause different issues for the students having disabilities (Ali, 2021). We'll take a look at the most prevalent issues in inclusive online education:

1. **Difficult to Adapt to the Online Format:** When you move from a traditional classroom to an online model, the learning experience is completely different. Students in a traditional classroom are expected to merely listen and take notes, whereas virtual talks, working with a personal cabinet, and accessing resources in multiple multimedia formats necessitate activity. These changes may be difficult for students who have a "traditional" mindset. Certain students with disabilities are facing the problem to access the e-learning resources at their homes.
2. **Lack of Computer Knowledge:** In today's world, a lack of computer literacy is a serious problem mainly for disabled students and teachers. It will affect both students and teachers. Many faculties and students still have no idea how to use a computer and simple office software like Microsoft Word and PowerPoint. Even among experienced professors and students, there may be a lack of knowledge of remote learning technology such as online educational platforms, video conferencing systems, and multiple apps for communicating and viewing learning materials. (Alhabeeb and Rowley, 2018).
3. **Technical Problems:** Technical issues are frequently a stumbling block in online learning. Compatibility issues with learning platforms and operating systems, browsers, and smartphones may exist, and slow Internet connection speeds may result in missed online classes or difficulties downloading video lectures. Students become irritated and alienated from the learning process as a result of all of this. Many special needs students are facing technical issues in the home and it maybe they will not get enough help from family members.
4. **Limited Social Engagement:** In the traditional classroom, students can make direct connections with one another and with the teacher, responding promptly, sharing



experiences, joking, and making nonverbal communication, all of which help to build social skills. When students migrate to online learning, they lose a crucial ritual of engaging with people who share their interests. If they are not in the company of friends, there is no activity in the classroom, and they have no personal interaction with the teacher, students studying remotely may feel lonely. This psychological factor has a negative impact on both motivation and performance. E-learning could support the enhancement of the social skills of students with disabilities.

5. **Lack of In-person Interaction:** The physical presence of a teacher and fellow students in a classroom creates an environment that cannot be recreated through virtual methods. Students are unable to turn off webcams or doze off because of the physical model. Physical classrooms also allow teachers to pay more attention to the individual needs of each student. Interactive eLearning modules, on the other hand, can assist students to become more engaged.
6. **Insufficient Digital Infrastructural Problems:** Though online learning does not necessitate large buildings, large classrooms, chairs, tables, or blackboards, this does not eliminate the need for infrastructure (Chmiliar 2017, Chai et. al. 2015) A computer, appropriate software, steady energy, and high-bandwidth internet are all required. If a person cannot purchase this infrastructure, it is provided to them through public libraries in most industrialized countries. In developing countries like India, Pakistan, Bangladesh, and others, however, this level of infrastructure is only accessible to a small percentage of the population. The unavailability of resources for learning (e-learning software) for teaching students with disabilities is a major issue.
7. **Questionable Credibility of Degrees:** Although the industry has started recognizing online degrees, there are still a lot of fraudulent and non-accredited degrees being offered online. The number of scam operators is rising who are offering fake certificates which do not have any credentials. These scams not only lose the credibility of the online certificates but also the faith of prospective employers in online programs.
8. **Language of the Course:** India is a multi-linguistic country, and a vast majority of the population comes from rural areas. The majority of online courses have English-language content. Hence, those students who are not able to speak English struggle with the availability of language content. Hence, it is the duty of computer professionals, educators, administrators, language content creators, and content disseminators, to sit together and give a viable framework and standard solution to the learners knowing only Indian languages (Singh, 2016)
9. **Time Management:** Utilization of E-learning as an approach to teaching is time-consuming. Utilizing E-learning in teaching for the students with disabilities during the pandemic would require additional effort and extra time to prepare the material and other relevant information.

Few other challenges like:

- Psychosocial support.
- Focus and concentration.
- Lack of appropriate training workshops for the utilization of e-learning.



Online education has the potential to transform the future of education if it can be implemented with the partnership of industry, universities, and government. Drastic changes in the course curriculum are required to bridge the gap so that all disabled students are also coped up and ready for industry-ready after passing out (Atanga et. al. 2020, Alhabeeb et. al. 2018). The inclusive online education process needs to be modified to make it more practical with the use of technology. In addition, courses should be developed in a variety of languages, so more young students of rural India students can get this opportunity.

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10.3 Application of digital technologies and digital products to create an inclusive educational environment

Digital technology has been proven to contribute to the construction and maintenance of an inclusive educational environment. Technology solutions could be hardware-based or software-based. Mobile devices, computers, media players, and game consoles are examples of hardware-based technologies. Software-based technologies are web apps, social media sites, video games, or chat services. There are numerous well-known advantages to using digital technologies in education. Mobile devices, gaming, and the Internet, for instance, can enable students to interact, discuss, and collaborate. However, because digital technologies are used in a variety of ways, different types of technology can provide advantages to different groups of learners at varying levels of expertise.

Inclusivity, first and foremost, refers to equity, followed by equality. Schools should guarantee effective and integrated education for each and every child. Inclusivity is achieved via instructional tactics that build a feeling of connection, give tailored learning methodologies, and deliver an incentive for direct involvement.

Learners are capable of handling the instruction and accomplishing goals tougher or easier, which is feasible as digitalization is more fluid as well as pliable than stationary paper and pencil. At such a basic level, for several students, including notably those with autism and ADHD, for whom time management could be a difficulty, the inclusion of such a digital timer depicting the progression might enhance their self-management. Delving deeper, addressing students with varying levels of disability as well as educational requirements, digital equipment with significant visual aspects, including pictures as well as videos, might be effective for people whose educational standards may be inadequate. Reading challenges could be lessened by book reading on the internet, including acoustic, graphical, and infographics, assisted by recurrence, scheduling, and ordering. Videos can be repeated, and students can practice distinctive ways until they comprehend. All of these dynamic media can be considered on communication devices such as smartphones and tablets that also enable students to develop their learning skills anywhere.

Mobile technologies can also be beneficial for students whose attendance at school is difficult due to familial or cultural constraints. Throughout this approach, the boundaries of classrooms are growing ever larger and more translucent.¹⁸⁶ Teleconferencing can, however, connect instructors and learners to certain other institutions, specialists, and local residents.

This can help to broaden learning opportunities for all children, particularly gifted students. instance, the customization of educational possibilities for students having diverse capacities could be enhanced through enabling students to post and obtain solutions that match their feelings as well as objectives. These advantages have been demonstrated in podcasts, blogs, internet forums, online games, and learning platforms. A general factor underpinning the use of digital technologies for blended education is providing learners the initiative to acquire knowledge in ways that are tailored to match specific requirements. Digital technologies provide students with versatile resources because of being capable of interacting with both the education curriculum and evaluation through methods that embrace unique capabilities as well as permit the influence of shortcomings to be mitigated. Incorporating extensive deployment of several different forms of digital technologies as well as being advantageous

¹⁸⁶ Beetham, H., & Sharpe, R. (2013). *Rethinking Pedagogy for a Digital Age* (3rd ed.). Routledge.



to all students, digital learning is yet another strategy for digital technology and inclusive learning technology being implemented in schools worldwide.

Such institution visits provide an opportunity for students who may not have been allowed to be involved in school trips owing to physical or financial constraints to understand procedures, societies, as well as other events throughout remote areas. Virtual field trips could give incentives for gifted students whose reasoning requires them to be encouraged to expand their knowledge and abilities.

For instance, virtual field excursions to Amazon can utilize multimedia to watch films and photographs, professionals can interact with the classroom via virtual teleconference facilities, and intra-interactive exercises are supplied for students to accomplish. Such expeditions and multimodal learning activities offer students insights that would never be generally available or practicable.

There are several digital tools instructors can employ for diverse learners in schools while delivering a feeling of connectedness to every student. Several of them are mentioned below:

10.3.1 Equity Maps (2022)¹⁸⁷

Equity Maps is a platform that allows users to build a "space for all voices to be heard." It's an iPad application that could be simply incorporated into group conversations, encouraging cooperation but also social inclusion for all students. This app enables monitoring of extremely silent students that attempt to incorporate students further into the academic tasks. Furthermore, it itself is a self-observation technique for instructors to evaluate whether they control their respective classes. Instructors may monitor every sort of input from learners in any manner and create a document accessible in CSV format, grant permission evaluation, measure classroom participation and interaction, stimulate broader cooperation, and foster balanced conversations.

10.3.2 Explain Everything (2022)¹⁸⁸

Explain Everything is a virtual whiteboard suited for online education. This solution provides instructors with the advantages of a whiteboard and multimedia presentation tools. It is accessible on the iPad, Android, Chromebooks, and all current platforms. It covers a wide variety of file formats that instructors may incorporate into instructional films to engage learners at a level that enables them to be less instructor dependent. The tool helps display drawings and notes to record the central concepts of a conversation or argument. In this manner, everyone can witness the interpersonal engagement in an activity and get a glimpse of how individual thoughts have grown during the exercise. The platform provides a wider area for cooperation and constructive engagement where learners may research, develop, and disseminate ideas in an inclusive environment.

10.3.3 Flipgrid (2022)¹⁸⁹

Flipgrid is indeed a tool that educators could utilize for children to enhance inclusiveness and foster diversity throughout their classes. This platform provides services for each and every educator, from departing people that support appearing and listening to, to camera-shy learners who recommend capturing audio lectures of a whiteboard or blackboard that they can construct into text messages as well as decals, to deaf or hard-of-hearing (DHH) learners who could use sign language for their video

¹⁸⁷ Equity Maps (2022). <https://equitymaps.com>

¹⁸⁸ Explain Everything (2022). Interactive Whiteboard for Teaching and Learning. <https://explaineverything.com>

¹⁸⁹ Flipgrid (2022). Empower Every Voice. <https://info.flipgrid.com>



content or perhaps even generate a demonstration, including using subtitles. Including its incorporated Immersive Reader functionalities, Flipgrid may be utilized to increase reading skills through delivering transcription, deciphering answers, speaking aloud, and interpretations. Also, it can be utilized by instructors to distribute explanation films with the group for learners to review whenever they choose. Even though its primary use is for obtaining a person's speech and existence to provide online learning and teaching, Flipgrid offers spacetime for each and every audience to hear, either with the audio on or off, the camera on or off, or with substitute visual effects that personalize the experiential learning in the virtual classroom.

10.3.4 Empatico (2022)¹⁹⁰

Empatico paves the way for each and every learner to be able to impart a unique distinctiveness. Teachers register an account as well as the site identifies a suitable school colleague with whom they may cooperate. Learners gain from the engagement with various cultural contexts through Empatico while encouraging compassion on a worldwide platform. The software is also modified for special education, including sign language instructions, vocabulary terms, and even vocabulary to be transmitted via external devices. In this approach, non-verbal kids may engage directly in Empatico events. Empatico connects united learners from across the globe to uncover connections and appreciate their uniqueness outside the school walls.

10.3.5 Wakelet (2022)¹⁹¹

Wakelet enables instructors to assemble all the materials they wish to provide to their learners in one location for comprehensible communication. It may also be employed as a tool to interact with caregivers, contact them directly and keep them updated. As a management tool, it helps instructors arrange and spread information with their learners by merely establishing a gathering and storing separate things. Learners could also use the application to investigate particular disciplines and develop digital portfolios. In this approach, instructors may watch the progress of students' efforts even if they study in groups or pairs. This accessible platform encourages learners to explain their imagination and expertise in a secure educational process. It is also coupled with including an Augmented Reader so that every learner may understand the content as well as other academic resources at their own speed to assist students in accomplishing the required results.

Education is far more than the aggregate of thoughts and conceptions that learners recall. It's about every learner as unique with distinct requirements and also belonging to a group of students where they feel appreciated. Current digital tools enable different opportunities for inclusive instructional strategies and availability for every learner with varying learning challenges, enabling them to attain their promise. There are opportunities for future study examining technological tools and inclusive learning, as technology enables us to quickly advance and as methodologies and conceptions of inclusive learning progress.

¹⁹⁰ Empatico (2022). Connect Your Classroom to the World. <https://empatico.org>

¹⁹¹ Wakelet (2022). Save, organize and share content. <https://wakelet.com>



10.4 Assistive Technologies and Tools for Online Teaching for Students with Disabilities

Assistive technology (AT) includes hardware or software that assists a person with a disability in using the digital opportunities, it may help meet the educational needs of students with disabilities. Technology has the potential to significantly transform the lives of individuals with disabilities by helping them function independently and facilitating their involvement in society (Reham, 2021). Assistive technology helps bridge the gap between students with learning disabilities (LD) and their peers without LD. However, this implies a need for teachers to become well-trained and proficient in the use of AT. There are established AT competencies for educators, and AT services professionals must be knowledgeable about AT to select and recommend specific technology to individual education program teams (Atanga, 2020). Educational technology (e.g., audio and video recordings, and playback devices) has been used in classrooms since 1920 and is currently a widely endorsed and expected aspect of enhancing student learning (Alenezi, 2017; Edyburn, 2001). Tools such as automatic page turners, book holders, and adapted pencil grips to help learners with disabilities participate in educational activities (Hess, 2018; AFB 2022). Computer software and hardware, such as voice recognition programs, screen readers, and screen enlargement applications, to help people with mobility and sensory impairments use computers and mobile devices (AFB, 2022). Assistive technology (AT) may be useful for addressing the educational needs of students with disabilities by helping them access the academic curriculum more easily, thereby reducing the need for instructor assistance (Reham, 2021). Improving inclusive pedagogical practises in large courses is an ever-increasing necessity as university enrolments increase and student bodies become more diverse. An inclusive classroom environment starts with course and syllabus design, reaches through day-to-day interactions, and extends all the way to assessment practises for student work (University of Michigan, 2022). The resource guides are designed to help you create a foundation for inclusivity in your classroom. By creating guidelines for discussion, welcoming the use of gender pronouns and other markers of social identity, or engaging some of the other best practises sourced here, you can begin to set a tone of inclusivity in your space. Alternatively use the search feature on the right-hand side to type keywords or questions into the search. (University of Michigan, 2022). There are many assistive technology tools available for free online (Martin, 2022). Many AT tools are high-tech and depend on digital devices. AT can also be categorised according to purpose. The Wisconsin Assistive Technology Initiative (Reed, 2007) suggested 14 AT categories which assist with motor aspects of writing, composition of written material, communication, reading, mathematics, mobility, positioning, seating, vision, hearing, organisation, computer access, daily living activities, and recreation and leisure (Reham, 2021). Several studies have highlighted the positive impact of using AT in the learning process on the success and motivation of students with disabilities (Erdem, 2017; Kaur et al., 2017; Muflih, 2019; Stanberry & Raskind, 2009). Today, assistive technology tools can help students with certain disabilities learn more effectively and there are many tools that can help with learning.

10.4.1 Assistive Technology Summary Points

1. Assistive technology ranges from low- to high-tech.
2. Assistive technology can be used in two ways: to support learning and to bypass a challenging task such as handwriting.
3. In order to be effective, assistive technology needs to be embedded within quality instruction (Young).

10.4.2 Assistive technology for online reading

The best text-to-speech apps make it simple and easy to read documents aloud, on either your desktop, tablet, or phone, by techradar team The Best Text-To-Speech Software in 2022 are:



1. Amazon Polly¹⁹²
2. Linguatec Voice Reader¹⁹³
3. Capti Personal¹⁹⁴
4. NaturalReader¹⁹⁵
5. Voice Dream Reader¹⁹⁶
6. OrCam Read¹⁹⁷
7. Immersive reader¹⁹⁸
8. Kurzweil 3000¹⁹⁹
9. Closed Captioning²⁰⁰
10. Reciteme²⁰¹

While traditionally this has been in the realm of professional dictation and transcription services, these days text-to-speech has become far more common and an ordinary feature of everyday life. The use of audio for commands has especially become popular for use with assistants such as Alexa and Siri, which also allow for speech-to-text to be used, among other tools. It's also becoming much more common for audio to be used to convert text-to-speech for a number of reasons (Fearn, 2021).

The team of *Understood* company whose mission is To help those who learn and think differently discover their potentials, take control, find community, and stay on positive paths along each stage of life's journey, offers the following Assistive technology online reading tools list:

- **Audiobooks and digital TTS books** let you hear books read aloud. Some people like to read along with the book so they can see the words at the same time. Audiobooks are read by human voices. Digital TTS books are created with TTS and use computer-generated voices.
- **Optical character recognition (OCR)** reads aloud text from images and pictures. You can use OCR by taking photos of worksheets and paper documents, and even objects like street signs. They can also scan documents in. OCR can read words from pictures on web pages (such as image files, like JPG). Like TTS, OCR uses computer-generated voices.
- **Graphic organisers** are visual representations, like diagrams and mind maps, of ideas and concepts. Students can use graphic organisers to take notes while reading, which can help with comprehension. Graphic organisers can be digital or pen and paper .
- **Annotation tools** let you take notes and write comments while reading. This can make it easier to retain information. Annotation tools can be part of software or apps, or they can be traditional pens, markers **Display control**, and sticky notes.
- **Display control** allows you to control how text is displayed. When reading on a screen, they can change the font, font size, colour, and spacing of text. You can also cover (or mask) parts of the screen to lessen distractions while reading. When reading on paper, you can use a simple

¹⁹² <https://aws.amazon.com/polly/pricing/>

¹⁹³ <https://www.linguatec.de/en/text-to-speech/voice-reader-home-15/>

¹⁹⁴ https://www.captivoice.com/capti-site/public/entry/get_capti_subscription#free

¹⁹⁵ <https://www.naturalreaders.com>

¹⁹⁶ <https://www.voicedream.com/reader/>

¹⁹⁷ <https://ixd.prattsi.org/2021/09/assistive-technology-orcam-read/>

¹⁹⁸ <https://ixd.prattsi.org/2020/09/assistive-technology-immersive-reader/>

¹⁹⁹ <https://ixd.prattsi.org/2021/09/assistive-technology-kurzweil-3000/>

²⁰⁰ <https://ixd.prattsi.org/2021/09/assistive-technology-closed-captioning/>

²⁰¹ <https://reciteme.com>



adaptive tool, like a plastic reading guide. Some books use large print or special fonts. Or they may replace certain words with images (Understood, 2022).

10.4.3 Assistive technology for online writing

Technology can be a huge boost for adults and kids who struggle with writing. A keyboard, for example, can help people who have trouble using a pen or pencil. (AT) tools like this can make the physical act of writing easier. AT can also help with spelling and grammar, and with organising and expressing thoughts in writing (Understood, 2022).

- **Keyboards and touchscreens** can also help people who struggle with handwriting. Keyboards and touchscreens let you input letters and words through typing or touching the screen, rather than by using a pen or pencil.
- **Dictation (speech-to-text)** allows you to write by using your voice. As you speak, the words appear on the screen. Keep in mind that to use dictation, you have to be able to speak clearly. You also need to learn verbal commands for things like punctuation. Some dictation software can also be used to convert audio recordings into digital text.
- **Word prediction** suggests correct spellings of words after only a few letters are typed. Word prediction sometimes uses “word banks” (commonly used words in a topic area) to help writers come up with words and complete their sentences. Keep in mind that unlike dictation, word prediction requires using a keyboard.
- **Spellcheck and grammar check** are available on most word processors. Some AT tools for writing take spellcheck and grammar check to the next level by checking for incorrect words that sound alike or that don’t make sense in context.
- **Text-to-speech (TTS)** is typically thought of as a reading tool. But TTS can also help with writing. That’s because it can read aloud what’s written, so you can check for mistakes. Some TTS tools can also read words aloud as they’re typed.
- **Graphic organisers** are visual tools that help break down ideas and projects into smaller parts. You can use these tools to brainstorm and plan what you want to write. Graphic organisers come in many forms, from mind maps to diagrams to flow charts. They can be digital or pen and paper.
- **Dictionaries and thesauri** (print or digital) let you define a word or find the right one. There are different types of dictionaries and thesauri, too. For example, a picture dictionary uses images to define words. (Understood, 2022).

10.4.4 Assistive technology for online maths

Kids and students can struggle with many aspects of maths, from understanding maths concepts to doing simple arithmetic. Tackling word problems and writing out maths equations may also be hard for them. Assistive technology (AT) software is getting more useful all the time and a wide range of features can help students with calculation, understanding concepts, writing out maths, and solving basic to advanced maths problems (Understood, 2022):

- macOS Calculator²⁰²
- Windows 10 Calculator²⁰³

²⁰² <https://support.apple.com/guide/calculator/welcome/mac>

²⁰³ <https://support.microsoft.com/en-us/windows/calculator-in-windows-10-8dc0eb59-a45f-72b6-71bd-e752920f36c3>



- iPhone Calculator²⁰⁴
- ModMath²⁰⁵
- ModMath Pro²⁰⁶
- EquatIO²⁰⁷
- Mathshare²⁰⁸
- GeoGebra²⁰⁹
- GeoGebra Calculator Suite²¹⁰
- FX Draw Tools²¹¹
- MathType²¹²
- ChemType²¹³
- Math Learning Center²¹⁴
- Mathigon Polypad²¹⁵

The value of assistive technologies in education as facilitators of access to information, access to website material and access to learning materials cannot be underestimated (Lyner-Cleophasj, 2019). Still research Assistive technology applications for students with reading difficulties: special education teacher's experiences and perceptions pointed to how challenging it can be for some of the students' possibilities of accomplishing successful use of AT tools and to the importance of further research regarding individual customization and adequate teacher support of app interventions and usage (Nordström, 2019). Social justice cannot be achieved without the inclusion of all people, including people with disabilities, in educational settings. The human rights-based approach is entrenched in various national and international policies and treaties. Policies, guidelines, intention and rhetoric must be enacted and put into practice (Lyner-Cleophasj, 2019).

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²⁰⁸ <https://mathshare.benetech.org>

²⁰⁹ <https://www.geogebra.org>

²¹⁰ <https://www.geogebra.org/calculator>

²¹¹

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10.5 Assistive Technologies and Tools for Online Examination for Students with Disabilities

Until recently, due to incomplete and misinterpreted information, there were myths that the use of technology in various tests and exams benefits students with disabilities. Over time, understanding has changed and inclusive education, using the conditions created by assistive technology, has created ways to allow students with disabilities to take some form of examination. Students who use AT tools or platforms can study and complete their education in general education successfully, and in addition, they maintain their confidence and self-esteem.

Students with disabilities need accommodations or alternate forms of assessment so that their learning can be measured at system and classroom level and targeted teaching strategies can be employed. Various kinds of accommodations should be made available to students depending on their needs and technology can play a pivotal role in providing assessment opportunities to students with disabilities. Put simply, diverse assessment approaches are necessary for testing students with disabilities along with a range of pedagogies that address their learning needs [1].

Students with disabilities in the inclusive education system must be able and allowed to use technologies for testing, for example screen readers, magnifiers and special keyboards and various Braille tools or and speech recognition, which transform speech to text. It is necessary to help students overcome and diminish their physical challenges. To ensure better inclusion and facilitate the learning process for students with disabilities, new tools and technologies are being developed to provide equal opportunities for all to study and work. It is very necessary to allow students to demonstrate their knowledge, skills and understanding, unhindered in their demonstration by any disability, so they can be fairly assessed [2].

In fact, when gathering information about taking tests and exams for students with special needs, it must be concluded that their successful use during tests and exams is ensured by the student's previous experience in using them. Educators, in turn, need to be informed and able to ensure that these technologies are used in testing processes. The student should be regularly using the AT for their day-to-day education if that AT is to be permissible for use in the examination. This means that the availability of AT for assessment is largely dependent on what is generally available to the student for their education [3].

AT, equipment that helps to reduce learning gaps, helps to make this a reality by enabling students with disabilities to learn in new ways, and these technologies are often inseparable from those used only in exams and assessments. These processes are associated with a long-term, systematic learning environment. According to the research AT shouldn't be restricted to a specific subject area, and the use of technology should not solely occur within a computer lab; rather, assistive and instructional technology should be an integral part of all subjects and the use of these tools should be built into the curriculum [4].

AT and software are being developed to meet different disabilities for example, here are eight of the best AT tools that help people with disabilities study regularly: Timers, reading guides, text to speech, alternative keyboards, Audiobooks, FM listening systems, writing supports, graphic organisers [5].

However, there are some of the tools enable students with Dyslexia, learning disabilities and/or vision impairment to participate in exams independently: Claro for Exam, Texthelp Exams and Assessments,

c-pen exam reader, Kurzweil 3000 exam software. Also, Speech Recognition software can be used in exam accommodations:

Free: These voice dictation apps are free; some are built-in parts of popular operating systems:

- Apple Dictation (Mac OS)
- Chromebook Accessibility Features (Google's Chrome OS)
- Windows Voice Recognition (Windows OS)
- Google docs voice typing (Google Docs)
- Speechnotes (App for Android OS).

Paid: The disability office (ODS) at your school may have paid text to speech software, such as Dragon Naturally Speaking (Multi-platform app).

Online or remote assessment is likely to be far more inclusive for many students, especially in relation to handwriting vs typing, and in the exam room setting, which can often overwhelm students. However, online assessment will create additional barriers for some students with different categories of disabilities. (University of Leeds, 2020)

Cohort	Issue
Blind or visually impaired students	<ul style="list-style-type: none"> • Compatibility of exam software with assistive technology, specifically screen readers and voice dictation software. • No access to reader or amanuensis (scribe). • Video assessments are often inaccessible. • Unable to read graphs, diagrams, charts or equations unless effectively described.
D/deaf or hearing-impaired students	<ul style="list-style-type: none"> • Any element which is presented via audio, including instructions or uncaptioned videos. • Students whose exam papers are usually interpreted by a British Sign Language (BSL) interpreter. • Students who use BSL who would ordinarily sign their answers to a BSL interpreter, who then scribes the answer
Autistic students Students with Specific Learning Difficulties (e.g. dyslexia)	<ul style="list-style-type: none"> • Clarity of instructions when there is no invigilator or module leader in the room to check with.
Students with mental health conditions	<ul style="list-style-type: none"> • Anxiety around new formats and processes
Students with Attention Deficit Disorder (ADHD) or other disabilities which affect concentration	<ul style="list-style-type: none"> • Maintaining concentration in a non-formal setting. • Managing time.
Students with disabilities which affect handwriting and typing	<ul style="list-style-type: none"> • No access to amanuensis (scribe)
	Compatibility of exam software with assistive technology, specifically screen readers and voice dictation software.

Table 6: Online assessment will create additional barriers for some disabled students [6].



It is critical to point out that use of timed online testing is highly problematic for many students with disabilities. If using this method of alternative assessment, please liaise with your Disability/Access Office concerning any exam accommodations (e.g. extra time) which may be required for students with disabilities on your programme and the accessibility of the platform you are intending to use. If a platform is not digitally accessible and students require the use of assistive technologies, the only equitable solution may be to offer the student(s) an alternative assessment mechanism [7].

In summary, it can be concluded that the desire, understanding and opportunities of teachers to introduce these technologies in the teaching process, providing equal opportunities for all students, clearly play an important role. Before making any decisions about appropriate assessments, ensure that you are informed about the diverse needs of disabled students who are on your module and that they are allowed to use the AT tools they are used to.

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10.6 Digital Mediation for social interactions in the Inclusive Education.

Telecommunications and information technology have grown at an incredibly rapid pace in the last half-century of social change. The World Wide Web has established a global communication system network employing digital technology to permeate all social activity systems and processes. Is digital technology now a part of nearly every aspect of our lives?

Digital technology, like many other essential instruments, aids us in the conduct of human interactions and communications, as well as the transmission of information. For "direct" computer-based engagement, communication channels such as newsgroups, email, and buddy lists might be considered to be examples of appropriate channels.

Human interaction has been assisted by a diverse range of digital technologies for boosting action awareness, expanding the options for action and product tools, and expanding the contexts in which activities and actions are carried out and performed. A wide range of activities and actions are carried out on intranets such as the World Wide Web, notification servers, mobile computing and collaborative filtering, among other technologies. Working people are guided through the course of their daily operations by management systems such as workflow management and other similar tools.

If we consider solving computational problems or human computer interactions or computer/digital mediated interactions, all of them are happening very fast but surprisingly none of them are really old processes. The Internet we use now supports reasonable video streaming and audio streaming. Storage technologies support multimedia as well on demand. Notification mechanisms and awareness are being enhanced substantially. So, apparently, the digital mediated interaction era has just begun [2].

Digital mediation is a form of computer mediated communication. This is an interaction of technology and mediation between a political formal sphere and a civil society sphere for governments, political representatives, public administration and other institutions like trade unions, business, or other non-governmental organizations. This has become an universally culturally accepted way of communication now. Certainly, the way mediation used to be before has got some new dimensions by digital mediation [3].

But many scholars who are focused on activity theory and historical psychology do not use digitalization and kind of underestimates it. The biggest challenge for digitalization is mostly theoretical and methodological problems. We are mostly dependent on symbols, tools, artifacts for mediation activities currently. Certainly, we are going through an outstanding revolutionary transformation in terms of digital mediation which is reforming our society and culture[3].

Digital mediation transforms a partial form of human interactions. An individual may not hear voice tones if the interaction is based on the transmission of words; An individual may only see facial expressions without any arm or hand gestures if the interaction is based on the transmission of voice; and even if all of these are transmitted during our interaction, it may differ significantly from physical communication. Disruption of social norms and behavioral norms is a result of digital mediation of information. Diverse emerging technologies that make it easier to see people, things, and activities in their environments have been the focus of extensive study and development. Anonymity, anonymity, censorship, privacy; security; accountability; reciprocity; trust; and trust difficulties can arise from frequent public appearances and appearances that are public. The two are inextricably linked throughout [2].



We promote novel forms of organization, employment, and enjoyment by substituting or augmenting direct human contacts with technology-based interactions. Despite this, the context and motivation for the interaction change. Sometimes we are completely unconscious of our surroundings: for example, one person who is interacting is completely unaware of what other people are seeing and doing, or the way individuals are reacting to their social and physical environments, and so on and so forth. Despite the fact that the loss or alteration of context is widely acknowledged, its significance is grossly underestimated, especially given the fact that we employ context from our subconscious mind the majority of the time [2].

During each interaction, we are constantly striving to comprehend the meaning of our interaction as well as the message that our speaker is attempting to convey. Recognizing a speaker's context also entails understanding the meaning of their actions and words, to be aware of the items and people in their own physical environments and borders, and to be able to distinguish between their moods, knowledge, attentiveness, intentions, and motives. It should be noted that grasping the context of a speaker can be accomplished through both unconscious and conscious effort. Prior knowledge, perceptual information, and experience, as well as inferences and social conventions [2] all have an impact on this process.

To demonstrate these points, we can consider the example of videoconferencing. Presently we are not using digital video that widely and frequently, although it has become an intensive topic for research over a decade with a technical infrastructure that supports digital video and vice versa. Videoconferencing, whether digital or analog, is a definite choice for arranging geographically distributed remote meetings quite similar to a face-to-face direct interaction: It also transmits facial expressions for expressing non-verbal information. But, videoconferencing has its own limitations, inadequacies, and challenges. They tell us about the complexity of technology-based interactions [2].

We might think back to the time when the computer monitor and camera were initially launched together. People were drawn to display monitors: The focus of the room would frequently shift away from the meeting leader and onto the display monitor and distant attendees, which would ordinarily be an unfavourable situation from the standpoint of the meeting leader. In any conventional meeting, the person seated to the left of the meeting leader or presenter is almost always the meeting leader or presenter. Participants with less interest, who prefer to work quietly and calmly, tend to sit to the right of the table and, as we all know, occasionally slip away or remain on other topics during the meeting. People in any other room who were not in the meeting room where the camera was located may perceive the meeting leader as less prominent as a result of digital monitoring, and they may even ignore the meeting leader's reactions in some cases. People who are not very interested in the meeting but who are exposed to the monitor camera may receive the most attention in this form of meeting as a result of their exposure. It is possible that audio quality will be poor as well; audience sounds may be garbled or indistinct without the meeting leaders being aware of this fact. It is natural for a meeting leader or presenter to raise their voice across the room to be heard by the remote audience, but when the microphone is situated centrally, it can sound like they are shouting, especially if the remote audience is visible on a display monitor. (With the help of technology, we can both shout and mutter at the same time.) It's possible that the lighting was challenging; normal room lighting could have made people appear sickly and washed-out. Pauses and skips may occur as a result of a defective video transmission. These are some of the things that might go place during that meeting.



By the way, face to face direct interaction pauses in conversation are often interpreted as deep and thoughtful, video conference pauses can be totally different and can label people as strange and disorganized. When someone brings an object for display or a document copy to circulate, distant viewers normally cannot see that properly [2]. Technology allows digital information dissemination rapidly and easily, with prominent benefits. But at the same time it disrupts various social practices which need a particular information to be spread out with difficulty or slowly [2].

A finance-based article from 1995 titled “Tokyo Exchange Says Internet Is Too Fast” can be mentioned and summarized as follows: “Because of ‘insider trading’ restrictions that ban company officials and media representatives from dealing in securities for 12 hours after they learn earnings results, the Tokyo Stock Exchange wants companies to stop sending such results over the Internet right after they’re announced in news conferences.” As long as the internet is faster than any other media officials, this financial news could reach people quickly and could trade and make money faster where traditional print and new media might need way more time to make money and retain any advantage in comparison with digital media [2].

10.6.1 Evolution of Digital Mediation

If we look at media history and media theory, the former mediatization process can be analysed and understood. The very first problems of mediation were solved by Leont’ev and Vygotsky[3]. They belonged to the worldview of “Gutenberg galaxy” and were focused on print media. We can distinguish mediation and medium by analysing history. Pointing out activity theory and media theory can be also fruitful[3]. Modern digital mediation is quite different from their historical and theoretical medication concept.

We are living in an era when everyone knows about computers. The concept of the internet as a computer can be a bit difficult to many as long as the internet cannot be touched or seen. The Internet is a communication system that is based on 13 powerful servers. Over the last 10 years, these 13 server’s qualities has changed and improved a lot. The internet was kind of one to one or one to many devices for communication which we used to call as Web 1.0.

Even people used to struggle to give definition to “email” at the beginning. It has resemblance to writing a letter, with a message which often takes hours or days to arrive. Although for nearby people who mostly used to have a conversation over telephone, allowing several conversations with the same person within a day. So, for some people it was like a letter-like communication medium, beginning every message with a little formal greeting (e.g., “Dear Jonathan”) and concluding with another formal salutation. Although to the majority of people, “email” appeared like a relaxed telephone conversation. Although the disk space was very costly for saving email messages which were mostly ephemeral and short and also like speech [2].

But now, it is not a wonder that the internet has reached many-to-many communication which is called social software or Web 2.0 [3]. This helps us to collaborate and communicate in networks unlimitedly and globally. Social networks are good examples of Web 2.0 which is helping us to organize our life online and helping in real life too.

By the way, for most users, email seemed to be a good communication medium for chatting and exchanging information. But apparently, some issues appeared. Humour is considered to be a significant component in chatting and conversations. Humour is expressed and transmitted by voice tone, facial expressions etc. which are apparently absent in email communication. As a consequence,



whenever humour is attempted in any email, the outcomes are turned out to be disastrous and poor. For example, when the smiley emoji, like ;-)-was initiated to express humour, it became popular quickly, but this expression for humour is not appreciated to express appropriate and proper emotions[2]. Email can be a dangerous medium for chatting because of someone's misspellings and bad grammar too. For example, a harmless jockeying for rank and status by exaggerating postures as a difficult adversary for impressing their colleague and surrounding could instantly be summoned and can be appeared in court and can be considered as a legal factual threat. As a consequence, people who considered email to be once informal now consider it to be a formal way of communication. Dramatically, the demand to chat among a group of working people has seen a new form of digital communication and technology, namely "instant messaging". Instant messaging is different from email as long as it does not have any "Save" feature and is a temporary format of communication [2]. Some young computer users who haven't even written a letter explicitly might describe email to be a formal communication medium, where spelling and grammar is important, and instant messaging is a casual format of communication. But definitely, it is not impossible to archive and save instant messaging [2].

Avoiding insults needs to be maintained in chatting too. When we say something in a direct communication which offends and disrupts someone, we can quickly identify their discomfort and thus we can repair their damage. Although when an email message offends someone, undoubtedly it remains the same on the screen, unaware of someone's discomfort! Even writing a rude reply might not become more peace-making and conciliatory. An angry message violates a conversational and traditional social convention. So, your reply message may appear yet angrier and rude, leading to an online incident called "flaming". If we get an angry and rude message, we should try to avoid giving an instant message and might give a reply after a day from getting the original message. Procrastination is a good way to deal with this type of messages [2]. The evolution and diversification of digital social media adopts and conveys users to adopt new features and systems along with the existing ones [1].

Currently, Weiser's vision on automated monitoring technology widely known as "Internet of Things (IoT)" has been popular among buyers nowadays. Nokia, Sony, Philips collaborated among themselves to blend out internet of things and NFC technology. Meanwhile, Tim Berners Lee proposed the first version of Web 3.0 which we call "semantic web" [3]. The Semantic Web is denoted as an extension of the current web, where information is given a detailed and well-defined interpretation for better enabling people to work together with cooperation by using computers. The Semantic Web will work like a global web of data or a database. The Semantic Web will help machines to understand semantic data and documents by not writing any human speech. Now, the question is how the "semantic web" will be possible? We will be able to build a semantic web by using language and tools such as browsers and ontology builders, semantic annotators, ontology integration tools, reasoners etc. and various applications regarding knowledge management, natural language processing search engines and e-commerce systems.

10.6.2 Digital Mediation and Inclusive Education

We have many studies which are focused on digital mediation and inclusive education. Digital platforms are a powerful media to interact with students and parents. Santarosa et al. in their paper reflected on usage of mobile devices for disabled students with autism for supporting digital and educational inclusion programs in Brazil. They discussed the possibilities and the limits for implementing the one-to-one technological configuration for public schools in Brazil. This was exploratory and qualitative research. From their collected data, they observed various flaws and potentialities of this interaction-based research. From their collected data, the laptop did not appear to be a user-friendly device and was a bit difficult to understand because of its complex operating



system, with multiple configurations and choices. Usage of tablets is found to be more intuitive and friendly in comparison with laptops, as long as it is more natural and requires touching fingers on the screen by the students. It is also suitable for use from any position and from anywhere which is helpful for hyperactive students [6].

This is not a wonder that many researchers argue with the potentiality of digital technologies to improve family-school relationships. Nabal et al. [5] conducted in their research a study to find out the school's relationship with respective student's families regarding inclusive education. Their research included twice-weekly virtual meetings of researchers with teachers who teach early aged children. For each of the cases, to maintain records, a field diary was used and updated regularly. Smartphone apps were used to analyze and observe the communication between class tutors from the school and the families. Specifically, group messages were observed throughout the entire term of the school, individual messages exchanged between a teacher and a single family and institutional messages created by the management team were sent. Additionally, they arranged virtual meetings to realize operational activities of the school. The school has been seen to use a mobile app to send general messages to the entire educational community. At least one group message had been sent to all teachers and families of an age group or class for reporting-through an image, text, and/or video- every Friday. That school also used to send "news bulletin" for advising families about upcoming significant events. They also included sending particular messages between the teachers and a family, for example, for notifying an inability to attend. Additionally, every one or two month, the teachers forwarded their children's small or individual photos to their parents [5].

A study conducted by Marilyn Flear on pedagogical digital framing of tablets for preschool early aged children with disabilities with visual needs involved observations of a 4.1 aged boy with albinism. Her research observations were recorded digitally over a 74h period/ a 3-week period within preschool and at home. Vygotsky's theory on inclusion discussed the design, and the concept of social developmental situations guided by detailed analysis. From the research findings it has been found to be contradictory to the traditional concepts of technology. Digital tablets help in inclusive practices for students across home and preschool environments. The study shows the new understanding for inclusive pedagogy of digital environments for early preschool aged children [7].

10.6.3 Seamlessly Mediation of Social Interaction Model

The evolution and diversification of social media tools helps users to adjust new systems and to adopt new features with existing ones. But this dynamism is suitable to address digital natives, it also limits technology to adopt capability of users, such as older adults and seniors, who react with less confidence and slowly to start using any computing system. For supporting digital users to deal with this kind of challenges, Rodriguez et al. proposes a "Social Message Translator" system, which translates messages from social media in all directions and self-adjusts the process in accordance to the end-user behaviour. Eventually, it changes the preferences of the social media end users and also deals with diversification. As a result, digital users are capable of perceiving technologies that supports longer time spans [8].

10.6.4 Existing Challenges

There are many existing challenges to digital mediation and inclusive education. "Digitalization" has been denoted as an existing challenge to historical-cultural theory and contemporary psychology specifically. The consequences of a methodological and theoretical investigation of the opportunities of digital media to combine components of sign and tool to create a new circumstance.



As long as means of communication has been changed from traditional to digital, research needs attention on the digital contexts. Certainly, focusing on digital mediation besides the historical-cultural concept framework is a challenge itself. It is stated that treating digital media to be a new way for mediation which opens a new era of possibilities for investigating higher mental development in digital society. Research focused on traditional activities such as reading, playing, communicating and writing being transmitted into digital contexts needs attention and has consecutive effects such as attention, will, memory, and thinking [4].

Every means of digital communication is unique and has their own challenges. The current means to support digital-mediated communication, each channel of interaction is represented by a specific social media application, such as WhatsApp, Facebook, Telegram, ad-hoc or Skype etc. Besides email communication, social media which works as modern interaction tools do not attach any standard protocols to allow them interoperating at both data and service level. So, each system follows its own path, focusing on the future less than the past and the present. Consequently, modern services keep compatibility only with the latest versions [8] with a high frequency of evolution which results in an asymmetry of preferences for social media between immigrants and digital natives. This might cause potential social isolation. Recent research shows that this asymmetry demands investigation to solve relevant problems that ranges over several factors, such as culture, age, life routines etc [8].

10.6.5 AI Based Secure Digital Mediation for social interactions

The social interaction aims for a large number of patterned behaviours which people want to achieve by specific communication. To achieve effective and fluent humanlike communication, Huang et al. proposed a framework model that shows the creation of social behaviours for humanlike robots by utilizing specifications of communal behaviour from sociology and reviewing the specifications in an interaction model systematically which is Activity-Theory-based. Authors presented a Robot Behaviour handbook or toolkit to generate humanlike behaviour in human robot interaction study specifically focused on gaze behaviour. This is an open-source framework to implement a community-based solution for habitual specifications and a Robot Operating System (ROS) module. The findings showed that statements from the knowledge domain allowed the Robot Behaviour toolkit for achieving positive cognitive, social, and task outcomes, such as developed information recall, robotic perceptions and collaborative works [9].

Social Media Translator is a model that can be used to reduce asymmetry and stretch out the functionality of the social media tools that people use rapidly. Rodriguez et al. [8] proposed an intermediary design of a software system that globally transmits messages between both sides of a communication channel as per requirement. The digital system, "Social Message Translator" (SMT), deals with changes in the social media inclination of the digital natives and the evolution of the system. In that way, a digital user could continue to use a specific interaction paradigm and user interface over time, irrespective of the social interaction evolution. The accuracy of the message translation model implemented by the mechanisms in SMT was examined and tested in a laboratory investigation and tests. The findings illustrate that the mechanisms permit ad-hoc or commercial social applications for interacting in a transparent and easy way, if particular needs are met by our systems. Consequently, the capability of SMT for reducing the asymmetry aligning communication mediums were evaluated to involve users involving one digital user and a relevant digital native. The findings indicate that every message was accurately delivered with the proper format to the proper channel and aligned with the interaction channels. So, it is practical to lessen the fundamental asymmetries of preferences regarding media interaction. These findings open various opportunities to develop coordination among all social interaction media [8].



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10.7 Internet of Educational Things or Internet of Learning Things for Inclusive Education

10.7.1. IoET/IoLT Model

10.7.2. AI-Edge Learning Platform

10.7.3. Security and Trusted Learning

10.7.4. AI Based Student-Device Interactions



11 Types of digital platforms and features that support inclusive HE teaching (Social media platforms, Knowledge platforms, Media sharing platforms, Service oriented platforms etc.)

Students with learning difficulties may find it challenging to immediately grasp information taught in regular schools. Learning based on digital platforms can help those students to instantly access the classrooms virtually with more interest. Some of the popular digital platforms that can be used in the schools or colleges to provide the needs of the students with special needs are discussed below:

11.1 Social media platforms

There are numerous methods to use social media for educational purposes. Social media can be used in the classroom as well as to help schools and universities market and promote themselves. Because many students are accustomed to using social media and technology in their daily lives, incorporating them into the classroom is more natural than before. Each social media site has a variety of uses in the classroom, ranging from sharing announcements to giving live lectures, among other things.

Few people have gone unnoticed by the recent rise of social media, particularly well-known programmes like Facebook, Twitter, YouTube, and Wikipedia. Even the most novice internet users are now aware of social networking sites, blogs, and maybe wikis and virtual worlds. Since its inception, Social media, which was named 'Person of the Year' by Time Magazine at the end of 2006, has come to dominate the industry.

Digital technology is currently used in a variety of ways all around the world. Over the last five years, the rise of social media has changed how the majority of internet users interact with it. The internet is no longer a one-way broadcast distribution system in which a single user gets data, information, and other resources from a small number of content providers (Selwyn, 2012).

The fast adoption of social media technology has resulted in a significant shift in how people communicate and collaborate. Because staff and students utilise social media tools in their personal lives, it's necessary to look into how they're being used in the classroom. Increased teacher-student and student-student connection, enhanced performance, learning convenience, and higher engagement have all been recognised as advantages of using Facebook for learning and teaching. The report also discusses some of the potential drawbacks and limitations of Facebook use, such as educator domination and privacy concerns. Finally, Facebook usage rules are offered that educators might use to encourage students to use social media. Future empirical research is needed as social media usage in higher education continues to rise (Chugh & Ruhi, 2018).

11.2 Knowledge sharing platforms or Online learning platforms

As per the ISTE poll, 50 percent of kids aged 10 to 18 go online at least once a week for homework aid, while 75 percent of students aged 5-7 play educational games on a daily basis. As a result, even in the realm of education, the new generation is becoming increasingly tech-savvy. In this generation knowledge sharing platforms are most important and also learning without technology unimaginable in higher education especially. Some of the best online learning platforms include Coursera, Skillshare, Udemy, CodeAcademy, Edx, Pluralsight, Future Learn, and Moodle. Apart from online learning platforms, we also have online course platforms like LearnWorlds, Teachable, Thinkific, Kajabi, and Podia (Benta, et al).



Higher education institutions, like all organisations, are confronted with a number of issues that necessitate the development of strategies in order to remain competitive. Higher education institutions require the knowledge, experience, and competence of academic staff to respond to issues that affect them. Because higher education institutions are focused on the creation and distribution of information, efficient knowledge sharing within the parent institution becomes vital. However, most higher education institutions do not follow this procedure. This article claims that in order for higher education institutions to increase academic excellence and research innovation, they must recognise and appreciate the knowledge developed within their walls, as well as encourage academic staff to share best practises, lessons learned, and information. The paper investigates the dynamics of knowledge sharing in higher education, as well as how trust and organisational culture stifle knowledge sharing (Maponya, 2005).

Because of its motivation powers, the education sector is transitioning from e-learning to m-learning, which encourages students to pursue self-motivated learning. This, however, necessitates online engagement through high-quality knowledge sharing (KS) of resource social capital (SC). Low student involvement in the past has prompted researchers to investigate whether social capital influences KS in m-learning. As a result, this is the driven goal articulated in a conceptual framework, which was tested using multiple-regression analysis after data from 334 Ahlia University undergraduate business students was collected. The findings show that in e-/m-learning on Moodle, m-learning moderate's students' SC through KS. This article reveals the implications for philosophy, practise, and society (Razzaque, 2020).

By their very nature, higher education institutions (HEIs) are knowledge-intensive settings. However, at these institutions, the management of organisational knowledge and the promotion of staff knowledge sharing are mainly ignored. For empirical testing, a conceptual model was created, and data was gathered through focus groups and interviews, as well as reflective journaling and content analysis. The findings back up the conceptual model by revealing the preconditions for establishing an enterprise social network enabled knowledge sharing environment, as well as the motivators and barriers to participation, as well as the perceived organisational and individual benefits of increased staff knowledge sharing activity (Corcoran & Duane, 2018).

11.3 Media sharing platforms

Media sharing platforms comes under the social media platforms only. "A social network is a social structure made up of individuals (or organisations) called 'nodes' who are linked (connected) by one or more types of interdependencies, such as friendship, kinship, mutual interest, financial transaction, dislike, or beliefs, knowledge, or prestige links."

Scholars use online social networking sites for professional reasons. Learning takes the shape of involvement and identity formation in such networks, as people engage in and contribute to networked practises. While current literature discusses the potential benefits of online involvement, empirical research on academics' use of online social networks is scarce in the educational technology literature (Veletsianos, 2012).

His (Hung, et al, 2010) study looked at how social networking technologies can be used to augment face-to-face classes to improve students' feeling of community and, as a result, foster classroom communities of practise in higher education. 67 students enrolled in four face-to-face courses at two Taiwanese public institutions provided data. The majority of participants generated significant feelings of social connectedness and expressed positive feelings about their learning experiences in classes



that employed social networking sites as a supplemental tool, according to the findings. Instructor concerns concerning the instructional use of social media are addressed, along with recommendations for further study and practise.

This study looks into the effects of gender and social networking sites (SNSs) such Instagram, YouTube, WhatsApp, Facebook, and Twitter on content consumption, creation, and sharing among higher education students' educational social media usage behaviours. The survey method is used to determine how much time students spend on social media for educational purposes. First, the Inside School Social Media Behaviour (ISSMB) measure is validated and linguistically adapted from English to Turkish. The three elements of the original scale were validated by the results. Second, a total of 365 university students participate in the administration of the derived scale. Gender difference was found to be a key factor in explaining content generation on social media. Instagram, WhatsApp, and YouTube are the most popular social media platforms are most used SNSs for educational use among students at the higher education level (Torun, 2020).

Both outside and inside school, the social media usage behaviours of young people can be examined according to different age groups do determine any age-related differences. The subject can be improved with new findings and results from different sample groups.

11.4 Service oriented platforms

For the past two decades, the learning management system (LMS) has dominated Internet-based education. The traditional LMS, on the other hand, is falling behind with improvements in Internet technologies and online social interactions. Current frameworks such as the e-learning framework (ELF), the IMS abstract framework, and the open knowledge initiative (OKI) have established the first steps toward service-oriented e-learning platforms to support technological variety (Dagger et. al, 2007)

Learning management systems (LMSs) are software applications that allow you to organise, track, and report on e-learning programmes. The authors' next-generation LMS creates a personal learning environment (PLE) in which LMS capabilities are incorporated into a context that users are accustomed with and use for other purposes - mashup platforms with gadgets, for example. The system allows users to select only the services they want, use services from various providers, and blend learning with other activities in a more natural way by modularizing LMS functionality as a collection of services. The authors put their system in place and tested it at the Spanish University for Distance Education, which has a virtual campus with over 200,000 students. According to their survey, the method is useful and simple to use for creating personalised PLEs (Ros et. al, 2013).

The findings show that e-service quality has a direct impact on perceived value and satisfaction, but not on willingness to pay. Second, the associations between service quality and willingness to pay were mediated by perceived value and satisfaction. However, it has been discovered that perceived value has a greater impact on willingness to pay than satisfaction. It is also claimed that one of the antecedents of satisfaction is perceived value. The study also investigates the direct link between perceived value and willingness to pay, as well as the role of satisfaction as a mediating factor between perceived value and desire to pay. From a managerial perspective, this research provides IT firms with a comprehensive theoretical foundation for building a successful online meeting platform that emphasises e-service quality, perceived value, and customer happiness. There has been no research into the relationship between e-service quality, value, satisfaction, and willingness to pay for online



meeting platform services. As a result, this research is beneficial to private university administrators, as well as creators and investors of online meeting platforms (Demir et al., 2020).

Earth observation programmes such as Copernicus, NOAA, and NASA Earth Data are producing an ever-increasing amount of data. Despite the high cost of these programmes, data utilisation is limited due to a lack of interoperability and data linkage. Indeed, multi-source and heterogeneous data utilisation could be greatly improved in a variety of disciplines, particularly in natural catastrophe prediction. This paper's (Masmoudi, et al, 2018), main goal is to give a high-level overview of the PREDICAT platform architecture. Based on data provided by our collaborators, including the international intergovernmental Sahara and Sahel Observatory, a scenario explaining the platform's operation is offered (OSS).

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12 Twenty Things to Promote an Inclusive Learning Environment

12.1 Conducting bridge courses for slow/disabled learners.

A bridge course will assist slow/disabled learners by specially trained teachers in getting a firm grasp of the subject's fundamentals. These courses provide an excellent foundation for slow/disabled learners to understand the difference and the connection between what they already learn in school and what they would learn in college. The bridge course's utilization of unique tactics will boost student's self-confidence (Chowdary, 2018). Additionally, it will provide students with the information necessary to take on greater difficulties in the future. As a result of bridge courses, there will be no more uncertainty or misperceptions regarding the subjects or peers which help slow/disabled learners to compete with other students.

12.2 Encouraging the advanced learners to help the slow learners to understand the concepts in the hostels (peer learning).

Classroom teaching is a big part of revising and teaching new things to the students. A person who is slow or has a disability in reading is more likely to be overlooked in a classroom where most of the students will learn quickly. As a result, people who are slow or have disabilities in reading will have a hard time learning their academic subjects, which also includes basic concepts and skills. Peer learning is one of the best ways for student with disabilities to learn and has it's been proven many times (Nunez, 2021). Students should be encouraged by their parents and teachers to study with their peers. Getting to know other kids who are his or her age will help the child become less shy. Collaboration and communication with peers will help slow/disabled learners able to take charge of their education (Castro, 2019). Instead of in a teacher-led classroom, students are more likely to interact, reflect, and look into ideas more in peer learning.

12.3 Identifying the cognitive levels of the slow learners (blooms taxonomy) and catering to their cognitive interests while teaching.

Cognitive skills are the intellectual abilities that students require to excel in education. Slow/disabled learners must be able to read, write, think, analyse, remember, solve, and comprehend to learn effectively. All of these cognitive talents must be coordinated to be competent. The cognitive talents of slow/disabled learners must be strong or the student will suffer. It is vital to build cognitive abilities before advancing and mastering new talents. Consider the following critical cognitive talents necessary for a slow/disabled learner the cognitive ability to reason and think logically must be taught to them (Ramlakshmi, 2013). A slow/disabled learner's ability to solve, plan, analyse, comprehend, deduce, and prioritise may be enhance.

Teachers must keep an eye out for these slow/disabled students who are unable to decide what to do next or who are unable to comprehend what is being taught. These students will struggle academically in subjects such as mathematics or comprehension exercises since they will lack reasoning skills. Logic and reasoning games may help them enhance their skills and prepare them to compete with their peers if they are introduced to them (de Carvalho, 2022). Slow and disabled learners have a difficult time maintaining focus and attention during the class, and they are more prone to being distracted. Students who are slow or disabled in their capability to concentrate and maintain their attention span must be assisted by the institution and their teachers in this endeavour. This group of students must be taught how to carefully focus their efforts and how to ignore distractions in order to remain focused on the task at hand. Slow or impaired students should be taught how to divide their attention in order to do multitask. Consequently, highly functional cognitive talents are developed as



a result of this process. It is helpful for these students to practice meditation a few times a week to improve their concentration (Sensiper, 2022). They may also lose track of the information because their processing speeds are slower, which makes it difficult for them to complete the work at hand. Maintaining extra attention and focusing on teaching these students will assist their minds in making sound connections and making affirmative decisions, which will benefit all students. The ability to hear and understand is also a vital cognitive ability. To be able to determine between sounds when reading and spelling words, students must be able to hear and understand them clearly (Kumar, 2022). Slow or impaired learners will have difficulties with this and they may also have difficulties with auditory perception. Require stimulation through related tasks that will be beneficial to the students.

12.4 Modifying the way of teaching to cater to the needs of slow learners based on student performance.

The method of teaching will have a significant impact on those who are slow or impaired. Teachers should have sufficient training to deal with these students. These thoughts that follow are meant to serve as a foundation for developing learning techniques that are personalized to each student. Students' interests, needs, and experiences should be taken into consideration while developing lessons; this will benefit slow and impaired learners (Ward, 2022). Additionally, students should have the impression that their education has been personalized to their interests or experiences. Slow learners require variation in teaching to remain engaged in the learning process. Along with helping slow and disabled learners maintain their attention, flexibility in teaching style allows them to see the same topic conveyed in different ways. It is beneficial for slow learners to repeat the lessons regularly. Therefore, programmable materials and interactive computer education are will widely assist slow learners in improving their fundamental skills (Fahimirad, 2018). Slow and disabled learners learn more successfully through sight and sound than through reading. Slow and impaired learners benefit from the use of movies, videotapes, and audio in courses to aid in their learning.

12.5 Encouraging the students to give feedback on the teaching methodology.

Feedback is critical for efficient learning. It enables slow/disabled learners and their teachers to interact more effectively. Students input will assist teachers in adopting necessary improvements to their teaching technique (Chu, 2020). Academic feedback is more strongly and consistently associated with achievement than any other teaching behaviour this association holds regardless of grade, socioeconomic background, race or school location. Through feedback, slow/disabled learner's confidence, self-awareness, and enthusiasm for learning can all be increased. Effective feedback throughout the year can aid in the adjustment of slow/disabled students to education and may even aid institutions in retaining students (Winstone, 2019). It is proved that by including students in the feedback process, learning would be strengthened, and assessment performance will also greatly improve.

12.6 Motivating the students to participate in the various technical events (Hackathon/Codeathon).

This is a unique way to motivate slow/disabled learners to improve their technical skills. The establishment and accomplishment of these objectives will motivate slow/disabled learners to become involved in the organisation and hosting of professional events in their intuitions. The need for unique experiences has been demonstrated to be the most significant motivator for slow/disabled learners to engage in activities outside of their official education (Craft, 2020). However, it has been discovered that the level of motivation is influenced of the individual depends on substantive tasks accomplished at each major stages. Overall, the outcomes of the events are dependable on their



studies. The preparations for the event by the slow/disabled learner demonstrate a thirst for new knowledge, a desire to participate in activities and apply previously learned knowledge (Goksun, 2019). It is natural for students to share their experiences with their colleagues; this will stretch the boundaries of traditional educational practices. Additionally, it inspires a strong drive in students to master event planning at their institutions and to embark on a new era of personal growth.

12.7 Mentoring the optimistic students to work on cutting-edge technologies.

The learning environment is more dynamic than it has ever been, and as a result, today's learner's techniques are quite unlike those for whom the traditional educational system was built. Classrooms are being redesigned and reinvented in a variety of ways to meet the increasing needs of modern digital learners as a result of technological advancements (Szymkowiak, 2021). With the emergence of remote learning, many institutions of higher education are substituting traditional educational technologies to stay up with their digital learning population. Slow/disabled learners require technology to be involved in the classroom environment. Slow/disabled students require more than a basic understanding of some technical tools to succeed in the twenty-first century workplace (Van, 2019). By incorporating these tools into the regular curriculum, institutions can better educate their slow/disabled students for the modern workplace. Cutting-edge technology will enable slow/disabled students to overcome the classroom's physical limitations, allowing them to link the curriculum to the real world (To, 2019). Numerous instructional tools incorporate a range of collaborative features. For example, Skype enables students to conduct virtual meetings with classmates located anywhere in the world. Students can quickly share and edit projects with one another using Google Drive. Technology enables slow/disabled students to rapidly and properly locate information. Traditional textbooks are being phased out in favour of search engines and e-books. Rather than employing private tutors, slow/disabled students can access one-on-one assistance using educational videos at any time and from any location using massive open online courses (MOOCs) (Dai, 2020). Outside of the classroom, slow/disabled children can take advantage of cutting-edge technology in every aspect of their lives. Within the classroom, cutting-edge technology will enhance the enjoyment and excitement of studying.

12.8 Experiential learning can be provided to the students through Augmented Reality and Virtual Reality.

Virtual reality and augmented reality (AR/VR) technologies are just as important as any advanced learning environment. Educators from a variety of fields can incorporate immersive technologies into their classrooms. Academic institutions should establish specific rooms for students and teachers who are slow or impaired to access AR/VR devices and create their material. It enables slow/disabled students and instructors to experiment with immersive learning in innovative ways (Ardiny, 2018). AR/VR technologies enable students who are slow or impaired to develop skills through hands-on experience while also reducing the cost and risk involved with field training. Finally, AR/VR systems have the potential to improve education by promoting hybrid learning methods. Immersive environments enable face-to-face interaction between students and teachers independent of their actual location. Slow/disabled students can engage with virtual items in fully digital surroundings, including complex 3D models that would be extremely expensive to replicate in the real world (Puggioni, 2020).



12.9 Setting realistic goals will encourage the students in performing well within a limited time.

Students will be more motivated to do their best in a short period of time if their goals are reasonable. A teacher can establish upper and lower boundaries on the goals of slow/disabled students in order to teach students about setting realistic goals. Games can be used to teach goal setting in a low-pressure and high-involvement context for students who are slow or disabled. Slow/disabled student will benefit from one-on-one goal-setting meetings, which give them attention and help them learn to evaluate the difficulty of their goals (Estrapala, 2020). Rather than simply imagining a goal, teachers should encourage their students to write it down and keep it in their minds. To help students understand the process of goal formulation, educators should make significant use of models in the classroom. In order to help students succeed, it's important to teach them how to set goals and track their progress. Goal setting and self-evaluation should be taught explicitly in the classroom (Philippakos, 2020). Students will need these broad skills to develop their ability to establish goals; therefore, teachers should teach them how to use effective learning strategies in setting goals.

12.10 Students have to be given opportunities to plan and organize, monitor their own work, direct their own learning, and to self-reflect along the way.

Even the brightest and most motivated students it may be difficult to learn on their own. Self-learning requires a willingness to learn, setting learning objectives, participating in the learning process, and evaluating self-progress. Successful independent study requires a diverse set of abilities and mindsets from slow/disabled students. Self-assessment of the students' current circumstances, study habits, family situations and support networks both at school or home and evaluation of past experiences with autonomous learning are all part of this process. Slow/disabled students must communicate their learning objectives to advising instructor or a teacher. A clear understanding of learning goals between slow/disabled students and instructors are like learning contracts (Burke, 2020). Once created, contracts should be assessed by the advising faculty member and questions about feasibility should be raised. Slow/disabled students need to understand themselves as learners in order to understand their needs as self-directed learning students. Slow/disabled students also need to understand their approach to studying (Zeng, 2018).

Earlier academic work may have encouraged a surface or strategic approach to studying. These approaches will not be sufficient for successful independent study. Independent study requires a deep approach to studying, in which slow/disabled students must understand ideas and be able to apply knowledge to new situations (Sanders, 2019). Slow/disabled students need to generate their own connections and be their own motivators which will make them independent. For slow/disabled students to be successful in self-directed learning, they must be able to engage in self-reflection and self-evaluation of their learning goals and progress in a unit of study (Durnali, 2020). Regularly consult with the advising instructor will help them achieve a correct own learning.

12.11 Students are expected to acquire an understanding of the content by reading the textbooks / online resources and by participating in class activities.

Reading is just as important as listening and learning in the classroom. Many students are unfamiliar with the concept of active reading when it comes to reading textbooks or online reading. Teaching higher-order cognitive skills like organising knowledge, criticising, and memorising to slow or disabled students should be a priority. Slow/disabled readers may benefit from this method of comprehension, and integration of information (Sun, 2018). The teacher should teach importance of textbook. Many



purposes can be served by a textbook. In certain cases, the textbook contains all of the course materials. Slow/disabled students should interact with their teachers and examine the syllabus in order to determine how much time and weight they should devote to readings for each topic. In order to get through some of the more difficult chapters, students should seek help from their teachers. Breaking up a large reading into multiple smaller ones will help these students stay focused while reading. Chapters are frequently subdivided into smaller portions for readability (Okkinga, 2018). The slow/learner should be given a reading break at these points. Before taking a break, students should spend a few minutes summarising what they've read thus far.

During each break, students should be encouraged to engage in some form of physical activity. Make sure the learner goes over the information at least twice once they've finished reading. In order to retain information, students need to spend more time studying it. The student must spend some time getting to know the chapter before diving in. To put it another way, this is like watching a preview of a movie before you get to see it. Students should be taught to ask themselves questions about the content as they preview each chapter (Shih, 2018). Students who often engage in self-reflection are better able to apply what they learn in the classroom. Taking notes and highlighting are also part of actively reading (Gyllen, 2018). Another strategy to keep focused and assist students remember important information is to highlight facts. It's also a good idea to use the highlighter carefully while underlining.

12.12 Promote Collaborative learning like group discussion.

Collaborative learning (CL) is a learning approach wherein two or more students are cooperatively engaged in a learning process. In this regard, among slow/disabled learners within a learning group, they communicate, engage to solve difficulties during learning, make use of their cognitive and meta-cognitive skills during interactions (Garcia, 2021). Therefore, interactions are the key to CL. There are two kinds of interactions in CL, primarily cognitive interactions in that slow/disabled learners will be actively participating in the processes of thinking, reasoning, and analysing. The other sort is socio-emotional interactions whereby learners will comprehend each other, complete their skills, be empathic, and feel the essence of their collaborations with each other (Schnaubert, 2019). The broad concept of CL makes it unlimited to certain rules of learning because active interactions can be made in many ways. In summary, numerous learning acts such as asking each other, discussing, explaining to each other, debating, and being actively engaged in learning will help the slow learners to overcome their difficulties.

12.13 Inviting the experts with experience in handling students with learning disabilities to take the lectures to understand the new technologies

The use of technology in special experts with experience helps break the barriers for people with disabilities and provide them with access to the most relevant educational programs. Experts with experience will help students with special needs to get modern education and achieve any required information (Naser, 2020). Experts help provide students in reaching higher flexibility and differentiation in educational methodologies. With modern technology, teachers can also adapt to these techniques for benefit of slow/disabled students with minimum effort and choose one of the dozens of available teaching tactics designed to meet the needs of slow/disabled learners.



12.14 Conducting various awareness programmes to strengthen the mindset of the students.

The term "growth mindset" refers to the belief that one's abilities and intelligence can be developed. A fixed mindset, on the other hand, sees intelligence as fixed and unchanging. A growth attitude would be promoted to a slow/disabled student with a good outlook on life. A growth mindset can help slow/disabled students see learning as a process and claim control over their learning, which can lead to greater academic achievement (Wolcott, 2021). Educators should implement a variety of programs to raise awareness among students about how to deal with difficulties that arise in the classroom. Students should be made aware of the importance of practicing core abilities through assignments or exams by their instructor. Students should be able to examine and challenge their fixed mindsets with the help of education programs that promote critical thinking. Students must be inspired to believe in their abilities to learn and their inherent intelligence (Rhew, 2018). Students will honour awareness programs more if they are open to their input and transparent.

12.15 Act, don't react

Students are very smart, and it is part of their juvenile nature to try to get you. Sometimes ignoring a disruptive behaviour is way better than reacting to it and in case it becomes repetitive or serious then make sure to talk it out with the student involved alone and not in front of the whole class.

Classroom disruption is a major barrier for students' education and a risk factor for their academic success, as well as a major source of stress for teachers. Teachers in educational institutions have a tremendous behavioural problem as a result of the dramatic shifts in student's behaviour. The teacher's role in classroom management is to maintain discipline and motivation in the students, as well as to encourage their cooperation in the learning process (Alonso, 2019). The teaching process will fail if the teachers are unable to use a variety of teaching methods. Students' disruptive behaviours can be managed through the practice of classroom management. Preventing the occurrence of undesirable behaviours is one of the most difficult aspects of teaching. Teaching necessitates that teachers win the hearts of their students and even become emotionally attracted to the misbehaving ones. Interpersonal interactions are how people win each other's hearts (Scherzinger, 2019). Teaching students to build relationships with their peers has been shown to reduce behavioural issues in the classroom and lead to better academic performance.

12.16 The faculty mentors from the institute can communicate with all stakeholders of the students with learning disabilities to monitor their activities outside of campus.

Stakeholders of students with learning difficulties must be identified as the first step in monitoring their behaviour. Many people will have a significant impact on the growth of students. If teachers don't consider and build relationships with parents, the community, and other groups, they can have a significant impact on students (Briesch, 2020). Structure and guidelines that can be enforced to motivate students can be established by teachers who build and maintain close, warm relationships with their stakeholders, including their students. An increase in academic achievement can be seen when teachers and other stakeholders work together to keep an eye on students outside-the-classroom activities. Close monitoring of the students' activities will lead to a reduction in television viewing and an increase in school-related activities, which will have a positive impact on academic performance of the student (Boonk, 2018).



12.17 Metacognitive strategies- Self-questioning involves pausing throughout a task to consciously check your own actions.

Slow/disabled students need to figure out what they already know and what they need to learn to be good problem solvers and learners. Students need to know about the problem at hand, as well as how to use a certain process and when to reach their goals. Those who want to be good problem solvers need to be self-aware. Students who are aware of their thinking do better than those who aren't. Giving students a tool for self-reflection and problem-solving when things don't go as planned is important for their intellectual growth and success in the classroom. Metacognition is essential for their success outside of campus (Anthony, 2021). Those who have better metacognitive skills are more likely to quickly discard an unproductive strategy, while those who have less effective metacognitive skills are more likely to keep using the same strategy even when it doesn't work. When someone is an expert, they have metacognitive skills that only apply to their field of expertise. A student in a certain field must learn how experts solve problems. Metacognitive skills can be developed through specific training and opportunities by teachers and other content experts (Avargil, 2018). Especially if students work together, students can learn a lot about their metacognitive skills by making concept maps.

12.18 Universal Design for Learning (UDL)

The goal of UDL is to use a variety of teaching methods to remove any barriers to learning. It's about building in flexibility that can be adjusted for every person's strength and need.

Deploying Universal Design for Learning (UDL) approach to teaching and learning enables all students to have an equal chance of succeeding. This method allows slow/disabled students to access, engage with, and demonstrate their knowledge in a variety of ways (Dickinson, 2020). All students benefit from developing lesson plans this way, but those with learning and attention difficulties may benefit the most. In the classroom, UDL offers the same degree of flexibility. Teachers can efficiently teach a wide range of students using UDL concepts. This is accomplished by allowing learners to acquire information in a variety of ways and by allowing students to demonstrate their knowledge in a variety of ways. UDL lesson plans and assessments are built around three major principles: representation, action and expression, and engagement (Behling, 2018). General education classes are easier for students to access because they are where they spend most of their school day. Material can be tailored to fit each slow learner, rather than forcing each learner's needs on the information itself. Flexible material encourages slow/disabled students to work on their deficiencies rather than their strengths. The students will be provided a variety of learning opportunities to remove discrimination with help of UDL.

12.19 The core elements of mastery learning also provide the foundation for many innovations and interventions that teachers are implementing in classrooms today.

Learning objectives and goals are broken down into smaller, more manageable pieces in the Mastery Learning approach. Many students have found the mastery learning model to be effective (Yemi, 2018). Before new material is introduced, it gives students with learning disabilities an opportunity to learn the most important concepts. Students who are slow or impaired can participate in additional activities that help them learn more about a subject. Students can also learn at their own pace under this approach. In addition, students benefit from the feedback they receive as part of this process. In this



approach, slow/disabled students will be capable of learning if given the opportunity and resources (Winget, 2022).

12.20 Hold regular meetings with the students to monitor their progress and take necessary remedial measures.

Teachers can use student progress tracking to assess how well they are teaching students who are slow or disabled. For children who require specialized instruction, it will be useful in developing an individualized education plan (Compton, 2020). Using progress monitoring, a teacher can track students' progress and encourage them to set specific goals for themselves. As soon as the student decides on his or her goals and starts working toward them, the teacher should track their progress each week. The examinations are all at the same difficulty level, so the weekly tests can appropriately reflect the students' development (Goodwin, 2022). The teacher compares the student's expected rate of learning with the child's actual rate of learning on each exam. This will help the teacher to understand how to teach that slow/disabled student.

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